NYU:poly

POLYTECHNIC INSTITUTE OF NEW YORK UNIVERSITY

UNDERGRADUATE AND GRADUATE CATALOG 2011–2013

Brooklyn Campus
Six MetroTech Center
Brooklyn, NY 11201
Phone: (718) 260-3600
Fax:(718) 260-3446
Web: www.poly.edu

Long Island Graduate Center
105 Maxess Road
Melville, NY 11747
Phone: (631) 755-4300
Fax: (631) 755-4404
Web: www.poly.edu/longisland
E-mail: ligc@poly.edu

Westchester Graduate Center
40 Saw Mill River Road
Hawthorne, NY 10532
Phone: (914) 323-2000
Fax: (914) 323-2010
Web: www.poly.edu/westchester
E-mail: rtascio@poly.edu

Manhattan Location
Institute for Technology and Enterprise
55 Broad Street, Suite 13-B
New York, NY 10004
Phone: (718) 260-4015
Fax: (212) 547-7029
Web: www.poly.edu/manhattan
E-mail: vvivek@poly.edu

Visit our website: **www.poly.edu**

CONTENTS

PART 1

GENERAL INFORMATION

Polytechnic Institute of New York University
Mission Statement 4
Administrative Offices 6
Academic Calendar 8
Polytechnic Institute of NYU Profile 9
Academic Departments and Degrees 13
Degrees Offered at Polytechnic 14
Certificates Offered at Polytechnic 15
Undergraduate Academic Programs and Policies 16
Graduate Degree Requirements and Academic Policies 26
Academic Success, Advising and Tutoring Services 33
Admissions 35
Career Management Center 39
Communication Policy 41
Counseling and Psychological Services (CAPS) 42
Financial Aid 43
Institute Compliance Policies and Other Guidelines 49
International Students and Scholars 52
Programs and Services for First-Year Students 53
Registration 54
Residence Life 55
Statistics on Enrollment and the Student Body 56
Student Development: Activities, Advocacy and Leadership 57
Tuition and Fees 59

PART 2

ACADEMIC DEPARTMENTS

Applied Physics 62
Chemical and Biological Engineering 63
Chemical and Biological Sciences 65
Civil Engineering 67
Computer Science and Engineering 70
Electrical and Computer Engineering 73
Finance and Risk Engineering 77
General Engineering 81
Mathematics 82
Mechanical and Aerospace Engineering 84
Technology, Culture and Society 87
Technology Management 100

PART 3

ACADEMIC PROGRAMS

A Brief Guide to Course Descriptions 106
Bioinformatics 107
Biomedical Engineering 109
Biomolecular Science 116
Biotechnology 121
Biotechnology and Entrepreneurship 124
Business and Technology Management 127
Chemical and Biomolecular Engineering 133
Chemistry 139
Civil Engineering 144
Computer Engineering 160
Computer Science 165
Construction Management 178
Cyber Security 186
Electrical Engineering 188
Electrophysics 207
Environment-Behavior Studies 208
Environmental Engineering and Science 211
Financial Engineering 213
History of Science and Technology 224
Industrial Engineering 225
Information Management
Executive Master's Program (eIM) 228
Information Systems Engineering 234
Integrated Digital Media 236
Interdisciplinary Studies in Engineering 243
Management 245
Management of Technology
Executive Master's Program (eMOT) 256
Management of Technology 262
Manufacturing Engineering 265
Mathematics 269
Mechanical and Aerospace Engineering 278
NYU-ePoly 290
NYU-Poly Enterprise Learning 294
Organizational Behavior 297
Physics 302
Science and Technology Studies 309
Sustainable Urban Environments 320
Systems Engineering 324
Technology Management 325
Telecommunication Networks 330
Transportation 332
Urban Systems Engineering and Management 339

PART 4

SPECIAL PROGRAMS

General Studies Program 342
Higher Education Opportunity Program (HEOP) 343
Honors Program 344
The Center for K-12 STEM Education 345

PART 5

THE CORPORATION
THE ADMINISTRATION

Board of Trustees 347
Administration 348

ROUTES TO POLYTECHNIC INSTITUTE OF NYU

Brooklyn Campus 350
Long Island Graduate Center 351
Westchester Graduate Center 352

INSTITUTE POLICIES

Institute Policies 353

POLYTECHNIC INSTITUTE OF NEW YORK UNIVERSITY MISSION STATEMENT

To excel as a leading high-quality research university engaged in education, discovery and innovation with social, intellectual and economic impact in the New York region, the nation and the world.

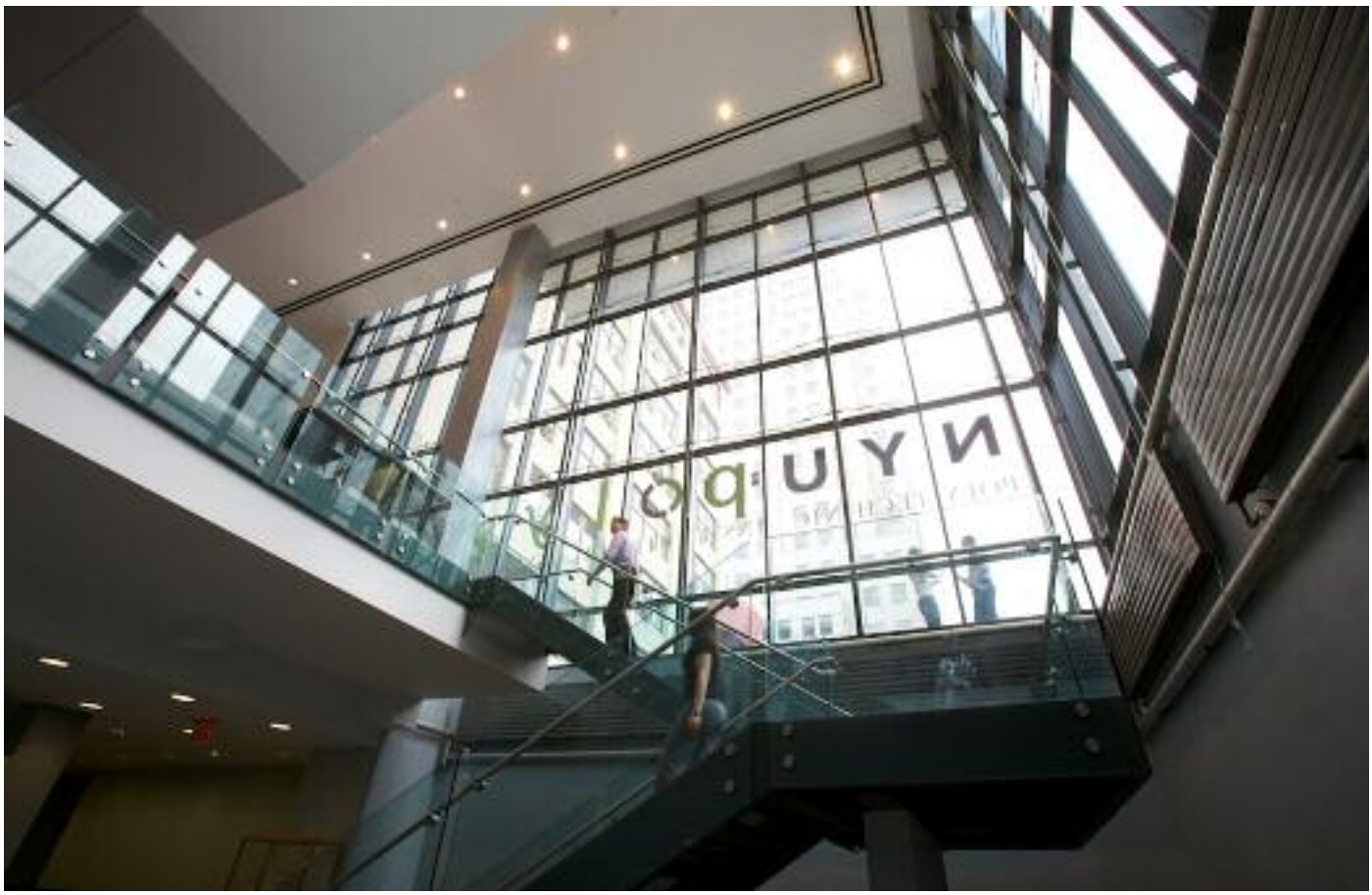
To achieve this mission, we educate, discover and invent. We engage students seeking educational achievement and opportunity, faculty seeking excellence and relevance, and organizations seeking solutions and talent. We creatively bring intellectual rigor, technological innovation and a passion for science to the communities where we work and live and to the citizens of the world.

We innovatively extend the benefits of science, engineering, management and liberal studies to critical real-world opportunities and challenges, especially those linked to urban systems, health and wellness and the global information economy.

Our learning environment develops the skills to discover and invent, stimulates innovation and encourages entrepreneurship. We refer to this environment of invention, innovation and entrepreneurship as i^2e. It is what has produced generations of PolyThinkers—action-oriented learners who are capable of thinking globally and across multiple disciplines.

PART 1

GENERAL INFORMATION



The Polytechnic Institute of New York University catalog is an official publication of the Institute. The catalog provides information about academic programs and a summary of Institute policies and procedures and selected activities and services. Information concerning admission, academic regulations and requirements, student services, academic offerings and a listing of the administrative officers and faculty are included. Every effort has been made to publish a complete and accurate catalog. However, requirements, deadlines, tuition, fees, curricula, courses and staffing are subject to change at any time without advance notice or obligation. Some course descriptions may vary from actual course content because of advancements in the discipline, emphasis of individual instructors or decisions of the faculty to change the scope or content of the course.

ADMINISTRATIVE OFFICES

ALUMNI RELATIONS
www.poly.edu/alumni
Tel.: (718) 260-3885 or 800-FON-POLY
Fax: (718) 260-3449
E-mail: alumni@poly.edu
Hours: Monday-Friday, 9am-5pm

ATHLETICS
www.poly.edu/athletics
Tel.: (718) 260-3453
Fax: (718) 260-3473
E-mail: mbraziel@poly.edu
Hours: Monday-Friday, 9am-5pm
GYMNASIUM/FITNESS CENTER
Hours: Monday-Friday, 11am-9:30pm;
Sat. & Sun., 12pm-7pm

BERN DIBNER LIBRARY OF SCIENCE AND TECHNOLOGY
www.poly.edu/library
Tel.: (718) 260-3530
Fax: (718) 260-3756
E-mail: blibrary@poly.edu
Hours: Monday-Friday, 9am-6pm;
Sat.-Sun., 12pm-6pm

BEST CENTER
www.poly.edu/business/incubators/best
Tel.: (718) 260-3581
Fax: (718) 260-3083
E-mail: bniswand@poly.edu
Hours: Monday-Friday, 9am-5pm

CAREER MANAGEMENT CENTER
www.poly.edu/business/career
Tel.: (718) 260-3650
Fax: (718) 260-3325
E-mail: careermgmt@poly.edu
Hours: Monday-Friday, 9am-5pm

CATT/WICAT
www.catt.poly.edu
www.wicat.poly.edu
Tel.: (718) 260-3050 / (718) 260-3856
Fax: (718) 260-3074
E-mail: wicat@poly.edu
Hours: Monday-Friday, 9am-5pm

COUNSELING AND PSYCHOLOGICAL SERVICES
www.poly.edu/life/health/counseling
Tel: (718) 260-3456
Tel.: (718) 260-3537 (for emergencies)
Email: counseling@poly.edu
Hours: Monday-Friday, 9am-5pm

CENTER FOR K-12 STEM EDUCATION
Tel.: (718) 260-3524
Fax: (718) 260-3733
E-mail: besner@poly.edu
Hours: Monday-Friday, 9am-5pm

FACILITIES MANAGEMENT
Tel: (718) 260-3020
Fax: (718) 260-3753
E-mail: acarino@poly.edu or facility@poly.edu
Hours: Monday-Friday, 8am-5pm

FACULTY INNOVATIONS IN TEACHING AND LEARNING
www.poly.edu/academics/support/fitl
Tel.: (718) 260-3625
E-mail: yjeanpie@poly.edu
Hours: Monday-Friday, 9am-5pm

FINANCIAL AID
www.poly.edu/financial-aid
Tel.: (718) 260-3300
Fax: (718) 260-3052
E-mail: finaidb@poly.edu
Hours: Monday-Thursday, 9am-6pm;
Friday, 9am-4pm

FINANCIAL OPERATIONS
Tel.: (718) 260-3819
Fax: (718) 260-3752
E-mail: vkagan@poly.edu
Hours: Monday-Friday, 9am-5pm

FRESHMAN PROGRAMS
Tel.: (718) 260-3391
E-mail: mparham@poly.edu
Hours: Monday-Friday, 9am-5pm

GENERAL STUDIES
www.poly.edu/general-studies
Tel.: (718) 260-3882
E-mail: generalstudies@poly.edu
Hours: Monday-Friday, 9am-5pm

GRADUATE CENTER
www.poly.edu/graduate
Tel.: (718) 260-3182
Fax: (718) 260-3426
E-mail: gradcenter@poly.edu
Hours: Monday-Friday, 9am-5pm

HIGHER EDUCATION OPPORTUNITY PROGRAM (HEOP)
www.poly.edu/heop
Tel.: (718) 260-3370
Fax: (718) 260-4135
E-mail: heop@poly.edu
Hours: Monday-Friday, 9am-5pm

HONORS PROGRAM
www.poly.edu/academics/honors
Tel.: (718) 260-3986
Fax: (718) 260-3896
E-mail: ugacademics@poly.edu
Hours: Monday-Friday, 9am-5pm

HUMAN RESOURCES
www.poly.edu/careers
Tel.: (718) 260-3840
Fax: (718) 260-3981
E-mail: hr@poly.edu
Hours: Monday-Friday, 9am-5pm

INFORMATION SYSTEMS
www.poly.edu/life/student-0/information
Tel.: (718) 260-3123
E-mail: help@poly.edu
Hours: Monday-Friday, 9am-5pm

INTERNATIONAL STUDIES AND SCHOLARS
www.poly.edu/international-students
Tel.: (718) 260-3805
Fax: (718) 260-3710
E-mail: mgendel@poly.edu
Hours: Monday-Friday, 9am-5pm

JASPER H. KANE DINING HALL
www.poly.edu/life/dining
Tel.: (718) 260-3786
Fax: (718) 875-0509
E-mail: catering@poly.edu
Hours: Monday-Thursday, 7:30am-9pm;
Friday, 7:30am-6pm, Sat.-Sun., 11am-6pm

LAPTOP HELP DESK
www.poly.edu/life/student-0/information
Tel.: (718) 260-3368
Fax: (718) 260-3188
E-mail: notebook@poly.edu
Hours: Monday-Friday, 9am-5pm

LONG ISLAND GRADUATE CENTER
www.poly.edu/long-island
Office: 105 Maxess Road, Suite N201
Melville, NY 11747
Tel.: (631) 755-4300
Fax: (631) 755-4404
E-mail: ligc@poly.edu
Hours: Monday-Thursday, 9am-6pm

MAILROOM
Tel.: (718) 260-3396
Fax: (718) 260-3136
E-mail: mailroom@poly.edu
Hours: Monday-Friday, 8am-5pm

MANHATTAN LOCATION
www.poly.edu/manhattan
Office: 55 Broad Street, Suite 13B
New York, NY 10004
Tel.: (718) 260-4015
Fax: (212) 547-7029
E-mail: vvivek@poly.edu
Hours: By appointment only

OFFICE OF SPONSORED RESEARCH
Tel.: (718) 260-3360
Fax: (718) 260-3063
E-mail: cvillani@poly.edu
Hours: Monday-Friday, 9am-5pm

POLYTECHNIC TUTORING CENTER
www.poly.edu/academics/support/polytechnic
Tel.: (718) 260-3425
E-mail: tutoring@poly.edu
Hours: Monday-Thursday, 10am-6pm; Friday, 11am-5pm

PRINTING SERVICES
Tel.: (718) 260-3367
Fax: (718) 260-3136
E-mail: printshop@poly.edu
Hours: Monday-Friday, 8am-5pm

REGISTRAR
www.poly.edu/registrar
Tel.: (718) 260-3486
Fax: (718) 260-3052
E-mail: registrar@poly.edu
Hours: Monday-Friday, 9am-5pm

RESIDENCE LIFE
www.poly.edu/life/campus
Tel.: (718) 260-4160
Fax: (718) 260-4195
E-mail: reslife@poly.edu
Hours: Monday-Friday, 9am-5pm

SECURITY
Dibner Building - Tel.: (718) 260-3727
RH Front Entrance - Tel.: (718) 260-3537
RH Rear Entrance - Tel.: (718) 260-3213
WH Entrance - Tel.: (718) 637-5901

SPECIAL SERVICES
www.poly.edu/academics/support/trio
Tel.: (718) 260-3560
Fax: (718) 260-3945
E-mail: trio@poly.edu
Hours: Monday-Friday, 9am-5pm

STUDENT FINANCIAL SERVICES
www.poly.edu/life/student-resources/financial
Tel.: (718) 260-3700
Fax: (718) 260-3752
E-mail: stuaccts@poly.edu
Hours: Monday-Thursday, 9am-5pm; Friday, 9am-4:30 pm

STUDENT AFFAIRS
Tel.: (718) 260-3137
Fax: (718) 260-3197
E-mail: deanofstudents@poly.edu
Hours: Monday-Friday, 9am-5pm

STUDENT DEVELOPMENT
www.poly.edu/life/student
Tel.: (718) 260-3800
Fax: (718) 260-3197
E-mail: studentdevelopment@poly.edu
Hours: Monday-Friday, 9am-5pm

UNDERGRADUATE ACADEMICS
Tel.: (718) 260-3718
Fax: (718) 260-3896
E-mail: ugacademics@poly.edu
Hours: Monday-Friday, 9am-5pm

VARICK STREET INCUBATOR
www.poly.edu/business/incubators/160-varick
160 Varick Street/10 Hudson Square
12th Floor, NY, NY 10013
Tel.: (212) 292-3123
Fax: (212) 206-9190
E-mail: kuyan@varick.poly.edu
Hours: Monday-Friday, 9am-5pm

WEB AND MEDIA SERVICES
Tel.: (718) 260-3971
Fax: (718) 260-3756
E-mail: support@webteam.poly.edu
Hours: Monday-Friday, 9am-5pm

WESTCHESTER GRADUATE CENTER
www.poly.edu/westchester
Office: 40 Saw Mill River Road
Hawthorne, NY 10532
Tel.: (914) 323-2000
Fax: (914) 323-2010
E-mail: rtascio@poly.edu
Hours: Monday-Thursday, 9am-8:15pm; Friday, 9am-8:15pm; Sat. 8:30am-5pm

2011-2012 ACADEMIC CALENDAR

FALL 2011

Tuesday, September 6
Fall 2011 Classes Begin

Tuesday, September 13
Add/Drop Deadline

Monday - Tuesday, October 10–11
Columbus Day – No Classes Meet

Wednesday, October 12
Monday Classes Meet

Wednesday, November 16
Withdrawal Deadline

Monday, November 21
Spring 2012 Registration Begins

Thursday - Friday, November 24–25
Thanksgiving – No Classes Meet

Tuesday, November 29
January Graduation Application Deadline

Friday, December 9
Last Day of Undergraduate Classes

Monday - Tuesday, December 12–13
Undergraduate Reading Days

Wednesday - Friday, December 14–23
Undergraduate Final Exams
(Schedule Published November 2011)

Friday, December 16
Last Day of Graduate Classes

Monday - Friday, December 19–23
Graduate Final Exams

SPRING 2012

Tuesday, January 3
Winter Mini Begins

Thursday, January 5
Winter Mini Add/Drop Deadline

Tuesday, January 17
Winter Mini Ends

Monday, January 23
Spring 2012 Classes Begin

Monday, January 30
Add/Drop Deadline

Monday, February 20
President's Day – No Classes Meet

Monday - Friday, March 12–16
Spring Break

Monday, April 9
Withdrawal Deadline

Friday, April 13
May Graduation Application Deadline

Monday, April 30
Last Day of Undergraduate Classes

Tuesday - Wednesday, May 1–2
Undergraduate Reading Days

Thursday - Tuesday, May 3–15
Undergraduate Final Exams
(Schedule Published April 2012)

Monday, May 7
Last Day of Graduate Classes

Tuesday, May 8
Graduate Reading Day

Wednesday - Tuesday, May 9–15
Graduate Final Exams

POLYTECHNIC INSTITUTE OF NEW YORK UNIVERSITY PROFILE

INTRODUCTION

Polytechnic Institute of New York University (NYU-Poly) is the nation's second oldest private engineering institution and one of the New York metropolitan area's preeminent resources for science, technology, engineering and mathematics education and research. A private coeducational institution, NYU-Poly has a distinguished history in electrical engineering, polymer science and aerospace and microwave engineering. The Institute is focused on demanding societal challenges in the areas of urban systems, health and wellness and global information technology. These challenges include mapping, securing and extracting infosphere information; creating intelligent sensor systems; engineering smart cities; and tailoring biomolecular interactions. The Institute prepares graduates to play leading roles in these areas through invention, innovation and entrepreneurship (i^2e).

The student body includes more than 1,700 undergraduates and approximately 2,400 graduate students. Twenty percent of the undergraduate population are women; 9 percent are black, 12 percent are Hispanic and 31 percent are Asian. Polytechnic undergraduate programs prepare students in science, technology, engineering and mathematics education and research for immediate entry into the professional practice of their specialties or for continued graduate study.

Polytechnic is accredited by the Middle States Association. Undergraduate programs in civil, computer, chemical, electrical and mechanical engineering are accredited by the Accreditation Board for Engineering and Technology (ABET). The undergraduate chemistry program is approved by the American Chemical Society. Degree and certificate programs listed in this catalog are registered by the New York State Education Department.

HISTORY

Founded in 1854 as the Brooklyn Collegiate and Polytechnic Institute, the school originally educated young men, ages 9 to 22, and was located on Livingston Street in downtown Brooklyn. In 1889, the collegiate and preparatory departments separated, and the collegiate division adopted the name Polytechnic Institute of Brooklyn. The Institute, historically referred to as "Brooklyn Poly," moved its campus to Jay Street in 1957. In 1961, it opened a Long Island campus in Farmingdale as a graduate and research center.

In 1973, the New York University School of Engineering and Science merged into Polytechnic and the school was renamed the Polytechnic Institute of New York. The Institute began offering undergraduate programs at its Long Island campus in 1974 and, in 1975, opened the Westchester Graduate Center now located in Hawthorne.

In 1985, the New York State Board of Regents granted the institution university status and the official name became Polytechnic University.

The next 15 years saw a period of great activity as the University played a key part in the creation of MetroTech Center, a 16-acre, $1.5-billion university-corporate park, which was built around Polytechnic's existing buildings and revitalized an area that had been in decline. Polytechnic updated its facilities, renovated its student-center building and built a new home for its library and for the Center for Advanced Technology in Telecommunications. The University also began to offer several programs in management of technology and financial engineering in the heart of Manhattan's high-technology and financial district.

During this time, the University launched the Campaign for Polytechnic–Fulfilling the American Dream–to raise $275 million to transform itself into one of the nation's premier technological universities. In 1998, Polytechnic received a $175 million bequest from the estates of Donald F. Othmer, a longtime Polytechnic professor, and his wife, Mildred. At that time, it was the largest single cash gift ever made to a private American university. In 1999, Polytechnic received its second largest contribution from alumnus and former student of Professor Othmer, Joseph J. Jacobs, who gave $20 million.

In 2000, Polytechnic began construction on two new buildings on the MetroTech campus: the Joseph J. and Violet J. Jacobs Building, an eight-story academic and athletic facility with classrooms and laboratories and a full gymnasium; and the 20-story, 400-bed Donald F. and Mildred Topp Othmer Residence Hall, Polytechnic's first on-campus residence hall in Brooklyn. Both buildings opened in summer 2002.

In 2008 the University entered into a formal affiliation with New York University in recognition of the synergies between engineering, science, technology, medicine, dentistry, public policy, law and the arts. Now known as Polytechnic Institute of New York University, or NYU-Poly, the affiliation has further enhanced its capability to prepare leaders to address the challenges of the 21st century.

The Institute also has redirected its education programs, consolidating all undergraduate programs at its MetroTech campus while still offering graduate programs in Long Island and Westchester. In addition, Polytechnic delivers on-site and online programs locally and globally. Polytechnic students have the ability to study abroad at NYU's global sites and other affiliated international universities.

ACADEMIC PROGRAMS

Polytechnic offers the Bachelor of Science degree in 15 disciplines, covering computer science, engineering, the physical sciences, mathematics and liberal arts. The degree Master of Science is offered in 34 disciplinary specialties. The degree Master of Engineering in Interdisciplinary Studies in Engineering is offered with different concentrations. The degree Doctor of Philosophy is offered in 12 disciplines.

Bachelor of Science programs prepare students for entry-level employment in various professional disciplines, and for study at an advanced level. Master of Science programs are oriented toward professional development in the subject area and can be arranged to provide the core coursework for PhD study. The PhD is the terminal research degree for those who seek careers in industrial or academic research. The degree requires an independent research dissertation that advances the state of the art in the discipline of study. Details of academic degree requirements and detailed program descriptions are given in Part 3 of this catalog.

ACADEMIC DEPARTMENTS

The Institute faculty is grouped into academic departments for administrative purposes. Each degree program is planned and administered by the faculty of a department (or, in some cases, by faculty from several cooperating departments). Academic departments manage instructional laboratories and most research laboratories.

Part 2 of this catalog describes the faculty and facilities of the following eleven academic departments, and identifies the degrees that each department supervises.

- Applied Physics
- Chemical and Biological Engineering
- Chemical and Biological Sciences
- Civil Engineering
- Computer Science and Engineering
- Electrical and Computer Engineering
- Financial and Risk Engineering
- Mathematics
- Mechanical and Aerospace Engineering
- Technology, Culture and Society
- Technology Management

RESEARCH AT THE POLYTECHNIC INSTITUTE OF NYU

The Polytechnic Institute of NYU offers major research programs in experimental, theoretical and computational areas, leading to significant contributions in the advancement of technology. Polytechnic faculty continue to excel as world leaders in areas that include electromagnetics and wave propagation, wireless communications, telecommunications, and distributed information systems, cybersecurity, data management, software engineering and development, polymer chemistry and engineering, mechanical engineering, biomaterials, biocatalysis, biomolecular science, engineered interfaces, plasma science and technology, sensors and sensor systems, urban technology relating to urban infrastructure and smart cities and materials science and engineering.

BUSINESS INCUBATORS AND ACCELERATORS

NYU-Poly hosts two business incubators and one business accelerator. The mission of the Brooklyn Enterprise on Science and Technology (BEST) incubator, which opened in 2005 on the Brooklyn campus, is to provide an educational environment to stimulate the establishment and growth of science- and technology-based start-up and spin-off companies, expand Brooklyn's existing industry base, attract high-technology industry to the region and create jobs and enhance economic development within Brooklyn.

In 2009, NYU-Poly and the City of New York, together with Trinity Realty, launched the Varick Street incubator. The incubator was established to combine next-generation technology with highly adaptable business models. The incubator helps emerging companies shorten the time from innovation to impact, transforming them into thriving businesses with highly valuable products and services. A number of these start-ups were founded by NYU-Poly faculty and current or former students, allowing them to bring their products from the lab to the marketplace.

INTELLECTUAL PROPERTY

The Institute's written policy on intellectual property governs the rights, benefits and releases related to faculty and student project work. The policy is available from the Office of the Associate Provost for Research and PhD Programs.

FACULTY

The heart of the Polytechnic Institute of NYU is its teaching and research faculty. There are more than 150 full-time faculty, in addition to adjunct faculty, teaching and research assistants, scientists and post-doctoral and special fellows. The Polytechnic faculty is committed to providing the best possible educational environment to stimulate and develop the mind-set of inventors, innovators and entrepreneurs in the classroom and in the laboratory, through individual guided studies and projects, advising and strong one-on-one relationships with students. The faculty originates, organizes and approves all curricula taught at the Institute and also establishes academic standards for student performance.

ALUMNI

The Polytechnic Institute Alumni Association (PIAA), which traces its roots to 1863, promotes the welfare of alumni and the Institute through the support and advancement of continuing education, communication, fundraising, student recruitment and retention and fellowship among alumni. The association is governed by an elected Executive Council and an International Board of Directors. Polytechnic's more than 30,000 living alumni can be found in all 50 states and at least 64 countries.

The association, coordinating with the Office of Development & Alumni Relations, provides unique engagement opportunities that benefit alumni worldwide, including international and regional alumni gatherings and various networking and social programs organized by class year, discipline, affinity and other criteria.

Each year, the association recognizes alumni accomplishments with the Distinguished Alumni Award, Dedicated Alumni Award and Outstanding Graduate Award, which are presented during Commencement and other prestigious events.

NYU-Poly alumni are encouraged to take advantage of a number of services and benefits available through the Office of Alumni Relations. Benefits include the opportunity to audit Polytechnic courses at reduced tuition, use of the Bern Dibner Library of Science and Technology, access to online job listings through PolyLINK, the services of the Career Management Center, use of the NYU Federal Credit Union, access to the NYU Travel Adventures program, as well as discounted life, health, auto and home insurance programs.

CAMPUSES

Brooklyn Campus

Polytechnic's main campus is in the center of downtown Brooklyn, a vibrant residential and business community. The Brooklyn campus forms the nucleus of MetroTech Center, the largest urban university-corporate park in the United States. Developed in 1982, the 16-acre, $1-billion complex features a tree-lined commons and pedestrian walkways and is home to several technology-dependent companies that have fostered research and employment relationships with the Institute. Its academic buildings create an environment that facilitates faculty, student and staff interactions in laboratories, project space and study space, which together encourage invention, innovation and entrepreneurial activities both in and outside the classroom.

- Rogers Hall, the main academic building, is named after the late Harry S. Rogers, Polytechnic's fifth president (1933-57). The building houses faculty and department offices, classrooms, research and teaching laboratories and a cafeteria, dining hall and student lounge.

- Bern Dibner Library of Science and Technology/Center for Advanced Technology in Telecommunications (CATT) Building, opened in 1992, provides 128,000 square feet of academic space. The building houses several key elements of the Institute: a state-of-the-art library, named after the late Bern Dibner '21 Hon'59, a Polytechnic alumnus, trustee and benefactor; the New York State-funded research center, CATT; computer laboratories; and administrative offices for the Departments of Technology Management, Electrical and Computer Engineering and Computer Science and Engineering. The building also houses the Center for Faculty Innovation in Teaching and Learning.

- Joseph J. and Violet J. Jacobs Building, opened in 2002, honors the late inventor, innovator and entrepreneur Dr. Jacobs '37 '39 '42 Hon'86, founder of Jacobs Engineering Group, former chairman of the Polytechnic Board of Trustees, and his wife. The eight-story building, the main entrance to the Institute, contains lecture halls; laboratories for chemistry, biology and environmental engineering; and "smart" classrooms wired for multimedia technologies. The building also includes a full multipurpose gymnasium, including a fitness center and basketball court.

- Donald F. and Mildred Topp Othmer Residence Hall, opened in 2002, honors the late Dr. Othmer, a long-time Polytechnic professor of chemical engineering and prolific inventor (1932–76) and his wife. The 20-story building houses more than 400 students in two-bedroom suites and two-bedroom apartments with kitchenettes and data, voice and cable television ports for every student. The building includes student lounges, study rooms, laundry facilities, health offices and storage space.

- Joseph W. and Samuel Wunsch Hall is housed in a historic landmark. Anchoring the third side of the MetroTech campus, it was built in 1846. This Greek Revival building was the home of the African Wesleyan Methodist Church, the first black congregation in Brooklyn and was a stop on the Underground Railroad. It was authentically restored and reopened in 1996 through the generosity of the Wunsch family, in memory of two entrepreneurial brothers and Polytechnic alumni Joseph '17 and Samuel Wunsch '29. The building houses the Office of Undergraduate and Graduate Admissions.

- Joseph J. Jacobs Administration Building houses the Registrar, Student Financial Services, Student Development, Career Management Center and the Office of International Students and Scholars. Other administrative offices include development and alumni relations, communications and media relations, human resources, financial operations, the president's and provost's offices and offices of the vice presidents.

Long Island and Westchester Graduate Centers

Polytechnic Institute of NYU's graduate programs at its Long Island and Westchester Graduate Centers maintain the same high academic standards as NYU-Poly's Brooklyn main campus, but are tailored to meet the needs of working professionals looking to advance their career. Students enrolled at the Westchester or Long Island Graduate Center may pursue a master's degree or certificate program or simply take selected courses.

The Long Island Graduate Center offers master's programs in electrical engineering, computer science, construction management, management of technology and telecommunications networks, in addition to a number of certificate programs in these areas.

The Westchester Graduate Center offers part-time master's degree programs in management, computer science, cyber security, electrical engineering, computer engineering, construction management and telecommunication networks. The Westchester Graduate Center is also home to Polytechnic's MS in Information Systems Engineering, offered in an executive-degree program format.

Manhattan Location

Located in the heart of New York City's high-technology and financial district, Polytechnic's 55 Broad Street site allows the Finance and Risk Engineering and the Technology Management Departments to serve the area's burgeoning population of technology managers, financial experts, entrepreneurs and other professionals. The Finance and Risk Engineering Department offers certificate programs in Risk Management and Financial Technology Management.

Master's degrees offered at this site through the Department of Technology Management include Accelerated Management of Technology and Management of Technology, along with an Information Management Master's degree program taught in an executive-degree format. The 55 Broad Street site also houses the Department's Institute for Technology and Enterprise (ITE). ITE presents seminars and roundtables on various subjects related to modern technology management and supports research and advanced curriculum development for graduate and executive master's programs dealing with technology and innovation management and entrepreneurship.

BERN DIBNER LIBRARY OF SCIENCE AND TECHNOLOGY

The Bern Dibner Library of Science and Technology serves as Polytechnic Institute's information hub, specializing in applied science and engineering. Wireless networks allow users to access the library's electronic services both from within the library and from other campus locations.

The library, through its website (http://library.poly.edu), offers electronic access 24 hours a day, seven days a week, to an ever growing collection of electronic resources shared with other NYU libraries. Users can view full text of books and journals and imaged course materials and chat with librarians in real time. Subject-related web guides created by professional staff facilitate further study and research.

Polytechnic users also have onsite access to the vast resources offered by other NYU libraries. These in-house services are augmented by participation in regional and national cooperatives. The Institute library is an active member of the Academic Libraries of Brooklyn (seven participating libraries), the New York Metropolitan Reference and Research Library Agency (currently 250 member institutions) and the Long Island Library Resource Council (over 200 participating libraries). The library is also a member of Nylink, which offers access to New York State resources, as well as the Online Computer Library Center, which maintains an international catalog compiled and maintained by 71,000 libraries in 112 countries.

On-site skilled information professionals provide support through the following products and services:

- One-on-one assistance in the retrieval and use of online resources including the catalog and electronic databases;
- Tutorials on effective research methods offered in conjunction with various academic departments. Workshops are open to all Polytechnic students, faculty and staff and provide training in the use of information services and software;
- In-class instruction in effective use of information resources for freshmen and upperclassmen, offered at instructor's request;
- An in-house print collection of more than 130,000 books and journals, providing support for undergraduate and graduate programs in engineering, the sciences and technology management;
- A document delivery service, which obtains, on request, books, journal articles and reports not available in Polytechnic's in-house collections or online.

CENTRAL COMPUTING FACILITIES

The mission of Polytechnic's Information Systems department is to provide

state-of-the-art computing, networking and communications technologies to students, faculty and staff in support of the mission of the institution. These technologies are specifically designed to be aligned with NYU-Poly's course offerings in Computer Science and Engineering and in support of the Institute's role in educating and training knowledge workers of the future.

Polytechnic provides electronic access through wired and wireless networks, which allow students to roam seamlessly around campus while staying connected to the Internet and all educational support and information resources. Additionally, students living in the Othmer Residence Hall have voice, data and cable connections in their rooms and throughout the building.

Polytechnic requires every undergraduate student to have a laptop computer as mobile technology and timely, pervasive access to information is integrated into the curriculum and throughout the campus. The combination of student laptops, a ubiquitous network, online information and e-learning support tools promotes "congregate learning" and links the NYU-Poly community into the larger electronic teaching and learning community.

Since many of the learning and information support systems are Web enabled, students can access these resources off campus as easily as on campus. Students can view their schedule of classes and communicate with their instructors directly from the self-service pages.

Through the online Student Center, students can keep track of their academic and financial status. Through an institute-wide course management system, students are able to examine their course information. A Learning Management System (LMS) is used to facilitate and share learning materials between students and faculty. Faculty members use the LMS as a preferred method to enhance their courses by uploading syllabi and related documents and to communicate with students. Students are encouraged to interact with their instructors using electronic means, allowing students to have access to guidance, support, mentoring and advisement anytime, anywhere.

Polytechnic also provides access to central computing laboratories in support of various discipline-specific fields. These labs consist of a collection of desktops and workstations. These resources access a wide range of server operating systems and applications, giving students exposure to a highly heterogeneous technology environment and reflecting the most widely used tools available in the engineering and technology professions.

THE FUTURE

As Polytechnic moves forward in the 21st century it will build on its past, remain true to its mission to educate intellectually curious students who are eager to change the world through invention, innovation and entrepreneurship, and prepare graduates to become leaders in a global arena that demands scientific, technological and entrepreneurial acuity.

Polytechnic will continue to innovatively extend the benefits of science, engineering, management and liberal studies to critical real-world opportunities and challenges, and our affiliation with New York University will continue, especially those linked to urban systems, health and wellness, and the global information economy.

ACADEMIC DEPARTMENTS AND DEGREES

DEPARTMENT OF APPLIED PHYSICS

BS Physics
BS Physics and Mathematics
(dual-major offered with Department of Mathematics)
MS Physics
PhD Physics

DEPARTMENT OF CHEMICAL AND BIOLOGICAL ENGINEERING

BS Chemical and Biomolecular Engineering
MS Chemical Engineering
PhD Chemical Engineering

DEPARTMENT OF CHEMICAL AND BIOLOGICAL SCIENCES

BS Biomolecular Science
MS Biomedical Engineering
MS Chemistry
MS Biotechnology
MS Biotechnology and Entrepreneurship
PhD Biomedical Engineering
PhD Materials Chemistry
Advanced Graduate Certificates: Bioinstrumentation, Biomedical Materials

DEPARTMENT OF CIVIL ENGINEERING

BS Civil Engineering
BS Construction Management
MS Civil Engineering
MS Construction Management
MS Environmental Engineering
MS Environmental Science
MS Transportation Management
MS Transportation Planning and Engineering
MS Urban Systems Engineering and Management
PhD Civil Engineering
PhD Transportation Planning and Engineering
Advanced Certificates: Construction Management[2], Executive Construction Management (Exec 21), Traffic Engineering, Transportation Management and Economics, Transportation Planning

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

BS Computer Engineering[1]
BS Computer Science
MS Computer Science
MS Cyber Security
MS Information Systems Engineering
PhD Computer Science
Advanced Graduate Certificates: Cyber Security, Information Security Professionals, Information Systems Administration, Software Engineering

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

BS Computer Engineering[1]
BS Electrical Engineering
BS Electrical and Computer Engineering (dual-major program)
MS Computer Engineering
MS Electrical Engineering
MS Electrophysics
MS System Engineering
MS Telecommunication Networks[1]
PhD Electrical Engineering
Advanced Graduate Certificates: Computer Engineering, Image Processing, Power Electronics and Systems, Power Systems Management, Telecommunication Network Management[1], Wireless Communications

DEPARTMENT OF FINANCE AND RISK ENGINEERING

MS Financial Engineering
Tracks: Financial Markets and Corporate Finance, Computational Finance, Risk Finance, Technology and Algorithmic Finance
Advanced Graduate Certificates: Financial Engineering, Financial Technology Management, Risk Management

DEPARTMENT OF MATHEMATICS

BS Mathematics
BS Mathematics and Physics
(dual-major offered with Department of Applied Physics)
MS Mathematics
PhD Mathematics

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

BS Mechanical Engineering
MS Mechanical Engineering
PhD Mechanical Engineering

DEPARTMENT OF TECHNOLOGY, CULTURE AND SOCIETY

BS Science and Technology Studies
BS Integrated Digital Media
BS Sustainable Urban Environments
MS Environment-Behavior Studies
MS History of Science and Technology
MS Integrated Digital Media
Advanced Graduate Certificates: Environment-Behavior Studies, Integrated Digital Media

DEPARTMENT OF TECHNOLOGY MANAGEMENT

BS Business and Technology Management
MS Information Management, Executive
MS Management
MS Management of Technology
MS Organizational Behavior
PhD Technology Management
Advanced Graduate Certificates: Construction Management[2], Electronic Business Management, Entrepreneurship, Human Resource Management, Information Management, Project Management, Organizational Behavior, Technology Management, Telecommunications Management

DEGREES OFFERED OUTSIDE DEPARTMENTS

MS Bioinformatics
MS Industrial Engineering
MS Manufacturing Engineering
ME Interdisciplinary Studies in Engineering
(Wireless Innovation)
Undergraduate Certificate: General Studies
Advanced Graduate Certificates: Achieving World-Class Quality, Industrial Engineering, Manufacturing Engineering and Production Science, Manufacturing Excellence by Design: Holistic Approach

1. Offered jointly by the Department of Electrical and Computer Engineering and the Department of Computer Science and Engineering.
2. Offered jointly by the Department of Technology Management and Department of Civil Engineering.

DEGREES OFFERED AT POLYTECHNIC

Polytechnic offers a wide range of degree programs leading to the degrees Bachelor of Science, Master of Science, Master of Engineering and Doctor of Philosophy. These programs are offered at four Institute locations: Brooklyn, Long Island, Manhattan and Westchester and online at www.poly.edu/epoly. In addition, a MS in Management is offered in Israel. The table below indicates the degrees registered at each campus. Please check with each department to confirm that a program is currently available at the locations indicated below.

Graduate courses taken at any campus are applicable toward MS and PhD degree programs officially offered at another campus. Most graduate courses are offered in the evening or late afternoon. While PhD seminars, qualifying exams, etc., are available only on the Brooklyn campus, dissertation research may be at another campus where the faculty adviser is resident.

Program Title	HEGIS code[1]	CIP Code[2]	Brooklyn	Long Island	Westchester	Manhattan	Israel
Bioinformatics[3]	1999.20	26.1103	MS				
Biomedical Engineering	0905	14.0501	MS, PhD				
Biomolecular Science	0499	26.0210	BS				
Biotechnology	0499	26.1201	MS				
Biotechnology and Entrepreneurship	0499	26.1201	MS				
Business and Technology Management	0599	15.1501	BS				
Chemical and Biomolecular Engineering	0906	14.0701	BS				
Chemical Engineering[3]	0906	14.0701	MS, PhD				
Chemistry	1905	40.0501	MS		MS		
Civil Engineering	0908	14.0801	BS, MS, PhD				
Computer Engineering	0909	14.0901	BS, MS	MS			
Computer Science	0701	11.0701	BS, MS, PhD	MS	MS		
Construction Management	0599	14.3301	BS, MS	MS	MS		
Cyber Security			MS				
Electrical Engineering[3]	0909	14.1001	BS, MS, PhD	MS	MS (Power Concentration)		
Electrical and Computer Engineering (dual major)	0909	14.1001	BS				
Electrophysics	0919	14.1201	MS	MS			
Environment–Behavior Studies	2201	42.2101	MS				
Environmental Engineering	0922	14.1401	MS				
Environmental Science	0922	14.1401	MS				
Financial Engineering[5]	0599	27.0301	MS			MS	
History of Science and Technology	2205	54.0104	MS				
Industrial Engineering[3]	0913	14.3501	MS				
Information Management[4]	0599	52.9999	MS	MS	MS	MS	
Information Systems Engineering	0990	11.0103			MS		
Integrated Digital Media	0605	11.0803	BS, MS				
Interdisciplinary Studies in Engineering (Wireless Innovation)[3]	0999	14.2701	ME	ME	ME		
Management	0506	15.1501	MS	MS	MS		
Management of Technology[4]	0599	15.1501	MS	MS		MS	MS
Manufacturing Engineering[3]	0913	14.3601	MS				
Materials Chemistry	1905	14.1801	PhD				
Mathematics	1701	27.0301	BS, MS, PhD				
Mechanical Engineering	0910	14.1901	BS, MS, PhD				
Organizational Behavior[3]	0514	52.1003	MS				MS
Physics	1902	40.0801	BS, MS, PhD				
Science and Technology Studies	2299	54.0104	BS				
Sustainable Urban Environments	4903	45.1201	BS				
Systems Engineering	0901	14.2701	MS	MS			
Technology Management	0599	15.1501	PhD			MS	
Telecommunication Networks[3]	0799	11.0901	MS	MS	MS		
Transportation Management	0510	14.0804	MS				
Transportation Planning and Engineering	0908	14.0804	MS, PhD				
Urban Systems Engineering and Management	0999	14.0803	MS				

1. Higher Education General Inventory System.
2. Classification of Instructional Program.
3. These degrees are offered with select courses delivered at the Manhattan Center 2 Broadway, and online at www.poly.edu/epoly.
4. Executive format program.
5. Pending approval by New York State Education Department.

CERTIFICATES OFFERED AT POLYTECHNIC

Program Title	HEGIS code[1]	CIP Code[2]	Academic Department	Campus
Achieving World-Class Quality	0913	14.1901	Offered Outside Department	Brooklyn
Bioinstrumentation	0905	14.0501	Chemical and Biological Sciences	Brooklyn
Biomedical Materials	0905	14.0501	Chemical and Biological Sciences	Brooklyn
Computer Engineering[3]	0909	14.0901	Electrical and Computer Engineering	Brooklyn, Long Island
Construction Management	0599	14.3301	Civil Engineering/Management	Brooklyn, Long Island, Westchester
Cyber Security[3]	0799	11.1003	Electrical and Computer Engineering	Brooklyn
Electronic Business Management	0599	15.1501	Management	Brooklyn
Entrepreneurship	0506	15.1501	Management	Brooklyn
Environment-Behavior Studies	2201	42.2101	Technology, Culture and Society	Brooklyn
Executive Construction Management (Exec 21)	0599	14.3301	Civil Engineering	Manhattan[4]
Financial Engineering	0599	27.0301	Finance and Risk Engineering	Brooklyn, Manhattan
Financial Technology Management	0599	27.0301	Finance and Risk Engineering	Brooklyn, Manhattan
General Studies			Offered Outside Department	Brooklyn
Human Resource Management	0515	52.1001	Management	Brooklyn
Image Processing	0999	14.1001	Electrical and Computer Engineering	Brooklyn
Industrial Engineering	0913	14.3501	Offered Outside Department	Brooklyn
Information Management	0702	15.1501	Management	Brooklyn, Manhattan
Information Security Professional (NSTISSI 4011)(Pending NYS approval)			Electrical and Computer Engineering	Brooklyn,Westchester, Long Island, Manhattan
Information Systems Administration (NSTISSI 4013)(Pending NYS approval)			Electrical and Computer Engineering	Brooklyn
Integrated Digital Media[5]	0605	11.0803	Technology, Culture and Society	Brooklyn, Westchester, Long Island, Manhattan
Management	0599	15.1501	Management	
Manufacturing Engineering and Production Science	0913	14.3601	Offered Outside Department	Brooklyn
Manufacturing Excellence by Design: Holistic Approach	0913	14.3601	Offered Outside Department	Brooklyn
Operations Management	0506	15.1501	Management	Brooklyn
Organizational Behavior[3]	0515	52.1003	Management	Brooklyn
Power Electronics and Systems[3,5]	0909	14.1001	Electrical and Computer Engineering	Brooklyn
Power Systems Management[3,5]	0901	15.1501	Electrical and Computer Engineering	Brooklyn, Westchester, Long Island, Manhattan
Project Management	0506		Management	Westchester, Long Island
Risk Management	0504	27.0301	Finance and Risk Engineering	Brooklyn, Manhattan
Software Engineering	0799	14.0903	Electrical and Computer Engineering	Brooklyn, Long Island
Technology Management	0599	15.1501	Management	Brooklyn, Westchester, Long Island, Manhattan
Telecommunication Network Management[3]	0799	11.0901	Electrical and Computer Engineering	Brooklyn, Long Island, Westchester
Telecommunications Management	0599	15.1501	Management	Brooklyn, Long Island
Traffic Engineering	0908	14.0804	Civil Engineering	Brooklyn
Transportation Management and Economics	0908	14.0804	Civil Engineering	Brooklyn
Transportation Planning	0908	14.0804	Civil Engineering	Brooklyn
Wireless Communications[3]	0909	14.1001	Electrical and Computer Engineering	Brooklyn, Long Island

1. Higher Education General Inventory System.
2. Classification of Instructional Program.
3. Also offered online via www.poly.edu/epoly.
4. These certificates are offered with select courses delivered at the Manhattan Center, 2 Broadway, and online at www.poly.edu/epoly.
5. Pending approval by New York State Education Department.

UNDERGRADUATE ACADEMIC PROGRAMS AND POLICIES

PROGRAM AREAS

Polytechnic Institute of New York University focuses uniquely on the world of technology and its interactions with society. To fulfill its mission, NYU-Poly offers degree programs in five general academic areas:

- Computer Science and Engineering
- Engineering
- Sciences and Mathematics
- Science and Technology Studies
- Technology Management

COMPUTER SCIENCE AND ENGINEERING

Computer science and engineering is an important and expanding field as today's society advances further into the Information Age. Computer science and engineering includes designing systems (computer hardware and software) and developing principles for applying computers to new uses. The field requires high levels of theory and practice and often involves developing or integrating complex software.

Computer science and engineering is a major element in modern information technology, allowing information to be used to analyze and solve problems in diverse fields, including telemedicine, heath care, finance, entertainment, manufacturing, telecommunications, transportation and biomedicine. Because of the breadth of its potential applications, computer science and engineering at NYU-Poly has a multidisciplinary focus.

The curriculum integrates basic science, computer science, mathematics, humanities and social sciences. Students take electives in technical and non-technical subjects, a mix that allows for flexibility and breadth in their studies at NYU-Poly.

The current faculty works in state-of-the-art fields such as high-speed imaging, classification, software virus protection, high-speed graphics, text and data mining, fault-tolerant computing, database-management systems, software engineering, data compression, data security, parallel and distributed computation, scheduling theory, computer vision and Internet and Web technologies. This faculty experience, combined with a strong curriculum that integrates theory and practice, positions NYU-Poly graduates well for the 21st century.

ENGINEERING

Engineering is the creation of devices and implements that can control or manipulate nature to produce a desired effect, applying science to build the infrastructure and tools society needs to improve the quality of life and the environment.

The modern engineer must have a firm background in the sciences and mathematics. Science reveals fundamental knowledge about the natural world. Mathematics is the language used most often to describe that world and is used by engineers to manipulate it. Additionally, a background in the liberal arts provides a fundamental understanding of society, its structures, needs and desires. No one can hope to improve society without such understanding. Engineers also must deeply appreciate the role they play in society, particularly in terms of their professional ethics and responsibilities. Finally, engineers must have excellent written and oral communication skills to work effectively with other engineers, professionals, decision-makers and the public.

NYU-Poly's engineering programs build on a firm foundation of mathematics and science to develop the analytic and conceptual skills required of a practicing professional. Laboratory classes introduce students to devices and systems currently used in their fields and help develop their skills in using computer-aided design packages. Undergraduate programs prepare students equally for entry into the profession and for continued education at the graduate level.

NYU-Poly, by giving students a comprehensive education in scientific and engineering principles and by developing creative skills required for engineering design and analysis, provides its graduates with the ability to continue to learn and grow in rapidly developing technological fields throughout their careers.

Current NYU-Poly faculty and alumni are advancing varied fields such as telecommunications, microwaves, imaging sciences, quantum electronics, pulsed power, smart materials, aerospace, robotics, geotechnology, biomedical engineering, financial and risk engineering, cyber security, gaming, software engineering and sensors and sensor networks. Through the NYU-Poly engineering curriculum, students are equipped to advance this tradition forward to the next generation of technological breakthroughs.

THE SCIENCES AND MATHEMATICS

Science and mathematics underpin modern technology. As scientists and mathematicians discover and describe secrets of the natural world, engineers look to apply them to developing new technology. Without the physical sciences and mathematics, engineers would have no tools with which to invent the technology of tomorrow.

NYU-Poly's undergraduate science and mathematics programs give students unique opportunities to study basic theory while interacting with design disciplines. The undergraduate program structure in these areas encourages students to select concentrations of elective courses in technology areas.

Students use modern laboratories and interact with faculty who are world-class researchers. Many upper-level classes are small, allowing students to develop one-on-one relationships with faculty and to work with them in their research areas.

The future of technology depends on the ability to develop a better and more accurate understanding of nature and its opportunities and constraints. For technology to advance, scientists must continue to unlock the secrets of the universe, and mathematicians must continue to develop the analytical and logical processes through which they can extend and apply what they investigate and discover. NYU-Poly programs prepare scientists and mathematicians for this vital role, enabling them to lead society to a better future.

SCIENCE AND TECHNOLOGY STUDIES

Science and Technology Studies (STS) is an interdisciplinary field in which methods of analysis from a wide range of fields in the humanities and social sciences are used to study the relations among science, technology and society. Such methods include historical, philosophical, sociological, psychological, scientific, literary, journalistic and cultural and media-studies approaches. STS creates technology-savvy, ethical and socially responsible users, developers and critics of science and technology. It contributes a key element to developing well-rounded engineers and scientists. Such professionals are capable not only of technical expertise and its dissemination, but also of innovative and creative ways to reason and communicate with fellow citizens. STS graduates have the best of both worlds: broad training in the liberal arts coupled with expertise in science and technology. This combination makes them stand out and gives them an advantage over graduates of more narrowly focused programs.

TECHNOLOGY MANAGEMENT

NYU-Poly's Department of Technology Management is the leading learning, research and development hub in the New York City/tri-state region, devoted explicitly to the

critical arenas of innovation, information and technology management.

The department has achieved this distinguished position with a continuous stream of high-quality and relevant research, development and pace-setting learning programs. Its faculty contributes to theory and practice in an increasingly knowledge-intensive age.

The research and development conducted within the Department of Technology Management is varied, including scholarly books and articles in respected journals and timely case studies. Some of this material forms part of the content in educational programs, helping to keep programs up-to-date and distinctive. The department is also committed to integrating technology into all educational programs to enhance learning. Because all managers must understand how technology and innovation are essential for delivering value to organizations and to the market, the department offers a portfolio of educational programs dealing with the broad spectrum of innovation, information and technology management in the modern economy.

In addition to its academic programs at the undergraduate, graduate and doctoral levels, the Department of Technology Management offers short-term nondegree courses and workshops, including those tailored to the needs of specific firms and industries on contemporary topics in technology management.

UNDERGRADUATE DEGREE REQUIREMENTS

This section details the general Institute-wide degree requirements applicable to all NYU-Poly undergraduate degrees. Academic departments may place additional requirements on individual degrees. Such additional requirements are explained in the program sections of this catalog. In no case may a department specify requirements less stringent than those indicated here.

Outcomes Assessment

NYU-Poly conducts outcomes assessments to monitor student academic achievement, effective teaching methods and continuous improvement of the Institute, as well as to facilitate compliance with accreditation standards. To obtain periodic measurements of student perceptions and intellectual growth, undergraduates must participate in surveys, focus groups, interviews or related activities. While individual input is collected, the data from these assessments are published only in aggregate form. Undergraduate students must complete online course surveys for all courses in which they are registered each semester (except guided studies and courses in which the enrollment is fewer than six students). Graduating seniors must complete exit surveys online. Any additions to or exceptions to this requirement are disseminated to the Institute each semester by the Office of Assessment and Institutional Research. Student compliance with outcomes-assessment activities generally is a precondition for receipt of semester grade reports, transcripts and degrees.

BASIC DEGREE REQUIREMENTS AND DEFINITION OF CREDITS

Programs for the degree Bachelor of Science require 120 to 128 credits, depending upon the major as described in the program's section of this catalog. Undergraduate semester credits are based on the number of 55-minute periods scheduled each week during one semester. Normally, one credit signifies a minimum of either one 55-minute period of class work, or three 55-minute periods of undergraduate laboratory, over a period of 15 weeks, which includes a final exam. In a few cases, more time per credit is given. The final examination period is an integral part of the semester.

Students may attend the Institute part-time or full-time. All undergraduate degrees typically can be completed in four years of full-time study. To earn the degree Bachelor of Science from NYU-Poly, students must satisfy Institute residency requirements. Nearly all undergraduate courses are given during the day. A selection of evening undergraduate courses is available, but it is not possible to complete any undergraduate degree by taking courses entirely in the evening.

To earn a bachelor's degree, students must have a cumulative GPA of 2.0 or better in all courses at NYU-Poly; further details can be found in the section on academic standing and probation. Some programs have additional graderequirements in specified courses or groups of courses. Most undergraduate engineering curricula require students to participate in team projects, including participation in team design-project exercises. Students must participate in outcomes assessment, as described below.

SELECTION OF A MAJOR

Undergraduate students admitted to NYU-Poly are encouraged to declare their major upon admission, although incoming first-year students may enter initially as "undeclared". First-year students wishing to consider several program options are encouraged to use their first semester to explore major fields in consultation with departmental advisers. While NYU-Poly's first year curriculum is nearly uniform for all engineering majors and very similar for other majors, students who choose to delay selecting their major until the end of the freshman year must select courses in consultation with their academic advisers.

Students are free to change their major at any time, given that their scholastic standing is acceptable to the program into which they wish to transfer. However, changes in major may involve some loss of credit. Students entering NYU-Poly with an undeclared major must declare any currently offered undergraduate major by the end of their first year.

SELECTION OF A MINOR

A minor is an approved concentration of academic study within a single discipline. In specified programs, undergraduate students may select a minor in a field distinct from, or related to, their major, with approval of advisers in both the major and minor fields. The name of the minor appears on students' transcripts if the approved 14-15 credits in the minor field have been completed with at least a 2.0 GPA. With the consent of a student's major department, some courses used to satisfy the minor requirements also may satisfy the required or electives course requirements in the student's major program. The names and associated requirements for minors are listed in the sections of this catalog devoted to related major programs.

COURSE PLACEMENT EVALUATION

NYU-Poly gives select incoming first-year students placement and diagnostic examinations in writing and mathematics. Transfer students are required to take the mathematics diagnostic exam.

NYU-Poly's placement and diagnostic evaluations are intended to ensure that each student receives the most pertinent instruction in basic areas needed to complete their degree program successfully. Placement evaluations may supersede the results of Advanced Placement examinations and/or acceptable transfer credits from another institution of higher education as determined by the designated adviser and the department offering the course.

Mathematics Diagnostic Examination

The Mathematics Diagnostic Examination is an extensive test to profile students' knowledge and skills in basic and advanced mathematics. The mathematics department uses the scores on various components of this examination to place students in pertinent mathematics courses. Entering first-year students (except those with AP credit) are placed in MA 902/912, MA 914, MA 1024, MA 1054, or MA 1324.

Writing Placement Examination

Both employers and accrediting organizations increasingly emphasize the need for students to have well-developed written and oral communications skills. No engineer or scientist can be an effective professional without the ability to

communicate, not only with those in his or her own field, but also with professionals in other technical and non-technical fields, with private and public decision-makers and with the general public. As such, NYU-Poly's degree programs involve frequent writing and speaking assignments across all areas of the curriculum. It is essential that all students have necessary background skills before enrolling in upper-division courses related to their professional studies.

To ensure that students are placed into the proper writing course, some admitted undergraduate students will be required to take the Institute's writing-placement exam. This timed essay exam is used to evaluate each student's writing ability and to ensure that he or she is placed into the appropriate writing course. On the basis of this test, students are placed in one of the standard first-year courses (EN 1013W, College Writing Workshop or EN 1033W, College Writing Workshop for ESL Students) or they may first be required to take one or more semesters of an introductory course in English (EN 1080W Introduction to College Writing for ESL Students) before proceeding to the first-year courses.

If an incoming undergraduate student is not required to take the English placement exam and does not have any AP credits to transfer to NYU-Poly, the student is placed in EN 1013W. Then, all students are given a first-day writing assignment during the first class period of all the writing courses. Individual instructors read and assess these assignments, and if a student seems to have been placed into an inappropriate class, the instructor consults with the Writing Program director and assistant director, and the student may be moved into a more appropriate course. Note: EN 1080W does not carry credits toward a degree. However, it does contribute to the full-time credit load during the semester in which it is taken.

Students who successfully complete EN 1013W or EN 1033W continue to HuSS 1023W, First-Year Writing Seminar, or EN 1233W, First-Year Writing Seminar for ESL Students. Students who successfully complete EN 1080W usually move into EN 1033W. Occasionally, however, a student who has completed EN 1080W may have the choice to enroll in EN 1013W if the instructor believes the student has achieved sufficient fluency in English. Students placed in EN 1080W may take this course during their first regular semester. Typical schedules can be rearranged to accommodate this approach. Institute guidelines do not permit undergraduate students placed into EN 1080W to progress to more advanced humanities courses until they receive a passing grade in that course.

WRITING AND SPEAKING ACROSS THE CURRICULUM

NYU-Poly has adopted a Writing and Speaking Across the Curriculum program to ensure that graduates develop adequate communications skills. The program ensures that significant writing and speaking assignments are included in designated courses throughout students' undergraduate program and that course grades are influenced by the quality of presentation in addition to mastery of content.

To support this program, the Polytechnic Tutoring Center (PTC) houses the Writing Center for students; the Center is staffed by instructors, professional writers and qualified tutors. Students are encouraged to make an appointment to improve their writing and speaking skills.

Core courses such as EN 1013W, EN 1033W, EN 1013H, HuSS 1023W, EN 1233W, EN 1203H, EG 1003, select humanities and social sciences electives, and all senior design projects are writing- and speaking-intensive courses. Each disciplinary curriculum also identifies other courses that fit into this category.

In addition to the required 6 credits of first-year writing, NYU-Poly students also are required to complete 18 credits within the humanities and social sciences. One of these courses must be Writing-Intensive (designed with a "W"), and one must be at the 3000 or 4000 level. For more information about this requirement, and to see a list of courses, please refer to the Technology, Culture and Society (TCS) departmental overview.

CORE REQUIREMENTS FOR ENGINEERING MAJORS

All engineering majors must follow the core curriculum outlined in this section. Non-engineering majors take particular parts of this core, as described in the programs section of this catalog. Students entering the Institute as undeclared majors also are required to closely follow this core curriculum and may select any NYU-Poly major at the end of one year of study. Changes in major may involve some loss of credit.

The core curriculum ensures that every engineering student is exposed to a relevant mix of general preparatory courses in the liberal arts, mathematics and the basic sciences. It is also intended to ensure a breadth of knowledge of fundamental engineering principles and an appreciation and understanding of all engineering disciplines.

The components of the core curriculum are as follows:

(1) Introduction to Major

Each department has a 2 credit introductory course designed increase students' knowledge of their field of study and familiarizes them with the different disciplines within their major. An additional benefit of these courses is that students begin to interact with faculty in their major department, encouraging engagement and fostering community building through intellectual and scholarly activities. In their first year of study, students must take their department's version of this course (usually listed as XXX1002 or XXX1012) when it is offered. Students who have completed more than 32 credits are not permitted to enroll in any Introduction to Major course except MG1002.

(2) Engineering and Technology Forum

All incoming first-year students, including transfer students with fewer than 6 credits, must take EG 1001, Engineering and Technology Forum (1 credit). In this course, the notions of invention, innovation and entrepreneurship (i^2e) are brought to the forefront of students' educational experience in an effort to introduce undergraduates to elements of a research-intensive institution and to encourage intellectual and scholarly interaction with their peers and faculty. This course includes presentations and discussions on emerging and exciting topics by leading engineers, scientists, inventors and entrepreneurs. The readings of the course are case studies on innovations, inventions and entrepreneurship as well as relevant contemporary and emerging environment-, economic-, global-, energy- and health-related topics. The course encourages collaboration and creativity coupled with peer-to-peer learning and exposes students to an array of collegiate academic skills such as the elements of a research-intensive institute, information-technology resources and ethics in science and engineering.

(3) Engineering Design

The centerpiece of the core curriculum for engineering majors is engineering design. Introduction to Engineering course (EG 1003) ensures that all engineering majors have a common base of knowledge of key engineering principles and a thorough appreciation of the range of applications of these principles across engineering disciplines. This first-year engineering course provides an early introduction and immersion in engineering as both an intellectual discipline and a professional pursuit.

The Accreditation Commission for Engineering and Technology (ABET) defines six fundamental areas of engineering: mechanics, electric and electronic circuits, materials science, thermodynamics, transport phenomena and computer science. The

engineering design core is constructed to expose all engineering majors to many of these fundamental areas.

All engineering students are required to take the following two courses:

1. EG 1003 Introduction to Engineering (3 credits)
2. Capstone Design Project*

*Actual course code depends on department.

EG 1003 is focused on hands-on experiential learning and the process of engineering design as the unique professional function of the engineer. Each major defines its own capstone senior-design projects, but every engineering student must complete one.

Transfer students may replace EG 1003 with an advanced technical course if they enroll in the Institute at a sophomore or higher level, subject to adviser approval.

(4) Mathematics Core

Every engineering student must complete a minimum of 16 credits of study in mathematics.

The following courses are required of all engineering students:

MA 1024	Calculus I or MA 1054 Calculus I with Pre-calculus (4 credits)
MA 1124	Calculus II or MA 1154 Calculus II with Pre-calculus (4 credits)
MA 2012	Elements of Linear Algebra I (2 credits)
MA 2132	Ordinary Differential Equations (2 credits)

Each engineering discipline specifies 4 to 8 additional credits of mathematics from the list below.

Consult the program's section of this catalog for information on specific requirements and preferred sequencing for each discipline.

MA 2112	Multivariable Calculus I (2 credits)
MA 2122	Multivariable Calculus II (2 credits)
MA 2212	Data Analysis I (2 credits)
MA 2222	Data Analysis II (2 credits)
MA 2312	Discrete Mathematics I (2 credits)
MA 2322	Discrete Mathematics II (2 credits)
MA 3012	Probability I (2 credits)
MA 3122	Complex Variables I (2 credits)

(5) Basic Science Core

The basic science core consists of 14 credits of study in the critical areas of chemistry and physics. The following courses are required of all engineering majors:

CM 1004	General Chemistry for Engineers (4 credits)
PH 1013	Mechanics (3 credits)
PH 2021	Introductory Physics Laboratory I (0.5 credit)
PH 2023	Electricity, Magnetism and Fluids (3 credits)
PH 2031	Introductory Physics Laboratory II (0.5 credit)
PH 2033	Waves, Optics and Thermodynamics (3 credits)

NOTE: Some departments may require additional credits of science. See the programs section of this catalog for details.

(6) Engineering Problem Solving and Programming

This course, CS 1133, is an introductory course in engineering problem solving and computer programming for all undergraduate engineering and science students without experience in programming in any language. CS 1133 enables students to develop problem-solving skills used by engineers and scientists. The course covers the fundamentals of computer programming and its underlying principles, using the MATLAB programming language. Concepts and methods introduced in the course are illustrated by examples drawn from various engineering and technology disciplines. Useful numerical techniques and their applications to real-world problems in science and engineering are discussed.

(7) Writing

Engineering students will take two writing classes in their first year at NYU-Poly. These classes serve as a primer for students to develop their ability to engage with a text, to look at it critically and to respond to the text in kind. In order to do so a student needs to be able to formulate their ideas in a clear and concise manner. This sequence of courses emphasizes the necessity of strong writing skills not just for student's undergraduate education, preparing them for writing across the curriculum, but for success after their undergraduate degree as well.

(8) Humanities and Social Sciences

Every engineering student must take a minimum of 18 credits in the humanities and social sciences. These courses have two objectives: to develop students' communication skills and to expose them to a balanced study of the liberal arts. Both areas are critically important and contribute to the general literacy of engineering undergraduates as they deal with the world and societal issues that set the context for the practice of their professions.

ENGINEERING COMPETENCIES

All NYU-Poly undergraduate engineering programs are accredited by the Accreditation Board for Engineering and Technology (ABET). ABET identifies the following core competencies that every engineering program should address: (a) an ability to apply knowledge of mathematics, science and engineering; (b) an ability to design and conduct experiments and to analyze and interpret data; (c) an ability to design a system, component or process to meet desired needs; (d) an ability to function on multidisciplinary teams; (e) an ability to identify, formulate and solve engineering problems; (f) an understanding of professional and ethical responsibility; (g) an ability to communicate effectively; (h) the broad education necessary to understand the impact of engineering solutions in a global and societal context; (i) a recognition of the need for, and an ability to engage in, lifelong learning; (j) a knowledge of contemporary issues; (k) an ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

Some course descriptions list the ABET competencies that they address.

MODIFICATIONS TO CURRICULA

COURSE SUBSTITUTIONS

Curricula sometimes change to keep students abreast of the latest knowledge and methods within the subject area, especially in the science, engineering and technology areas taught at NYU-Poly. Students are informed of these changes by their major department.

The Institute responds to changes in curricula and course content and addresses special situations. To that end, it occasionally needs to substitute a course for one that is specified in the curriculum to meet degree requirements. A student documents such substitutions on an Adjustment of Degree Requirements form available from the Office of the Registrar's website. Each substitution must be documented on the form and approved by the student's major adviser and by the Office of Undergraduate Academics. If a graduation checklist has been issued at the time of the substitution, the change should be formally entered on the checklist and approved by the major adviser and the Office of Undergraduate Academics.

INTERRUPTION OF STUDY

NYU-Poly graduates must fulfill degree requirements using courses that currently meet the current standards in the field. Accordingly, students have up to eight years to complete the degree requirements in effect when they first enrolled in a NYU-Poly undergraduate degree program. This time limit is irrespective of any leave of absence granted during the eight-year period. As courses continuously evolve, the Institute may replace some courses in the original degree requirements with comparable ones with updated contents. Should the Institute establish a new set of degree requirements for new students, continuing students may choose to satisfy the new requirements. In such cases, the Institute decides which portion of the new requirements may be satisfied by the courses students have completed and also rules on modification, if any, of the original eight year time limit.

If a student has exceeded or is about to exceed the eight-year limit and has not yet finished their degree requirements, they need to appeal for an extension in order to finish the remaining courses.

To appeal, the student must consult with their academic adviser and fill out the "Extension of Time Limit to Complete Degree" form. All courses remaining in order to complete their degree must be listed and the time frame in which they will be completed.

The form should then be signed by their academic adviser and the Dean of Undergraduate Academics before it is submitted to the Registrar's Office.

BS/MS PROGRAM

Undergraduates with strong academic records in certain programs may apply for admission to the BS/MS Program, which leads to the simultaneous award of a bachelor's and a master's degree, sometimes in less time than it takes to complete both separately. This program allows students to make accelerated progress towards completing the two degrees through combinations of AP credits, summer course work and additional credits completed each semester; additionally, undergraduate students enrolled in this program are allowed to take graduate level courses before they complete the bachelor's degree. Qualified students are considered for admission into the program toward the end of their sophomore year or the beginning of the junior year at the latest; however, students interested in pursuing this option should talk to their undergraduate adviser as soon as possible. Some possible combinations of BS and MS majors that are available in this are described in the programs section of this catalog. Students accepted to this program are required to maintain a cumulative GPA of at least 3.4 for the duration of the program; some departments may have a higher GPA requirement. Additional information can be obtained from the departmental adviser, including the specific sequence of courses that will be necessary to complete two degrees simultaneously. International Students in F-1 or J-1 status must obtain permission and the necessary I-20/DS-2019 from the Office of International Students and Scholars before enrollment in the combined BS/MS program. The application for the BS/MS Program is available in the Office of Undergraduate Academics.

DUAL UNDERGRADUATE DEGREES

It is possible for students to earn two separate BS degrees in two disciplines. Special requirements for each degree are determined by the departmental undergraduate adviser or department head for each department, in accordance with the following rules:

- The set of courses includes all of the required courses for each degree. Some elective credits for one curriculum may be fulfilled with required credits from the other, given that sufficient senior/graduate level electives are completed to provide depth in each discipline.
- The total credits required for both degrees must exceed those required for one of the degrees by at least one full year of credit. Courses satisfying requirements in both degrees may be counted only once for this purpose. Total credits required for the two degrees are, therefore, computed using the following formula:

  Total Credits = Credits (Degree 1) + Credits (Degree 2) / 4

This is a minimum, and some combinations of degrees may require additional credits. Where the two majors are closely related, such as electrical engineering and computer science, physics and electrical engineering, etc., five years of study will generally suffice to earn both degrees. Where the two degrees are less closely related, such as civil engineering and chemistry, electrical engineering and humanities, mechanical engineering and physics, etc., additional credits and more than five years will be required.

- Students working towards two degrees must (1) register in a "home" department which will be responsible for the student's primary (first) degree, and notify the department of the intent to pursue a second degree, (2) apply for and receive admission to the second department in the same manner as a student wishing to change degrees, (3) obtain approval from both departmental faculty advisers when registering or withdrawing from a course, (4) maintain good academic standing in the Institute and in each academic department and (5) complete all courses specified in the graduation checklist provided by each department with satisfactory grades.
- Both degrees may be simultaneously earned, or the primary degree may be earned first. Graduating with the honors distinction is separately determined for each degree. To graduate in the minimum amount of time with two degrees, students should choose this option as early as possible. The courses of the two degree programs can then be interwoven to provide good academic continuity and to satisfy all prerequisites in an orderly fashion. Please note that many students, rather than earn two undergraduate degrees, prefer to earn a single bachelor's degree followed by a master's degree in a different, but related, discipline.

Students interested in the dual degree option should check with their undergraduate advisers, as not all combinations of disciplines can be conveniently packaged in this manner.

3+2 PROGRAM WITH THE COLLEGE OF ARTS AND SCIENCE AT NYU

General Information

NYU's College of Arts and Science offers a dual-degree program in science and engineering with the Polytechnic Institute of NYU. This program affords highly qualified and motivated students who are technically oriented the opportunity to pursue both a liberal arts program with a major in science and a traditional engineering program. The program is ideal for the student interested in science and engineering who is also eager for a liberal arts experience before entering an undergraduate engineering environment. Upon completion of this five-year program, students receive the Bachelor of Science degree from the College of Arts and Science at New York University and the Bachelor of Science degree from the Polytechnic Institute of NYU.

The available dual-degree combinations are as follows:

- BS in biology/BS in chemical and biomolecular engineering
- BS in chemistry/BS in chemical and biomolecular engineering
- BS in computer science/ BS in computer engineering
- BS in computer science/ BS in electrical engineering
- BS in mathematics/ BS in civil engineering
- BS in mathematics/ BS in computer engineering
- BS in mathematics/ BS in electrical engineering
- BS in mathematics/ BS in mechanical engineering
- BS in physics/BS in civil engineering
- BS in physics/BS in computer engineering
- BS in physics/BS in electrical engineering
- BS in physics/BS in mechanical engineering

Detailed programs of study for each of the curricula are available from the NYU's College Advising Center, Silver Center, 100 Washington Square East, Room 905.

Students who are interested in this program apply directly to NYU's College of Arts and Science, indicating their interest in this program on their application. Application materials for this dual-degree

program may be requested from New York University, Office of Undergraduate Admissions, 665 Broadway, 11th Floor, New York, NY 10012-2339.

The Academic Program

Students accepted into the program spend their first three years of study in the College of Arts and Science (CAS) at New York University. In the first year at the College, the different curricula call for many of the same courses. This gives students time to consult with faculty at both schools before committing themselves to a particular science/engineering major.

During Freshman Orientation, if they have not already done so, students select a major area for their study at CAS from the disciplines of biology, chemistry, computer science, mathematics, and physics. In their first year, students will have the opportunity to change this major and to reflect on their choice of engineering major. In the spring of the third year, an orientation program helps students prepare for the transition to NYU-Poly in the fourth year.

In the first three years of the program, students satisfy their core liberal arts requirements and also take some of the NYU-Poly courses required for their choice of engineering major. Students may elect to withdraw from the dual-degree program in engineering and complete only the College of Arts and Science general and major requirements at New York University. The final two years of study are undertaken at NYU-Poly's campus.

At NYU-Poly, students complete the remaining technical courses required for their engineering major in their final two years.

HONORS DISTINCTIONS

HONOR SOCIETIES

Students with superior academic records and co-curricular achievements are selected in their junior and senior years to join one of the NYU-Poly chapters of a national honors society. Closely allied to the professional and technical societies, these honors societies encourage and recognize outstanding scholarship and leadership.

Current Participating Societies at NYU-Poly:

Chi Epsilon - civil engineering
Eta Kappa Nu - electrical engineering
Omega Chi Epsilon - chemical engineering
Pi Mu Epsilon - mathematics
Pi Tau Sigma - mechanical engineering
Sigma Xi - research
Tau Beta Pi - engineering
Upsilon Pi Epsilon - computing sciences

DEGREES WITH HONORS

Degrees with honors are awarded to undergraduate students of high scholastic rank upon unanimous recommendation of the faculty. Honors are based upon the following breakdown of cumulative GPAs:

BS Cum Laude: 3.40 - 3.59
BS Magna Cum Laude: 3.60 - 3.69
BS Summa Cum Laude: 3.70 or greater

Transfer students are eligible to graduate with honors, including being selected as valedictorian, after they complete a minimum of 64 credits at NYU-Poly.

UNDERGRADUATE CREDITS

RESIDENCY

To satisfy residency requirements for the BS degree at NYU-Poly, students must complete a minimum of 64 credits at the Institute in approved courses. The student's adviser will assist them in selecting the courses required to complete their degree. Additionally, students must complete their last 32 credits at the Institute. One-half of the courses counted toward a minor must be taken at the Institute. All transfer credits are subject to NYU-Poly's normal transfer-credit rules and processes.

TRANSFER CREDITS FROM OTHER UNDERGRADUATE INSTITUTIONS

Students who have completed some undergraduate courses at other colleges or universities before beginning studies at NYU-Poly are encouraged to transfer credits to NYU-Poly programs. NYU-Poly awards transfer credit for relevant courses completed satisfactorily at other accredited institutions. Students transferring to NYU-Poly from other universities must have transcripts of their courses examined by the Undergraduate Admissions Office and an adviser from the student's major department to determine the acceptability of individual substitutions and general acceptance of credits from their former institution(s). Much of this can be accomplished during the application process if the student's record is complete. All evaluations of transfer credits must be completed by the end of the student's first semester of registration at NYU-Poly. Some programs may choose to delay approval of transfer credits until students demonstrate satisfactory progress for a semester at NYU-Poly.

Undergraduate transfer credit is not given for any course in which a grade less than C has been earned. In addition, students completing a course at NYU-Poly for which transfer credit already has been given automatically forfeit the transfer credit for that course.

The contents and standards of courses vary from university to university. Thus, some transfer students find after a semester's work at NYU-Poly that they are better prepared for advanced courses if they re-enroll in a course at NYU-Poly for which they have been given transfer credit. Students may be required to enroll in such a NYU-Poly course after consulting with their academic adviser. In some instances, course requirements may be waived for students who demonstrate sufficient knowledge of specific course content through either written or oral examination given by the academic department offering such course. In such cases, no credit is awarded, but students are allowed to submit a more advanced course to satisfy degree requirements. This approach differs from "credit by examination," described later in this section.

Grades of courses for which transfer credit is given are omitted in computing a student's cumulative or current semester GPAs.

ARTICULATION AGREEMENTS

To provide students with alternative pathways to a BS degree from NYU-Poly and to facilitate the transfer process, NYU-Poly has developed cooperative programs with other institutions. Students completing approved programs at these institutions with sound academic achievement are guaranteed admission to the Institute. Students interested in learning more about the cooperative programs should contact the Office of Undergraduate Admissions.

TRANSFER CREDITS WHILE IN RESIDENCE

Undergraduates at NYU-Poly are expected to take all course work at the Institute. Exceptions are rarely made in cases where NYU-Poly does not offer timely courses of importance to the attainment of students' academic goals.

To obtain credit for courses taken elsewhere while enrolled at NYU-Poly, students must obtain written permission from the major academic adviser, the department head of the course for which transfer credit is requested and the Office of Undergraduate Academics. This must be done before registering for the course at another institution. Forms for such permission are available on the Registrar's website.

The following requirements apply to all courses taken outside NYU-Poly:

- The other institution must be accredited.
- Grades earned must be C or better for undergraduate courses.
- Pass/fail courses are not acceptable under any conditions.

- Only credits are granted; grades are omitted in computing cumulative or current semester GPAs.

CREDITS FOR COURSES TAKEN AT OTHER SCHOOLS OF NYU

Students will receive letter grades to be included in their term and cumulative GPA calculations for courses taken at other schools of New York University. Courses taken at NYU are generally classes that are not offered at NYU-Poly and may count as degree requirements with the permission of the student's academic adviser; foreign language courses taken at NYU will count as free elective credits, regardless of the student's academic program. Students must obtain permission to take courses at other schools of NYU before enrolling in the class by completing the "Permission to take a course at NYU (Washington Square Campus)" form available on the Registrar's website.

UNDERGRADUATE VALIDATION CREDITS

When it is unclear whether a course taken outside NYU-Poly is suitable for transfer credit, students may qualify for transfer credit by passing a validation examination. Permission to take such an examination must be recorded in advance on the student's transfer evaluation form at the time of application to NYU-Poly. The format of the examination is at the discretion of the department giving the course. Scheduling of the examination is by mutual agreement, but in no event more than one calendar year after the student begins study at NYU-Poly. A grade of C or better is required to validate course credits for undergraduate students. An examination may not be taken more than once. Students who register for or attend the course at NYU-Poly forfeit the right to take a validation examination.

ADVANCED PLACEMENT CREDITS

NYU-Poly grants students credit for approved Advanced Placement (AP) courses in high school, given acceptable performance on AP examinations. Students must request evaluation of AP credits by no later than the end of their first semester of matriculation. Credit also may be granted for college preview courses at NYU-Poly or other universities while a high-school student if these courses are relevant to the student's degree program and acceptable grades were achieved. Grades for advanced placement or college preview courses are omitted in computing the cumulative or current semester GPAs.

CREDIT BY EXAMINATION

Undergraduate students with an outstanding record or with specialized competence may establish a maximum of 16 credits toward the baccalaureate degree by passing comprehensive examinations. Each department determines the courses in which such an examination is available and the examination format. Students must obtain the approval of the department giving the course, the department of major study and the Office of Undergraduate Academics.

A grade of B+ or better is required to achieve credit by examination. Students registering for or attending a course at NYU-Poly may not subsequently take the examination for credit for the course or for a course with similar content. The examination may be taken only once.

Students pay a fee to the Office of Student Accounts before each examination and will receive the form to take the exam after making the payment. The course and credits are posted on student's permanent record without a grade and do not count toward the minimum-residence requirement for the bachelor's degree or toward the GPA.

UNDERGRADUATE THESIS

The undergraduate thesis allows students to apply knowledge gained in their major field of interest and use it to plan, conduct and report original research. The thesis may be a discourse upon a subject included in students' courses of study, an account of an original investigation or research, or a report on a project or an original design accompanied by an explanatory statement.

The undergraduate thesis is optional except for students in the Honors Program, who are required to complete an undergraduate thesis. All undergraduate students who plan to undertake a thesis should report to the head of their major department with their choice of a thesis topic at least one year before graduation. Department heads approve requests and appoint a thesis adviser. Students should contact their thesis adviser immediately and register for the thesis during the next registration period. Thereafter, the student must register for the thesis every fall and spring semester until it is completed and accepted and the final grade is entered into the student's permanent record. A student must take a minimum of 3 credits of thesis work for an undergraduate thesis.

Students must submit a bound BS thesis to the Office of Undergraduate Academics as outlined in the document entitled "Regulations on Format, Duplication and Publication of Reports, Theses and Dissertations,"available in the Office of Undergraduate Academics. All theses and results obtained become the property of the Institute.

GRADUATION

GRADUATION CHECKLIST

Academic advisers of undergraduate students nearing completion of their degree requirements receive a graduation checklist that lists courses in progress and courses remaining to be completed for the degree. After the list is approved by the major academic department, the student receives an e-mail notifying them of their graduation status.

APPLICATION PROCESS FOR THE BACHELOR OF SCIENCE

Students must file a formal application for the award of the degree Bachelor of Science from NYU-Poly. Application deadline dates for each semester are e-mailed to the students approximately two to three months before the date. Students who do not file by the published deadline date become candidates for the next graduating class.

Applications for BS degrees are available on-line at www.poly.edu/graduation. Degrees are certified and diplomas issued twice a year, typically at the end of January and middle of May. Commencement is held once a year, usually in mid-May. All work for the degree must be completed and submitted before the graduation date.

DIPLOMAS

Diplomas are mailed to the student about eight weeks after the degree conferral date. Diplomas are issued only once, subject to rare exceptions made on a case-by-case basis. All replacement diplomas are printed with the Institution name at the time of the student's graduation and are subject to a replacement diploma fee. Further information can be found on the Registrar's website.

TRANSCRIPTS

The issuance of transcripts and generally the release of any information about a student are subject to the provisions of Public Law 93-380, the Family Educational Rights and Privacy Act of 1974, as amended. Unless NYU-Poly's disclosure policy permits otherwise, official transcripts of the scholastic record are issued only upon the submission of a written request or upon the submission of a signed release from the student.

Unofficial transcripts are available to students through the Student Self-Service system. Those students without access to the Student Self-Service system may submit a written request for an unofficial transcript. A fee is charged for each unofficial or official transcript issued.

NYU-Poly reserves the right to withhold a transcript if a student fails to meet financial indebtedness to NYU-Poly.

Upon graduation, students should review

their transcripts carefully and report any errors to the Office of the Registrar before the record is sealed.

CLASS STANDING FOR UNDERGRADUATES

Students are classified at the end of each semester by the Office of the Registrar on the basis of earned and/or approved transfer credits beginning September 1, as follows:

Freshman	1 - 27 credits
Sophomore	28 - 61 credits
Junior	62 - 94 credits
Senior	95 or more credits

ACADEMIC YEAR FULL TIME

Undergraduate students registered for 12 or more credits per semester are categorized as full time. The normal course load for full-time undergraduate students is 14-18 credits.

For certain types of attendance and enrollment certifications, some students who are registered for less than 12 (undergraduate) credits may be certified as full time—specifically undergraduates pursuing Institute-authorized full-time, full-semester co-op work assignments. A form to establish full-time equivalency is available from the Office of the Registrar's website.

ACADEMIC YEAR PART TIME

Students registered for less than 12 credits per semester (except summer) are categorized as part time. Part-time students pay tuition at the prevailing per-credit rate and are ineligible for most financial assistance and scholarship programs.

SUMMER AND INTERSESSION

Students may register for up to 8 credits during each six-week summer term and for no more than 16 credits for the combined 12-week summer term. Six credits for a given summer term is considered full-time status.

UNDERGRADUATE INTERNATIONAL STUDENTS

FULL-TIME STATUS, PROGRAM AND DEGREE CHANGES, EMPLOYMENT

To maintain non-immigrant student status, international students must enroll full time, taking at least 12 credits on the undergraduate level for each fall and spring semester. Moreover, they may only register for one online course per semester. Students wishing to take more than one online course per semester must obtain prior approval from the Office of International Students and Scholars (OISS). Students may take less than a full course of study if fewer credits are needed during the last semester to graduate or for valid academic and medical reasons. All reasons for exceptions must be approved in writing by OISS before the last day of late registration each semester so that courses can be added to students' schedules if necessary.

Students in F-1 and J-1 status must obtain written permission from OISS to withdraw from classes, if the withdrawal will result in less than a full-time course load, or to take a leave of absence. They must also obtain written permission and a pertinent I-20/DS-2019 form from OISS before enrolling in a new degree program. The process of withdrawing from a course, changing degree level or taking a leave of absence through the Office of the Registrar keeps a non-immigrant student in good standing only with the Institute, but not with the U.S. Immigration and Citizenship Services (USCIS). In addition, students who plan to work as part of their course work or as part of an internship placement are required to obtain prior approval from OISS for any such employment.

Failure to comply with the immigration requirements for full-time status, course withdrawals, degree changes and/or leave of absence and employment violates the non-immigrant student status and makes a student ineligible for any benefit of that status. According to the USCIS, lack of compliance may also result in deportation.

POLICIES ON UNDERGRADUATE GRADING AND GRADES

COMPUTING THE GRADE-POINT AVERAGE (GPA)

The Office of the Registrar determines the GPA of undergraduate students according to the following numerical values assigned to letter grades:

Grade	Point Value	Description
A	4.0	Excellent
A-	3.7	Excellent
B+	3.3	Good
B	3.0	Good
B-	2.7	Good
C+	2.3	Passing
C	2.0	Passing
C-	1.7	Deficient, but passing
D+	1.3	Deficient, but passing
D	1.0	Deficient, but passing
F	0.0	Failing
S		Satisfactory
U		Unsatisfactory
W		Withdrawal
I		Incomplete, converts to F after 180 days
AUD		Audit
P		Pass

In computing GPAs, NYU-Poly does not consider or count courses graded W, I, S or U toward the total credits passed or earned. GPAs are computed by multiplying the numerical grade in each course by the number of credits for each course, adding these products for the courses taken and then dividing this sum by total number of credits represented by courses considered.

The W and I grades are described in greater detail in subsequent sections. Grades S or U are used to indicate progress in multi-semester research projects or theses, or for non credit-bearing remedial or other courses. Undergraduates enrolled in graduate courses may not receive grades of D or AUD.

COURSE WITHDRAWAL: THE W GRADE

Students may withdraw from a course or courses without academic penalty until the published withdrawal deadline of the normal fall or spring semester. Students should process their own withdrawals online via Student Self-Service. No approvals are required, but students are encouraged to consult with their academic advisers as withdrawing from certain courses may delay their planned graduation date. When the course duration varies from the norm, such as in six-, nine- or 12-week courses, withdrawal must be completed before two-thirds of the sessions are completed. Withdrawals must be processed online by 11:59 p.m. on the withdrawal deadline indicated on the published Academic Calendar. Withdrawn courses remain on the student's transcript with a grade of W and are not calculated into the GPA. Once entered on the student's record, a W cannot be changed to any other grade. An F grade is recorded for any student who ceases to attend a course without formally withdrawing in the required fashion by the required deadline. Students are also encouraged to consult with Financial Aid before withdrawing from a course, as it may effect their status and eligibility for aid.

AUDITING CLASSES

Undergraduate students may be allowed to audit certain classes in order to fill the gap which may exist in their prior course work. Approval of the academic department is required prior to auditing a class. The credits for the course do not count as a part of the student's semester credit load. Students auditing a course will not receive a grade for the course and the course will be annotated by AUD without counting towards student's GPA calculations. Students who decide to audit a class must do so during their initial registration for the class by filling out the form available from the Office of the Registrar; this option cannot be changed once selected.

INCOMPLETE GRADES

If a student cannot complete the course work at the usual time because of valid reasons, such as illness or other critical emergency, the instructor may give a grade of Incomplete/I.

In such cases, the instructor and the student must develop a detailed plan for completion which includes a specific completion date. Ordinarily, this date should not extend beyond the intersession, in fairness to students who finish course requirements on time and to ensure that students complete prerequisites for advanced courses. An I grade lapses into an F if the student fails to complete the work within the specified completion time line, or at most by 180 days after the semester's end in which the student was enrolled in the course for which the I was given. All I grades must be converted before graduation.

The grade of Incomplete/I is used sparingly and only in cases with valid reasons, not merely because students have planned poorly or overloaded themselves. An I grade should not be issued if a student is unable to complete the course requirements without attending or participating in the course a second time. If the student reregisters for a course in which an I grade was given, the I grade lapses to an F. If successful resolution of an I grade would require the repetition of any course or portion of a course, the student should consider formally withdrawing from the course.

CHANGE OF GRADE

Instructors may change grades for academic reasons after assigning an initial grade. The time period for change of grade is one year after the course was completed. Change of grade requests by instructors will not be processed after this one-year period. Changes requested later than this one-year period will be accepted only in case of errors or other administrative action and have to be approved by the Associate Provost of Undergraduate Academics.

REPEATING COURSES

If an undergraduate student takes a course two or more times, only the second and subsequent grades will count toward their GPA. This policy holds regardless of the first and second grades earned, even when the second grade is lower than the first. The repeated course must be taken within one year of the first course, or at the first time it is offered, where a course is unavailable to repeat within one year.

No undergraduate course may be repeated more than twice, for a total of three attempts. If a student earns an F grade after the last permitted attempt in a prerequisite course or a degree requirement, the student is then academically disqualified and is ineligible for readmission to any program with that requirement.

UNDERGRADUATE ACADEMIC STANDING AND PROBATION

DEAN'S LIST

Undergraduate students who achieve a semester GPA of 3.4 or better, with no grades of F, I or U for the semester, and are otherwise in good academic standing, are commended by the Department of Academic Success and placed on the Dean's List. This list is posted following the fall and spring semesters for full-time students and following the spring semester for part-time students. Only those who complete 12 or more credits during the fall or spring semester (or fall and spring semesters combined for part-time students) are eligible. Students who include project courses in their 12 or more credit programs are also eligible, provided that these courses represent no more than one-half of the credit load for a given period and all of the aforementioned requirements are met. Nondegree credit courses, such as EN 1080W, may count toward the 12-credit requirement. The Dean's List notation appears on the student's permanent record. Students who receive a grade of F and then repeat the course in a subsequent semester, thereby excluding the first grade from the GPA calculation, are not eligible for the Dean's List. However, students who convert a grade of I to a regular letter grade or receive a change of grade after a given semester that would then qualify them for the Dean's List may retroactively receive Dean's List honors by bringing the change to the attention of the Department of Academic Success.

Any change of grade should be finalized within one semester to be considered for the Dean's list.

GENERAL ACADEMIC STANDING

To remain in good academic standing, undergraduate students must maintain term and cumulative GPAs of 2.0 or greater. In addition, students must successfully complete a minimum number of credits for each semester of full-time study, excluding summers and mini-sessions. In the case of part-time students, a semester indicates the point at which 12 or more credits are undertaken. Thus, the first semester of study ends when 12 credits are accumulated; the second semester is calculated from that time onward until 24 credits are accumulated. According to these semester equivalents, grade-point requirements for part-time students follow those for full-time students.

The minimum number of cumulative credits to be achieved by the close of each semester of full-time study appears in the following table.

Minimum Credits and Minimum GPA Required by Semester of Full-Time Study

No. of Full-time Semesters Completed	Min. Required Cum Grade Point Average	Min Credits to be Earned
1	1.50*	8
2	1.50*	16
3	1.50*	28
4	1.67	40
5	1.78	56
6	1.88	68
7	1.95	84
>8	2.00	96

* Any time a student's cumulative GPA falls below 1.5 they are placed on Final Probation regardless of how many credits they have completed.

In calculating the number of successfully completed credits:

1. Courses for which a student received an F grade do not count toward the minimum credit earned.
2. If a student receives an F grade in a course which they repeat within one academic year, their GPA will be recalculated using the second grade earned and the first grade of F will be removed from the GPA calculation.
3. Credits with an I grade will be counted toward enrollment for one year. At the end of that time, any I grade that has not been changed by the instructor on record will automatically become an F grade.
4. Credits assigned a W grade do not appear in the calculation of credits undertaken, earned or successfully completed.
5. Transfer students will enter this table from the point at which their transfer credits place them.

A second requisite for enrollment is the maintenance of a 2.0 GPA or better or performance approaching 2.0 in a steady and realistic fashion. The table above contains the absolute minimum cumulative GPA to be achieved by the close of each semester of full-time or full-time equivalent enrollment.

The Department of Academic Success regularly monitors all undergraduate students and reviews their academic records after each semester and informs their academic adviser or other representatives from the student's major department of the results of that review. Students identified as being in academic difficulty may not register for more than 12 credits per semester unless otherwise approved by their adviser. Students in academic difficulty are placed on academic probation following the steps and actions described below.

ACADEMIC WARNING

Students whose midterm grades show they are in danger of failing a course receive e-mails of academic warning. The e-mails provide guidance for the student and invite them to

meet with their academic adviser to discuss their academic performance and what steps to take to complete their course(s) successfully.

ACADEMIC PROBATION

Students are placed on academic probation when (1) their semester and/or cumulative GPAs fall below 2.0, but remain above the minimum standards as outlined above or (2) their number of successfully completed credits falls below the minimum standards as outlined above. Students falling into these categories are notified by e-mail and are directed to meet with their advisers.

All first-year, first-time probationary students must take SL 1020, Academic Skills Seminar. The seminar consists of eight one-hour sessions, meeting weekly and taken on a pass/fail basis. SL 1020 helps students develop and enhance an awareness of their individual learning styles, study skills and time management techniques so they may be more successful students and return to good academic standing. Topics include establishing a mind-set for success, discussing career opportunities, setting goals, managing time, overcoming procrastination, learning study and test-taking skills and self assessing. SL 1020 is offered in small, interactive group sessions to support students as they develop strategies for academic success.

FINAL PROBATION

Students whose academic record indicates an unacceptable level of academic progress may be placed on final probation. Notified by letter and e-mail of their standing, these students must meet with their adviser to determine a study program and are limited to a maximum of 12 credits for the next semester to improve their performance. Disqualification results from failure to improve performance and to meet the minimum progress requirements as outlined in the minimum-progress table above. Students on final probation may not register before completing current courses.

DISQUALIFICATION

The Academic Standing Committee, comprised of members of the Department of Academic Success, faculty and a representative of the student's major department, shall jointly disqualify from the Institute any student whose cumulative GPA or number of credits successfully completed falls below the approved minimum shown in the above table for two consecutive semesters. Additionally, a major department may disqualify a student at or above the minima listed if it is indicated that continuation will not lead to a successful completion of degree requirements. If a student is disqualified, they will be notified via letter and e-mail.

Extenuating circumstances, such as serious medical problems (physical or psychological), must be documented by the Office of Student Affairs and can lead to a one-semester waiver of these criteria. Performance in the subsequent semester must meet minimum standards. Such arrangements must be made with the head of the major department and the Office of Student Affairs.

Disqualification Appeal

Students who would like to appeal their academic disqualification can begin the appeal process immediately. The disqualification appeal form is available from the Registrar's website. Students must begin the disqualification appeal process a minimum of three weeks before the first day of classes of the semester immediately following their disqualification. If students do not begin the appeal process by this deadline they must wait for one academic year before they can reapply for readmission to the Institute and initiate the appeal process.

LEAVE OF ABSENCE AND WITHDRAWAL FROM THE INSTITUTE

LEAVE OF ABSENCE

Undergraduates taking a leave of absence must obtain permission from the Academic Advisement Center (first-year students) or the Office of Academic Affairs (sophomore-senior students). Leaves of absence, if approved, are granted for a maximum of one year except in extreme cases. If the student does not return to the Institute after their official leave of absence is over, they will be required to reapply to NYU-Poly.

The policy includes an exception for veterans who leave the degree program for military service.

Leave of Absence and Readmission for Veterans

Undergraduate veteran students taking a leave of absence for military services will be readmitted with the same academic status and into the same degree program they had when they last attended the institution. The length of absence cannot exceed five academic years. If the period of absence exceeds five academic years, veteran students must obtain permission from the Dean of Undergraduate Academics. Such requests, when approved by the Dean's office, will constitute assurance of readmission to the degree program from which the leave was taken. If the period of absence exceeds the approved leave from the Dean's office, students must apply for readmission.

The policy includes exceptions for veterans receiving a dishonorable or a bad-conduct discharge, or who are court-martialed.

TOTAL WITHDRAWAL

Undergraduate students must notify the Office of Academic Affairs if they withdraw completely from the Institute before the deadline published on the academic calendar and during a semester in which they are registered. No total withdrawal is official unless a written form is approved by and submitted to the Office of the Registrar. Mere absence from courses does not constitute official withdrawal, but will lead to F grades recorded for courses not completed. To receive W grades for the semester, the withdrawal must be completed by the withdrawal deadline indicated on the academic calendar.

INVOLUNTARY WITHDRAWAL

NYU-Poly is concerned about the health, safety and well-being of its students. Students judged to be a threat to themselves or to others may be withdrawn involuntarily from NYU-Poly. The Institute seeks, whenever possible, to allow such students to continue as active students if they agree to undergo professional care. Full details on this policy are available from the Office of Student Development.

AUTOMATIC WITHDRAWAL

Undergraduates who do not formally file a leave of absence and who are not continuously enrolled are automatically withdrawn from the Institute. Students in this category must apply for readmission. If readmission is granted, students will be governed by the catalog and rules in effect at the time of readmission.

READMISSION

Students applying for readmission must do so through the Office of Undergraduate Admissions. The student's application for readmission will be sent to the student's academic department for evaluation. The academic department in consultation with the Office of Academic Affairs and Associate Provost of Undergraduate Academics determine whether the student is eligible to continue his/her studies at NYU-Poly.

GRADUATE DEGREE REQUIREMENTS AND ACADEMIC POLICIES

This section details the general Institute-wide degree requirements that apply to all Polytechnic graduate degrees. Academic departments may place additional requirements on individual degrees. Such additional requirements are explained in the programs section of this catalog. In no case may a department specify requirements less stringent than those indicated here. Master's degrees and certificate programs are the purview of the Associate Provost for Graduate Academics and PhD programs are the purview of the Associate Provost for Research and PhD Programs.

Outcomes Assessment
Polytechnic conducts outcomes assessment activities to monitor student academic achievement, effective teaching methods and continuous improvement of the Institute, as well as to comply with accreditation standards. To obtain periodic measurements of student perceptions and intellectual growth, graduate students are strongly encouraged to participate in surveys, focus groups, interviews or related activities. While individual input is collected, data resulting from these assessments is published only in aggregate form.

Definition of Credits
Graduate studies are expressed in terms of credits. One 55-minute period of graduate class work for a 15-week, single semester carries 1 graduate credit. A standard graduate course meeting for two-and-a-half hours per week in a single semester of 15 weeks is equivalent to 3 credits. This format is the most common for graduate courses. Graduate laboratories meet three times per graduate credit (i.e., two-and-a-half-hours per week in a single semester of 15 weeks is equivalent to 1 credit). Courses meeting more or less than two-and-a-half hours each week are assigned credits in the correct proportion. The final examination period is an integral part of the 15-week semester.

GRADUATE DEGREES AND ADVANCED CERTIFICATES

MASTER OF SCIENCE

Admissions
Admission to Master of Science programs requires a bachelor's degree and at least four years of college-level courses in a preparatory discipline from an institution acceptable to Polytechnic. An undergraduate GPA of 3.0 or better is needed for admission. GRE scores are recommended for all applicants. The scores are needed from those seeking merit-based scholarships. The GRE score is also mandatory for international students. Applicants seeking admission to management-related degrees may submit the GMAT score instead of GRE. Letters of Recommendation and a Statement of Purpose are also needed to be considered for admission.

Graduation Requirements
Candidates for the degree Master of Science must complete no fewer than 30 credits of advanced study and/or research beyond the bachelor's degree in the program selected. Academic departments may require additional credits for individual degrees. Specific course requirements for each MS program are detailed in the programs section of this catalog. To obtain the MS degree, students must maintain a Cumulative GPA of 3.0 (equivalent to a B letter grade) or better in all graduate work undertaken at Polytechnic, including those not used to fulfill specific program requirements. The average of B or better includes all guided studies, readings, projects, theses and dissertations. Students may offer no more than a combined total of 9 credits of project, guided studies and/or thesis toward fulfillment of the MS degree requirements. Students taking project or thesis must register for at least 3 credits of project and/or thesis every semester until the work is completed and a grade recorded (also refer to the section Maintenance of Study).

Residency Requirements and Transfer Credits
A maximum of 9 credits may be accepted as transfer credits, if approved by the student's department/program. Thus, graduate students in the MS programs must take a minimum of 21 credits of graduate work at Polytechnic for a 30 credit MS degree. Credits transferred must be from graduate courses taken elsewhere (see sections Transfer Credits and Multiple MS Degrees for exceptions), as long as those courses were taken after the undergraduate degree, not used to satisfy the graduation requirements for any undergraduate degree, and had a grade of B or better (also refer to the section Transfer Credits). Theses, projects and guided studies or readings courses cannot be transferred. Students must complete all requirements for the MS degree within a period of no more than five years after beginning their graduate studies at Polytechnic. This period includes any approved Leave of Absence. Extensions of this period are rarely granted and require prior approval from the respective Associate Provost. Students must request an extension at least 60 days before the 5 year period is reached. Individual programs may specify required courses, minimum GPAs in specific courses or course groups, and/or require a comprehensive examination, presentation of a seminar or completion of a project or thesis.

MASTER OF ENGINEERING

The admissions, graduation, residency requirements and other regulations are the same as those for the Master of Science. The Master of Engineering is for students seeking in-depth knowledge in fields requiring courses from multiple disciplines, especially those taught by several different academic departments. Students create their study program, including at least one graduate certificate, with the approval of a graduate adviser. A capstone experience is required for graduation. Candidates for the degree Master of Engineering must complete no fewer than 30 credits of graduate courses and/or research beyond the bachelor's degree in the program.

DOCTOR OF PHILOSOPHY

Requirements for the degree Doctor of Philosophy are qualitative and quantitative. Students will find that the formal requirements of residence, course credits and dissertation provide a framework within which they are free to construct individual programs for creative learning at an advanced level.

Graduate students wishing to enter into a systematic program leading to a PhD should confer with an adviser in the department of major interest regarding (1) selection of courses, (2) major and minor fields of study, (3) formulation of a guidance committee, (4) qualifying and language examinations and (5) degree candidacy. Students must satisfy the detailed requirements of the selected degree program.

Admissions
Students may apply to the doctoral program either directly after a bachelor's degree or after completing a master's degree. In either case GPAs greater than 3.0 are needed in all previous degree programs and GPA greater than 3.5 is typically expected. Admissions requirements for the doctoral program are at least as stringent as those of the MS, and the admissions process follows the same path as that of the Master of Science and Master of Engineering applications. Because doctoral research is a one-to-one match between an

applicant's research interests and those of a faculty member, applicants need to discuss their interests with the faculty in their program of interest. Highly qualified candidates whose interests are incompatible with the faculty's research interests may not be admitted. Additionally, most departments admit only the number of students that they can financially support and qualified candidates may not be admitted because limited funds can support only a given number of students.

Graduation Requirements
All doctoral students must maintain a GPA of 3.0 or better at all times and a B or better for the dissertation. Some departments have specific course or grade requirements that must be fulfilled. They must pass the qualifying examination(s) administered by their department or program and complete and defend a doctoral dissertation. Students may not register for dissertation research until they have passed the doctoral qualifying examination given by their major department. These examinations are generally scheduled once or twice yearly, and students should consult the academic department for information. Once students start their dissertation, they must register for at least 3 credits every semester until the dissertation is completed and accepted (also refer to the section on Maintenance of Study).

Residency Requirements and Transfer Credits
All doctorate candidates must complete a minimum of 75 credits of graduate work beyond the bachelor's degree, including a minimum of 21 credits of dissertation research (or more, depending on major). They must take a minimum of 27 credits, including all dissertation credits, at Polytechnic. Transfer credits can include a 30-credit blanket transfer for a prior MS degree and additional courses not included in the prior MS that are individually transferred. For the blanket 30-credit transfer, the prior MS need not be a 30-credit MS. Additional courses individually transferred cannot include project, thesis, dissertation, guided studies or readings, or special topics credits. Full-time students must complete all PhD work within six calendar years counted from the time of admission to graduate work at Polytechnic. Part-Time students must complete within 12 years. This period includes any approved leave of absence. Any extension of these periods requires prior approval of the respective Associate Provost. Students must request an extension at least 60 days before the time period is up.

Milestones
Students in the PhD program must take and pass doctoral qualifying examination(s) administered by their programs. Students are highly encouraged to take the examination(s) in their first year of the program. If students have not passed the examination(s) by the end of their second year, they may be disqualified permanently from the PhD program. Students cannot register for dissertation credits unless they have passed the qualifying examination(s). Within six months of passing the examination(s), the student and the dissertation adviser must form a dissertation-guidance committee. This committee oversees course selection for the student, provides research guidance and ensures that satisfactory progress is being made toward completion of the dissertation in a timely manner. Course selection must ensure that requirements of major and minors set forth by the respective programs are met. The committee, at its discretion or bound by departmental regulations, may request the student to present a dissertation research proposal. The committee is expected to meet at least once per semester to assess the student's progress. The doctoral student defends the dissertation in front of this committee. The student must obtain a checklist of the milestones and requirements from the respective Associate Provost.

GRADUATE ADVANCED CERTIFICATE PROGRAMS

Polytechnic offers several graduate advanced certificate programs in specialized subject areas for students who do not wish to enroll in a full-degree program. Students must apply for a certificate, be admitted, and enroll officially in a certificate program when they begin Polytechnic graduate study. Detailed descriptions of the certificate programs are available from the responsible departments.

Depending on the program, 12 to 15 credits must be taken at Polytechnic to earn a certificate. Courses taken for a certificate may be applied toward the future pursuit of a MS, ME or PhD graduate degree, but not to another certificate program. No transfer credits are allowed. (See section Transfer Credits for exceptions.) Applicants must be admitted formally to a certificate program before beginning course work. Admission requirements are the same as those for related MS programs. Students must have a cumulative GPA of 3.0 in all graduate courses taken at Polytechnic to receive a certificate. Requirements for certificates must be completed within three years, including any approved Leave of Absence.

Students in such a program who subsequently decide to pursue a graduate degree must file a separate application for admission to the respective graduate program. The following graduate advanced certificate programs are currently available:

- Achieving World-Class Quality
- Bioinstrumentation
- Biomedical Materials
- Computer Engineering
- Construction Management
- Cyber Security
- Electronic Business Management
- Entrepreneurship
- Environment-Behavior Studies
- Executive Construction Management (Exec 21)
- Financial Engineering
- Financial Technology Management
- Human Resource Management
- Image Processing
- Industrial Engineering
- Information Management
- Information Security Professional
- Information Systems Administration
- Integrated Digital Media
- Management
- Manufacturing Engineering and Production Science
- Manufacturing Excellence by Design: Holistic Approach
- Operations Management
- Organizational Behavior
- Power Electronics and Systems
- Power Systems Management
- Project Management
- Risk Management
- Software Engineering
- Technology Management
- Telecommunication Network Management
- Telecommunications Management
- Traffic Engineering
- Transportation Management and Economics
- Transportation Planning
- Wireless Communications

GRADUATE CREDITS AND REQUIREMENTS

RESIDENCY

To satisfy residency requirements for a graduate degree at Polytechnic Institute, students must complete the following minimum number of credits at the Institute:

- Master of Science: all but 9 credits needed for graduation (at least 21 credits of residency)
- Master of Engineering: all but 9 credits needed for graduation (at least 21 credits of residency)

- Doctor of Philosophy: 27 credits (including all dissertation credits)
- Graduate Certificate: all credits (see section Transfer Credits for exceptions)

CONTINUITY OF REGISTRATION

All graduate students must be registered for at least 1.5 credits each fall and spring semester until they graduate. If the student is unable to attend the Institute for a semester, the student must obtain a leave of absence for the semester. Failure to do so requires the student to reapply to the graduate program to resume studies, and no guarantee of readmission is implicit or explicit. Once students have started their dissertation thesis and/or project, they must register for at least 3 credits every semester until it has been completed and accepted. (Also refer to the section on Maintenance of Study.)

MODIFICATIONS TO CURRICULA

Curricula and courses change from time to time in order to keep students abreast of the latest knowledge and methods within subject areas. Students are required to satisfy the curriculum and degree requirements in effect at the time of their matriculation and must obtain current degree requirements from their program adviser.

In order to accommodate curriculum and course revisions, it is sometimes necessary to substitute a course for one specified in the curriculum. Students may also request course substitutions to tailor their studies to their interests. All course substitutions must be approved by both the program adviser and the Office of the Associate Provost for Graduate Studies.

TRANSFER CREDITS

Students may transfer a limited number of credits to meet the requirements for a master's or doctoral degree at Polytechnic if the graduate courses are (1) consistent with Polytechnic's residency requirements, (2) completed with grades B or better, (3) from accredited institutions, (4) consistent with the curriculum in which the student is registered, (5) taken after receipt of a bachelor's degree (with the exception of Polytechnic's undergraduate students; see below). The student's major academic department evaluates graduate transfer credits. Credits submitted for transfer are subject to the rules and regulations regarding period of validity, discussed in a subsequent section.

No transfer credit is permitted for graduate certificates. The exception is for NYU-Poly MS alumni who may be allowed to count some graduate course credit from their degrees earned here towards a Graduate Certificate, should they wish to re-enroll in NYU-Poly after graduation. Such credit would be subject to approval by the Certificate Program's academic adviser. A minimum of 9 new credits must be taken to earn a Certificate under these circumstances.

Grades for transferred credits or courses are not recorded and do not affect the GPA for the graduate program at Polytechnic.

MS or ME students may transfer up to 9 credits. No project, thesis, dissertation or guided studies/readings courses can be transferred.

PhD students may transfer up to 48 credits of course work. Transfer credits for the PhD can include a 30-credit blanket transfer for a prior MS degree and additional courses not included in the prior MS that may be transferred individually. For the blanket 30-credit transfer, the prior MS need not be a 30-credit MS, so long as a MS degree (or equivalent) was granted and a copy of the degree and detailed transcripts are presented. Additional courses individually transferred cannot include project, thesis, dissertation, guided studies or readings, or special topics credits.

Graduate courses taken at Polytechnic while students pursued an undergraduate degree at Polytechnic may be applied subsequently to a graduate degree, provided that they earned a B grade or better and that the individual courses were not used to fulfill requirements for an undergraduate degree at Polytechnic. Such courses are also subject to the 9-credit maximum transfer limitation for the MS degree and the grades are not figured into the cumulative GPA for the graduate program. The policy includes exceptions for students enrolled in a joint BS/MS program with a study plan pre-approved by an academic adviser.

PERIOD OF VALIDITY

More than undergraduate, graduate courses reflect the current state of the art in their respective fields. Thus, all courses taken more than 10 years before a request date for transfer of credits are ineligible to be transferred individually to Polytechnic by the routine transfer process. The exceptions are approved articulations and administrative actions. The blanket 30-credit transfer into the PhD program for a MS degree taken at Polytechnic or elsewhere is exempt from this period of validity and does not expire.

GRADUATE VALIDATION CREDITS

When it is unclear whether a course taken outside Polytechnic is suitable for transfer credit, students may qualify for transfer credit for that course by passing a validation examination. Permission to take the examination must be recorded in advance on the student's transfer-evaluation form. The examination format is at the discretion of the department giving the course. Scheduling of the examination is by mutual agreement, but in no event can it be scheduled more than one calendar year after the student begins study at Polytechnic. A grade of B or better is required for graduate students. An examination may not be taken more than once. A student who registers for or attends the course at Polytechnic forfeits the right to take a validation examination.

The sum of validation credits and transfer credits is limited to 9 credits for the MS and ME degrees.

MULTIPLE MS DEGREES FROM POLYTECHNIC

Effective Fall 2009, students pursuing a second or third MS degree from Polytechnic can use up to a maximum of 9 credits from previous MS degree programs attended at Polytechnic for satisfying degree requirements for their current MS program. Courses that are used for this internal transfer within Polytechnic must have a grade of B or better and will count in the total permissible transfer limit of 9 credits for the MS degree. Adviser approval is needed and the student can request this action only after completing 9 credits of course work in the current degree program with a B average.

GRADUATE REGISTRATION STATUS

Graduate students pay tuition at the per-credit rate. Full-time status is defined by the following:

- Full-time MS students are registered for 9 credits or more each semester. Students who are normally full-time may register for fewer credits during their last semester by registering for only the number of credits needed for graduation. During this last semester they are part time, but can be treated as full-time-equivalent for immigration and other legitimate reasons by requesting full-time-equivalency status.
- Full-time MS students in the lock-step, cohort-based, executive-format MS programs are registered for all courses specified by the program published in the catalog each semester. These programs have distinct courses and/or projects, each bearing credits approved for the program, but in no case fewer than 7.5 credits a semester.
- Full-time PhD students may register for a minimum of 3 credits per semester upon passing the PhD qualifying examination. Students must register for 9 credits or more until they pass the PhD qualifying exam. Other students who are not officially enrolled in a PhD program, regardless of whether or not they have passed the

qualifying exam, must continue to take a minimum of 9 credits until they change their academic status to PhD.

A status of non-matriculated or visiting student allows students to take up to three graduate courses at Polytechnic without formally applying for admission. If these students desire to continue at Polytechnic as a matriculated student in a graduate degree or certificate program, they must follow the formal application process.

MAINTENANCE OF STUDIES

PhD Students: PhD students who have taken all required courses with minimum dissertation credits and have completed their doctoral research may register for up to two semesters of "maintenance of studies" with no tuition charge (Institute fees apply). This category of registration officially maintains the student's degree candidacy and extends the time to complete the writing and defending of the dissertation. Students who have not completed their doctoral research must continue to register for dissertation credits.

MS Students: Under exceptional and well-documented circumstances, graduate students seeking a MS degree in a program that requires a MS thesis or MS project may, with the permission of the thesis or project adviser, request one semester of maintenance of study to complete the project or thesis. For permission to be granted, students must provide adequate written justification.

MAXIMUM TIME FOR COMPLETION

Programs for graduate certificates must be completed within three years. The MS or ME degree programs must be completed within five years of starting the program at Polytechnic. The PhD program must be completed in six years for full-time students and 12 years for part-time students from the time of admission to graduate work at Polytechnic. All time limits listed include any approved leave of absence.

Students exceeding these time limits require prior approval to continue from the respective Associate Provost. If granted, not all courses taken previously may count towards the degree. The Associate Provost, consulting with the department, will prepare a plan for the student to follow to obtain the degree.

GRADUATE INTERNATIONAL STUDENTS

FULL-TIME STATUS, PROGRAM AND DEGREE CHANGES

To maintain non-immigrant student status, international students must maintain full-time status every fall and spring semester for the entire semester (i.e., withdrawing from a course during the semester may jeopardize full-time status). Students are not required to enroll during the summer semester and may enroll for credits at their discretion. Moreover, they may register only for one online course per semester. Students wishing to take more than one online course a semester must obtain prior approval from the Office of International Students and Scholars (OISS). Students may take less than a full course of study if fewer credits are needed during the last semester to graduate, but they must notify Office of International Students and Scholars (OISS) at the beginning of the semester and obtain full-time equivalency status. Students may also take a reduced course load for valid academic and medical reasons. All reasons for such exceptions must be approved in writing by the Office of International Students and Scholars (OISS) before the last day of late registration each semester so that courses can be added to the student's schedule if necessary. If the reduction in load is permitted, students are granted full-time-equivalency status for the respective semester.

Students in F-1 and J-1 status must obtain written permission from OISS for any Leave of Absence request, or to withdraw from classes if the withdrawal results in less than a full course load. They also must obtain written permission and the pertinent I-20/DS-2019 form before enrolling in a new degree program. The process of withdrawing from a course, changing degree level or taking a leave of absence through the Office of the Registrar keeps a non-immigrant student in good standing only with the Institute, but not with the U.S. Immigration and Citizenship Services (USCIS), unless proper approval is obtained from OISS. Students who receive Incomplete (I) grade(s) must develop a credible academic plan for completing the requirements of respective course(s) within the following semester. MS students who receive one or more Incomplete (I) grade(s) in the final semester will be allowed to register for maintenance of studies for only one academic semester after the final semester to complete the requirements of the respective course(s). In addition, students planning on employment as part of their course work, or as part of the graduate co-op program internship placement, must obtain prior approval from OISS for any such employment.

Failure to comply with the immigration requirements for full-time status, course withdrawals, degree changes or leave of absence violates the non-immigrant student status and makes a student ineligible for any benefit of that status. According to USCIS, lack of compliance may also result in deportation.

POLICIES ON GRADING AND GRADES

COMPUTING THE GRADE-POINT AVERAGE FOR GRADUATE STUDENTS

For the purposes of computing GPAs for graduate students and graduate courses, the following schedule is used.

Grade	Point Value	Description
A	4.0	Excellent
A-	3.7	Excellent
B+	3.3	Good
B	3.0	Good
B-	2.7	Good
C+	2.3	Deficient, but Passing
C	2.0	Deficient, but Passing
F	0.0	Failing
S		Satisfactory
U		Unsatisfactory
W		Withdrawal
I		Incomplete, converts to F after 180 days
AUD		Audit

Grades S and U reflect progress on research efforts. Once the thesis or dissertation is completed, the letter grade is entered on the transcript. Noncredit seminar courses are also graded S or U. Other than research credits, no credit-bearing courses can be assigned S or U grades, except for approved specific internship courses. The S / U grading scheme of such courses is explicitly stated in the respective course descriptions in the catalog. A student cannot graduate if a grade of U is on the transcript for any such credit bearing course or for research efforts at the time of graduation. A grade of I cannot be assigned to a course that is graded S or U. Grades S, U, I, W and AUD are not included in computing the GPA, which is computed as indicated for undergraduate students.

GRADUATE BRIDGE AND PREPARATORY COURSES

Many programs offer graduate bridge or preparatory courses to accommodate the needs of students who lack certain undergraduate preparation. Generally, bridge or preparatory courses cannot be used to satisfy degree requirements, particularly for degrees within the department that offers the course. However, these courses are included in the calculation of a student's graduate GPA. Some graduate students may be required to take certain undergraduate courses as preparation for advanced graduate study. Undergraduate courses are not included in the student's GPA calculation.

REPEATING COURSES

The first time a graduate student repeats a course, the lower grade is not counted

towards the GPA. All subsequent grades in a course repeated more than once are included in the GPA, although degree credit is earned only once.

COURSE WITHDRAWAL: THE W GRADE

Students may withdraw from a course or courses without academic penalty until the published withdrawal deadline of the normal fall or spring semester. Students should process their own withdrawals online via Student Self-Service. No approvals are required, but students are encouraged to consult with their academic advisers as withdrawing from certain courses may delay their planned graduation date. When the course duration varies from the norm, such as in six-, nine- or 12-week courses, withdrawal must be completed before two-thirds of the sessions are completed. Withdrawals must be processed online by 11:59 p.m. on the withdrawal deadline indicated on the published Academic Calendar. Withdrawn courses remain on the student's transcript with a grade of W and are not calculated into the GPA. Once entered on the student's record, a W cannot be changed to any other grade. An F grade is recorded for any student who ceases to attend a course without formally withdrawing in the required fashion by the required deadline.

AUDITING COURSES

Graduate students may audit courses instead of receiving credits and grades for them. Regular tuition is charged and courses are treated as part of a full-time load. An AUD notation is made on the student's permanent record.

Interested graduate students should see their advisers and must notify the Office of the Registrar within the first two weeks of the semester if they select courses for audit status. Under no circumstances may an audit status be changed to credit status once elected. Audited courses do not count toward satisfying graduation requirements.

INCOMPLETE GRADES

If a student cannot complete the course work at the usual time because of valid reasons, such as illness or other critical emergency, the instructor may give a grade of Incomplete/I. In such cases, the instructor and the student must develop a detailed plan for completion which includes a specific completion date. Ordinarily, this date should not extend beyond the intersession, in fairness to students who finish course requirements on time and to ensure that students complete prerequisites for advanced courses. An I grade lapses into an F if the student fails to complete the work within the specified completion timeline, or at most by 180 days after the semester's end in which the student was enrolled in the course for which the I was given. All I grades must be converted before graduation.

The grade of Incomplete/I is used sparingly and only in cases with valid reasons, not merely because students have planned poorly or overloaded themselves. An I grade should not be issued if a student is unable to complete the course requirements without attending or participating in the course a second time. If the student reregisters for a course in which an I grade was given, the I grade lapses to an F. If successful resolution of an I grade would require the repetition of any course or portion of a course, the student should consider formally withdrawing from the course.

CHANGE OF GRADE

Instructors may change grades for academic reasons after assigning an initial grade. The time period for change of grade is one year after the course was completed. The Registrar will not process change of grade requests by the instructors after this one-year period. Changes requested later than this one-year period are accepted only in case of errors or other administrative action and must be approved by the respective Associate Provost.

GPA RESTART

If a student has completed a master's degree at the Institute and then pursues another master's degree at the Institute, the student's GPA is re-started. In this way, the academic performance for each degree is accurately represented.

GPA's may also be restarted for graduate students pursuing a master's degree under the following conditions: (1) the student changes major to a significantly different field of study and the change is approved by both the new department and the Associate Provost for Graduate Academics, and (2) the student requests that the GPA be restarted and the request is approved by the Associate Provost for Graduate Academics. The request to restart the GPA must be made during or before the first semester in the new major. Courses taken before the GPA restart cannot be counted towards satisfying the degree requirements of the new major. A GPA restart is only for the master's degree; a GPA cannot be restarted at the beginning of the PhD degree program. A GPA cannot be restarted during PhD degree program. Any GPA restart is noted on the student's transcript.

CONTINUATION OF STUDIES BEYOND THE INITIAL MASTER OF SCIENCE

Students planning to pursue additional studies immediately following the award of an advanced degree by Polytechnic should complete a Request for Continuation of Studies form in lieu of a new application for admission and submit it to the Graduate Admissions Office for review and approval to the department in which the new degree will be pursued. This form is available from the Office of the Registrar. Examples are (1) progressing from a MS program to a PhD program or (2) seeking a second MS degree from Polytechnic. In the latter case, students should be aware that Institute regulations govern graduate credits applied toward the first degree to be applied toward a second MS degree, see section Transfer Credits for rules on Certificates and section Multiple MS Degrees from Polytechnic.

ACADEMIC STANDING AND PROBATION

Graduate students are expected to progress in their studies and maintain a 3.0 GPA. Failure to do so results in students' placement on academic probation or disqualification based upon the guidelines set in the table below. For additional information, contact the respective Associate Provost.

Graduate students whose cumulative GPA falls below that specified in the following table will be disqualified from the Institute.

Number of Credits	GPA
1-6	2.0
7-12	2.33
13-18	2.66
>18	3.0

The entries are credits taken, not credits earned. Courses with W grades are excluded from the computation, as are project/thesis grades when assigned an S or U.

Students with GPA below the entries in above table are disqualified and, with rare exception, cannot be readmitted. All students with GPA lower than 3.0 are notified that they are on graduate probation and informed that they will be disqualified if the GPA falls below the entries in the above table. Such students must complete and submit a Plan for Removal of GPA Deficiency, approved by their graduate adviser, to the respective Associate Provost. If approved by the Provost's office, the student is allowed to continue.

Academic probation (cumulative GPA < 3) results in an automatic hold on the student's account that prevents the student from registering for subsequent courses. This hold and the Plan for Removal of GPA Deficiency reminds the student and the academic program that the student is not performing at the required academic standard, that both the student and the program are aware of the need for planning to help the student to succeed and that both have prepared such a plan.

In addition to the academic probation process described above, a major department may request that a graduate student be placed on academic probation at any time. The request and its justification are signed by the department head and sent to

the respective Associate Provost.

The student is permitted to register when the student's plan is approved by the Office of the Associate Provost for Graduate Studies and the hold is subsequently removed. The statement is kept on file in the Provost's office and the major department office. Students are cautioned that if they fail to follow the approved plan or fail to maintain a 3.0 cumulative GPA, they may lose regular status and/or be refused permission to register in subsequent semesters.

No indication of academic probation appears on a student's transcript, but a record is kept on file.

WITHDRAWAL FROM THE UNIVERSITY

VOLUNTARY WITHDRAWAL

Graduate students must notify the Office of Graduate Academics if they withdraw completely before the deadline published in the academic calendar and during a semester in which they are registered. No complete withdrawal is official unless a written form is approved and submitted to the Office of the Registrar. Mere absence from courses does not constitute official withdrawal, but leads to F grades recorded for courses not completed. To receive W grades for the semester, the withdrawal must be completed by the withdrawal deadline indicated in the academic calendar.

INVOLUNTARY WITHDRAWAL

Polytechnic is concerned about the health, safety and well-being of its students. Students judged to be a threat to themselves or to others may be withdrawn involuntarily from Polytechnic. The Institute seeks, whenever possible, for such students to be allowed to continue as active students if they agree to undergo professional care. Full details concerning this policy are available from the Office of Student Development.

LEAVES OF ABSENCE AND READMISSION

LEAVE OF ABSENCE

Graduate students taking a leave of absence for a specified time, not exceeding one academic year, must obtain permission from the Office of the respective Associate Provost. Such requests, when approved by the Office, constitute assurance of readmission to the degree program from which the leave was taken (provided the student remains in good academic standing). If the period of absence exceeds the approved leave, students must apply for readmission.

Once PhD students begin their dissertation, they must continually register for at least 3 credits of dissertation or maintenance of studies in every semester. (Also refer to the section on Maintenance of Study.)

Students failing to obtain a leave of absence who subsequently wish to attend Polytechnic must apply for readmission. Their subsequent attendance in the program is guided by the terms and conditions of the readmission and the catalog and rules effective at the time of readmission. The policy includes an exception for veterans who left the degree program to perform military service. For more information, refer to the section of leave of absence and readmission for veterans.

Leaves of absence will be recorded on the student's transcripts by the Registrar.

Leave of Absence and Readmission for Veterans

Veteran students in graduate programs taking a leave of absence to perform military services are readmitted with the same academic status and into the same degree program that they had when last in attendance at the institution. The length of absence from the institution cannot exceed five academic years. If the period of absence exceeds the period of five academic years, veterans must obtain permission from the respective Associate Provost. Such requests when approved by Office constitute assurance of readmission to the degree program from which the leave was taken. If the period of absence exceeds the approved leave from the respective Associate Provost students must apply for readmission.

The policy excludes veterans receiving dishonorable or bad conduct discharges, or who are sentenced in a court-martial.

AUTOMATIC WITHDRAWAL

Graduate students who do not formally file a leave of absence, or those who do not register for the semester beyond any authorized leave, are automatically deactivated. Students in this category must apply for readmission and no guarantee of readmission is made either implicitly or explicitly. If readmission is granted, students will be governed by the catalog and rules effective at the time of readmission and the terms and conditions of the readmission.

APPLICATION PROCESS FOR THE AWARD OF MASTER OF SCIENCE AND DOCTOR OF PHILOSOPHY DEGREES

Graduate students must file a formal application for the award of any Polytechnic degree or certificate. Filing dates for each semester are published by the Office of the Registrar. Students who do not file by the published deadline dates become candidates for the next graduating class.

Applications for the MS degree and graduate certificate are available online on the Graduate Admissions website. Applications for the PhD degree are also available in the Office of the Associate Provost for Research and PhD Programs. Degrees are certified and diplomas issued twice a year, at the end of the fall and spring semesters. Degrees are conferred at the annual spring commencement held in late May or early June. All work for the degree must be completed and submitted before the date of graduation.

Filing fees for diplomas are payable at the time of filing in the Office of Student Accounts. If the award of a degree is delayed, diploma fees are not charged again. By faculty vote, degrees are not awarded to members of the Institute teaching staff who hold the rank of assistant professor or higher.

Please note that a degree is not awarded unless the student applies for the award, even if all requirements are completed. The date of the degree follows the application date for its award, not when all requirements are completed. If the application is filed more than two years of completion of degree requirements, the approval process once an application is made is not automatic and additional administrative actions may be required on a case-by-case basis.

DIPLOMAS

Diplomas are mailed to the student about eight weeks after the degree conferral date. Diplomas are issued only once, subject to rare exceptions made on a case-by-case basis. All replacement diplomas are printed with the Institution name at the time of the student's graduation and are subject to a replacement diploma fee. Further information can be found on the Registrar's website.

PROJECTS, THESES AND DISSERTATIONS

Graduate Research

Investigations undertaken for graduate research help develop students' independent and creative thinking. Through this type of study, students are trained to analyze, research, synthesize and to contribute to the advancement of science and engineering.

Research for an advanced degree embodies knowledge of the field of mathematics, science or engineering chosen by the candidate, encompassing an understanding of basic principles, together with commensurate acquaintance with current practices, the literature and the work of leaders in the field of study.

MS students may elect to complete a MS project or MS thesis and may be required to do so in certain programs. Consult the programs section in this catalog for details. A thesis is generally a more extended piece of

work, usually entailing 6 to 9 credits, while the project usually entails 3 to 6 credits. At this level, research should exhibit a thorough understanding of advanced scientific thought or an ability to apply advanced principles constructively to engineering planning and design.

Each PhD student must complete a PhD dissertation. Research at this level must demonstrate critical and constructive thought as well as the ability to use the techniques necessary to explore and develop new knowledge in mathematics, science or engineering. A successful dissertation must demonstrably advance the subject area of research. Institute requirements for dissertations set a minimum of 21 credits of registration. All research should be characterized by accuracy of observation and measurement and by clarity and completeness in presentation. The conclusions presented must be supported by adequate studies and investigations and supplemented by a complete bibliography.

Registration for Projects, Theses and Dissertations

After a project, thesis or dissertation adviser and/or guidance committee is appointed, candidates should register each semester for the number of credits that realistically reflects the amount of time and effort they expect to devote to research. They must continually register each fall and spring until they complete their research and pass the required final examination such as project, thesis or dissertation defense. (Also refer to the section on Maintenance of Study). Registration (or maintenance of studies) cannot be interrupted until a grade is entered on the permanent record except with the permission of the respective Associate Provost. If, at the end of any semester, the adviser deems unsatisfactory any work covered by the credit of registrations, students may be required to re-register for the same unit and be obligated to pay full tuition and laboratory fees.

PhD students must continue to register for at least 3 credits of dissertation until they complete all research and the dissertation. Students may register for two semesters of "Maintenance of Study" if they have completed all research and have to finish only writing, defending or revising their dissertation in that semester. Similarly, MS candidates registered for thesis or project may, under well-documented circumstances, apply for one semester of "Maintenance of Study" as described above.

Manuscript Presentation

Degree candidates must present their research to the appointed guidance committee in final manuscript form for official acceptance no later than two weeks before the end of the semester. The accepted format for the bound research document is detailed in the "Regulations on Format, Duplication and Publication of Project Reports, Theses and Dissertations." Detailed information is available on the NYU-Poly website.

Graduate students registered for MS Project, MS Thesis, or PhD Dissertation credits must submit four final bound copies to their department for necessary signatures and then present them to the Office of the Graduate Center one week before the end of the semester.

Publication

Doctoral dissertations are published by UMI Dissertation Publishing (ProQuest). The cost of this service is charged to the student. By publishing with UMI, it ensures the dissertation thesis gains the widest possible audience. Any interested person can purchase copies of a dissertation through the company's website.

The faculty regards publication of the major content of a doctoral dissertation in a recognized scientific journal as a necessary final step if the work performed is to achieve maximum usefulness. The publication must indicate, by footnote or otherwise, its basis as a Polytechnic Institute of New York University dissertation.

ACADEMIC SUCCESS, ADVISING AND TUTORING SERVICES

The mission of the Department of Academic Success is to enhance the likelihood of students successfully completing their studies at the Institute. To this end, academic support functions are integrated and delivered comprehensively and seamlessly.

To ensure students' needs are addressed, Polytechnic has coordinated services among all areas reporting to the Department of Academic Success and key offices overseen by the Division of Student Affairs. To meet the department's mission, faculty are also involved in its activities.

The Department of Academic Success addresses a range of needs for first-year students—from proper course placement to advisement and monitoring and to tutoring. In addition, referrals and advocacy are provided. The department oversees the following academic support offices and services: Freshman Programs, Academic Advisement Center (AAC), the General Studies Program, the Higher Education Opportunity Program (HEOP), the Office of Academic Affairs, the Office of Special Services—TRIO Program and the Polytechnic Tutoring Center (PTC).

For more information about the department, visit www.poly.edu/academics/support.

FRESHMAN PROGRAMS

The Institute is committed to improving the persistence and performance of first-year students by helping them to acclimate to their academic discipline, its associative culture and student life. The office is the primary contact for first-year student issues and offers diverse and dynamic collaborative efforts with constituencies across the campus community. These partnerships provide a great sense of cohesion to the programs and services that meet the needs of first-year students. Programs and services offered include first-year advisement, faculty-student mentoring, early alert and academic probation initiatives, first-year instructors meetings and parent outreach. (See Section on "Programs and Services for First-Year Students" for an expanded description of the programs and services in this area.)

ACADEMIC ADVISEMENT CENTER

The mission of the Academic Advisement Center (AAC) is to provide centralized advising for all incoming, matriculated first-year students. The staff advises students on major requirements and Institute regulations and refers them to campus resources. In addition, academic advisers advocate for students with Polytechnic offices and help students deal with issues affecting them. Students are assigned advisers in their major departments after the first year.

Students may make an appointment or drop in to see their adviser. Advisement sessions cover an array of topics, including major requirements, Institute regulations and life-skills development. The center refers students to campus resources for additional support and guidance in an effort to address any Institute-related issues affecting them. In addition, academic advisers advocate for first-year students with the offices of the Registrar, Financial Aid, Student Accounts and Admissions, as well as other offices.

In conjunction with the Office of Academic Affairs, the center directs the review of first-year students' progress to determine academic standing. The academic advisers make decisions on eligibility for the Dean's List, academic probation and disqualification of first-year students and notify them of their academic standing. Students on probation are directed to meet regularly with their advisers to discuss their situation and learn how to make improvements to return to good academic standing. All first-year, first-time probationary students must enroll in and attend SL 1020, Academic Skills Seminar.

For more information about the center, visit www.poly.edu/academics/support/academic.

GENERAL STUDIES PROGRAM

The General Studies (GS) Program provides proactive support for students, allowing them an opportunity to matriculate and successfully obtain a science-, engineering, humanities- and management-based education. To ensure student success, General Studies students receive a broad variety of services, beginning with a mandatory summer program before the start of their freshman year and continuing throughout the academic year with mandatory, weekly tutoring and advisement sessions. Once admitted into Polytechnic, students must successfully participate in the program for one year before they are allowed to officially declare their major. Advanced Placement (AP) and transfer credits may not be used toward the completion of GS Program requirements. For additional information, please refer to Part 4, "Special Programs," in this catalog or visit www.poly.edu/general-studies.

HIGHER EDUCATION OPPORTUNITY PROGRAM (HEOP)

The Higher Education Opportunity Program (HEOP) is a New York State-funded program that provides broad and varied educational instruction to capable students who, because of limited academic and financial resources, might otherwise not have the opportunity to attend Polytechnic. Once admitted to the HEOP program, students receive financial assistance, counseling, tutoring, advisement and other support services during their college career. HEOP's goal is to retain and graduate students who are traditionally underrepresented in engineering and science. More information on HEOP is included in Part 4, "Special Programs," in this catalog or, visit www.poly.edu/academics/support/heop.

OFFICE OF ACADEMIC AFFAIRS

The office reviews all undergraduate students' progress each semester to determine academic standing. Decisions are made on eligibility for the Dean's List, academic probation, disqualification and appeals of academic disqualifications. Notifications for all academic actions are e-mailed to students and their academic departments and Institute support offices.

This office also coordinates evaluations of transfer credits in cooperation with the Office of Admissions and academic departments. The Office of Academic Affairs also serves as liaison between the Office of Undergraduate Academics and undergraduate advisers to ensure uniformity of advising practices. The staff also assists the Dean with articulation agreements with other universities.

OFFICE OF SPECIAL SERVICES - TRIO PROGRAM

The Office of Special Services is a federally funded TRIO program that provides a wide range of support services to low-income, first-generation college students and students with disabilities. The mission of the Office of Special Services-TRIO program is to enhance the likelihood that students accepted into the program will successfully complete the academic programs at the Institute.

The TRIO program provides eligible students with a variety of free and confidential tutoring, academic counseling and other support services to enhance students' academic performance and maximize their potential, including:

Individualized Tutoring
The office staff assigns qualified upperclassmen to tutor students one-on-one in physics, math, biology, chemistry and computer science. Students meet weekly throughout the semester with an assigned tutor, who addresses their individual concerns about the course. Small-group review sessions in upper-level courses are also scheduled for students throughout the semester and a variety of study aids, instructional software and other resources are available to participating students.

Academic Counseling
Academic counseling is available to help students manage the academic challenges of Institute life. The office offers individualized study-skills advisement and workshops on various topics, including goal setting, time management and test taking. These academically related skills assist students to master the technical curriculum at Polytechnic. The office also provides career guidance and testing and arranges on-site visits and tours to help students explore opportunities when they graduate.

Social Integration Activities
The program schedules cultural and educational workshops and trips throughout the academic year to help students acclimate to the Institute and develop peer support networks.

Financial Assistance
The program provides eligible students with financial assistance through grants and scholarships.

For more information about the Office of Special Services-TRIO Program, visit www.poly.edu/academics/support/trio.

POLYTECHNIC TUTORING CENTER (PTC)

The Polytechnic Tutoring Center (PTC) offers a range of academic support services to all registered Polytechnic students. Tutoring is offered for the biology, chemistry, computer science and physics courses for first- and second-year students. Tutoring is provided on a drop-in basis as well as through exam-review sessions.

The PTC also includes the Writing Center, where students receive help with college-level writing, reading and speaking assignments and with English-language mastery. The Writing Center is open to Polytechnic students at any level, from first-year undergraduates through doctoral candidates. Writing Center staff work with students individually and in small groups.

Tutors are carefully selected and trained. They include undergraduate peer tutors, graduate students and instructors. Tutors know their subjects well and understand where students may have difficulty. They are skilled at explaining material in a variety of ways for maximum comprehension. All students' questions are respected; no question is too basic to ask. The PTC also helps students improve their learning skills in order to become more successful in college and throughout their careers.

PTC services are free of charge. For more information about the center, visit www.poly.edu/academics/support/polytechnic.

ADMISSIONS

The course of studies at Polytechnic is academically rigorous and intellectually challenging; therefore, admission to Polytechnic is highly selective. Candidates for admission to graduate programs are evaluated by the department to which they apply. Students seeking admission to the undergraduate programs are evaluated by the professional staff of the Office of Undergraduate Admissions.

UNDERGRADUATE APPLICATION PROCESS

Application materials and information about undergraduate admissions may be obtained by contacting the Office of Undergraduate Admissions or on-line:

Office of Undergraduate Admissions
Polytechnic Institute of New York University
Six MetroTech Center
Brooklyn, NY 11201
Tel: (718) 637-5955
Fax: (718) 260-3446
E-mail: uadmit@poly.edu
Web: www.poly.edu/admit

Undergraduate applicants should complete the application for admission and forward it to the Office of Undergraduate Admissions with either the nonrefundable application fee or a fee-waiver request form. Applicants must request that their secondary school and/or college forward official copies of all transcripts to the Polytechnic Office of Undergraduate Admissions. Additionally, applicants must submit an essay and two letters of recommendation. All freshman applicants and transfer applicants with fewer than 30 college credits from an accredited institution are required to submit official copies of test scores of the Scholastic Assessment Test (SAT) or the American College Testing Program (ACT). Transfer applicants with fewer than 30 college credits from an accredited institution are required to submit official copies of their secondary school transcripts and SAT or ACT scores.

Polytechnic's Office of Undergraduate Admissions reviews applications once all required documents are received and notifies students of decisions in writing. Applicants are encouraged to apply early. Preference for admission and scholarship is given to applicants who submit all documents according to the following timetable:

Full-time undergraduate study
Regular Decision:
January 14, January 13, January 11
for the spring 2011, 2012, 2013 semesters.

Early Decision:
November 7, 2011 for Fall 2012;
November 5, 2012 for Fall 2013.

Priority Decision:
February 14, 2011 for Fall 2011;
February 3, 2012 for Fall 2012;
February 3, 2013 for Fall 2013.

May 1 (all years)– deposit for freshman admitted students due.

Full-time Transfer undergraduate study
January 14, 2011 for Spring 2011 semester;

January 13, 2012 for Spring 2012 semester;

January 11, 2013 for Spring 2013 semester;

August 12, 2011 for Fall 2011 semester;

August 10, 2012 for Fall 2012 semester;

August 9, 2013 for Fall 2013 semester.

The preceding timetable does not apply to international applicants. Because of the extra time required to process applications from abroad, consideration will not be given to applications received after December 1 for the spring semester, or after July 15 for the fall semester. All official records, with notarized translations, must also be received by these dates. (See "Admission as an International Student" for additional information.)
If accepted for admission, applicants should submit an enrollment deposit of $300 to reserve a place in the entering class. This deposit is applied to tuition and fees for the first semester and is non-refundable. Deposits to reserve a place in the entering freshman class are due May 1. Deposits to reserve a place for entering transfer students are due August 22. Students who submit deposits after the deadline will be placed on a waiting list for the fall semester.

Applicants accepted for the fall semester may begin their studies in the summer session. Polytechnic offers two summer sessions to help students who wish to accelerate or supplement their studies.

The Early Admission Plan for High School Juniors
On occasion, Polytechnic offers early admission to outstanding high school juniors. Programs can be arranged so that these students simultaneously satisfy high school requirements while completing their freshman year of college. Candidates for this program must complete the required entrance examinations in their junior year of high school and must present with their application a letter from their principal stating the secondary school's approval.

ADMISSION AS FRESHMAN
Requirements
Applicants for admission as freshmen are required to take the Scholastic Assessment Test (SAT). The American College Testing (ACT) Program may substitute for the SAT. Students who are admitted to Polytechnic and plan on enrolling are required to take two placement examinations before registration. Students who score a 4 or 5 on the Math and English Advanced Placement Exams or who achieve a high score on the SAT II Math and English subject's exams may be exempt from Polytechnic's placement exams.

The preferred secondary school course of study is:

Course	Years
English	4
Science	4
(Chemistry is required and physics is strongly recommended.)	
Mathematics	4
(Sequential I, II, III, precalculus, calculus)	

This course of study is only a directive, not an absolute requirement. The primary concern of the members of the Committee on Admissions is to determine an applicant's potential for success at Polytechnic.

Interviews and Campus Tours
Prospective students are strongly encouraged to visit the campus and interview with an admissions counselor. In some circumstances, an interview is required. Arrangements can be made by calling the Office of Undergraduate Admissions at 800-POLYTECH or (718) 637-5955. If advance arrangements are made, prospective students may be able to combine their campus visit with an interview with an admission counselor.

FRESHMAN ADMISSION WITH ADVANCED STANDING

Freshmen may receive advanced standing with college credit at Polytechnic by scoring exceptionally well on the Advanced Placement Examinations given by the College Board. Specific requirements for administering college credit—for the Advanced Placement and the International Baccalaureate Exam, for the French Baccalaureate or for the General Certificate Exam A levels, etc.—vary from department to department.

ADMISSION UNDER THE HIGHER EDUCATION OPPORTUNITY PROGRAM

The Higher Education Opportunity Program (HEOP) provides educational opportunity to economically and educationally disadvantaged students of New York state. Economic eligibility is based on New York State guidelines, which consider family size, family members who are students and family income.

Freshmen entering HEOP are required to take six weeks of work during the summer before beginning the freshman year to make up prerequisites and courses in which limitation is shown. Freshmen are admitted to this program in the fall only.

Transfer students may enter HEOP provided there is space available. Only students coming from similar programs approved by the HEOP central office are eligible to transfer into HEOP.

For further information, contact the HEOP office at (718) 260-3370.

ADMISSION AS AN INTERNATIONAL STUDENT

International students must meet four basic criteria for admission to Polytechnic and be in receipt of a valid I-20 or DS-2019:

- Academic credentials (grades, certificates, degrees) must be assessed as suitable for entry to the specific Polytechnic program. Transcripts must be submitted with official translations. One source for official translations is World Education Services at www.wes.org.
- Submission of SAT or ACT scores is required for freshmen. This requirement may be waived in some circumstances.
- The Test of English as a Foreign Language (TOEFL) or IELTS is required of all students whose native language is not English. This requirement may be waived, in some circumstances.
- Admitted international students applying for an F-1 or J-1 student visa are required to submit a signed and completed Polytechnic Declaration and Certification of Finances (Affidavit of Support) accompanied by a bank statement signed by a bank official to receive an I-20 or DS- 2019.
- Students holding F-1 or J-1 visas must enroll as full-time students.

If transfer credit is desired, candidates must include catalog or syllabus descriptions of courses completed. English translation must be provided where necessary. An official transfer-credit evaluation will be done, as soon as possible, after the student arrives at Polytechnic and meets with a member of the admissions staff and a departmental adviser.

ADMISSION AS A TRANSFER STUDENT

Polytechnic welcomes transfer students from accredited colleges and universities, provided they have maintained a strong academic record. Students with less than 30 college credits need to submit official high school transcripts and official SAT or ACT scores; however, under certain circumstances the submission of high school transcript(s) and SAT/ACT scores may be waived by Admissions. Students who have completed 30 or more college credits need only submit official college transcripts. All transfer applicants must also submit an essay and two letters of recommendation.

Once accepted, transfer students' credits will be evaluated by the academic department to which they are applying for evaluation to determine which are transferrable. Students are required to submit their college catalog, and/or syllabi, describing courses under consideration for transfer credit.

Transfer credits will be officially evaluated before the end of the first semester in which the transfer student is enrolled at Polytechnic by the academic departments. Transfer credit is awarded on the basis of current standards and curriculum. Therefore, it is possible that credits Polytechnic had previously awarded for courses taken at other universities may no longer be granted at this time. Transfer credit will not be considered for any course with less than a C grade. Any student who completes a course in residence at Polytechnic for which transfer credit has already been granted will automatically forfeit the transfer credit for that course.

In certain instances, course requirements may be waived for students who demonstrate sufficient knowledge of specific course content through either oral or written examinations given by the department. When course requirements are waived, the student will not receive credit for the course, but must substitute a more advanced course to satisfy the degree requirement.

The grades for transfer courses are not included in computing the Polytechnic grade-point average. New transfer students may be admitted on a part-time or full-time basis and are required to take a mathematics diagnostic examination and may be required to complete a writing placement exam.

ADMISSION AS A PART-TIME STUDENT

Students seeking a bachelor's degree may enroll on a part-time basis (11 credits or less). Part-time undergraduate students should be aware that it is not possible to complete a bachelor's degree program by attending only evening courses.

Regulations concerning subject requirements and admissions procedures are given in the section "Admission as a Freshman."

Following notification of acceptance, students are told when to contact the adviser of their major department. In some cases, this contact may be accomplished during registration.

SPECIAL AND VISITING STATUS

An individual requesting permission to register for one or two courses in a specific semester is assigned special- admission status. A special (nondegree) student application must be submitted to the Office of Undergraduate Admissions. Included in this status are individuals who want to take courses for professional advancement or personal development, or individuals from other colleges wishing to transfer credit back to their home institution but who do not want to earn a degree. A maximum of 6 credits or two courses may be taken in one semester and no more than a total of 9 credits or three courses may be taken. Exceptions can be made to this policy through the office of the dean of academic affairs. This policy does not apply to currently enrolled high school students or students in an approved Poly exchange program. A special student application must be filed each semester the individual remains in this status. Permission to take courses as a special student does not imply admission to a degree program.

Courses taken on a nondegree basis are not automatically applied to a degree program. Some courses, however, may be applied to a degree program with the approval of a departmental adviser. Students may enroll in up to 9 credits as a special student before formal admission is required.

Students should work with their home institution to insure that the courses they participate in at NYU-Poly will transfer back to the school where they will receive their degree. Students who wish to matriculate at the Institute and receive a degree from NYU-Poly should apply as transfer students and should not apply for visiting student status.

Visiting Student Application Process
To be eligible for consideration to participate in the NYU-Poly visiting student program for the fall and/or spring semesters, applicants must meet the following criteria:

- Currently achieving a cumulative GPA of a 3.0 or better. Students who do not meet this minimum academic requirement will not be considered.
- Not currently on academic, disciplinary, and/or medical leave or probation at their current institution. Students may take a personal leave for the semester(s) they are studying at NYU if such a leave is required by their home institution to maintain matriculation.
- It is also recommended that all applicants should be fully prepared for Calculus prior to enrolling as a visiting student at NYU-Poly.

Application Checklist
When completing and returning the application, applicants should read the checklist below to ensure that they have included the appropriate items and information (this list can be found on the application itself):

- Completed Application
- Official Transcript
- Application Fee of $50.00, payable to "Polytechnic Institute of NYU"

CONDITIONAL STATUS
An undergraduate degree applicant who is required to demonstrate additional ability to pursue the program applied for is assigned conditional status. Conditions may include taking introductory level courses, limited courses per semester, or attainment of a specified grade-point average.

STATUS
Within the full-time and part-time classifications of undergraduate admissions are three status groups: regular, conditional and special/visiting student. A change in status from conditional to regular should be applied for when the conditions of admission are satisfied. A special or visiting student must file an application for undergraduate admissions with the Office of Undergraduate Admissions.

READMISSION
Polytechnic students who have not been in attendance for one semester or more and have not been granted an approved leave of absence (see "Leave of Absence") must apply for readmission through the Office of Undergraduate Admissions. The student's application for readmission will be sent to the student's academic department for evaluation. The academic department in consultation with the Office of Academic Affairs and Dean of Undergraduate Academics determine whether the student is eligible to continue his/her studies at NYU-Poly.

Students who have been academically disqualified must apply for readmission through the Office of Undergraduate Admissions. Students applying for readmission are expected to state their reasons for leaving Polytechnic and explain why they want to return. They must also submit with their application for readmission official transcripts of college-level courses taken during this absence from Polytechnic.

GRADUATE ADMISSIONS
To be eligible for admission as a graduate student, an applicant must first hold a bachelor's degree from an institution acceptable to Polytechnic. The bachelor's degree program must comprise at least four years of college-level work. In case the bachelor's degree program is less than four years, additional college-level course work should be taken to satisfy the requirement of four years of college-level preparation. Attention is given to listings by the Accreditation Board for Engineering and Technology, the American Chemical Society, the Computer Science Accreditation Board and various regional accrediting associations. An applicant applying to a graduate program in an area of study different from the undergraduate field in which a bachelor's degree or its international equivalent was earned may be required to take additional courses for which credit toward degree requirements may not be given (see "Conditional Status").

Graduate admission information can be obtained from the Office of Graduate Admissions, Polytechnic Institute of NYU, Six MetroTech Center, Brooklyn NY 11201, (718) 260-3182, or online, at www.poly.edu/admissions/graduate.

ADMISSIONS PROCEDURES
In addition to the application form and fee, an applicant must have official transcripts from all previously attended undergraduate and graduate institutions sent directly to the Office of Graduate Admissions in an officially sealed envelope. An application should be supported by letters of recommendation from persons qualified to comment on the applicant's aptitude for graduate study and research. A Statement of Purpose from the applicant is also required. Applicants should outline reasons for undertaking graduate studies and future plans. A resume detailing the applicant's professional and academic background is also required. Official standardized admission test results are required as per the examination section.

All applicants are requested to send the entire application, including transcripts, letters of recommendation and all other supporting documents, in one package to facilitate processing and to avoid delays due to missing documents. Action on an application will be taken as soon as possible after all supporting documents are received.

Applicants applying before completion of their undergraduate studies must submit the original proof of completion of Bachelor's degree to Graduate Admission's Office before registering as a graduate student at Polytechnic.

APPLICATION DEADLINES
The deadlines for sending in completed applications for fall semester are:
March 30: (1) all applicants applying for scholarships, assistantships and financial awards and (2) all international applicants.
July 1: all other applicants.

For spring semester the deadlines are:
November 1: (1) all applicants applying for scholarships, assistantships and financial awards and(2) all international applicants.
December 1: all other applicants.

EXAMINATIONS
The Graduate Record Examination (GRE) or Graduate Management Admission Test (GMAT) is required for admission to some graduate programs and are recommended for all others. However, all international applicants must submit scores for the GRE (or GMAT if applicable) to be considered for admission. GRE or GMAT scores are also required for those applying for merit-based scholarships, fellowships and assistantships. Consult the departmental section of this catalog for specific requirements about each degree program.

INTERNATIONAL APPLICANTS

An international student must complete an application for admission by March 30 (fall admission) or November 1 (spring admission) to be reviewed for the term requested. Late applications or an incomplete file will delay review and perhaps entrance by at least one term.

Additionally, international students are required to demonstrate English proficiency. For detailed information, see "English Requirement for International Students." All international students must submit a notarized Certificate of Finance accompanied by a bank statement showing the ability to meet financial obligations for the course of study.

ENGLISH REQUIREMENT FOR INTERNATIONAL STUDENTS

To be granted regular admission to a graduate degree program, international students normally are required to demonstrate proficiency in English by obtaining a score of at least 80 on the internet-based Test of English as a Foreign Language (TOEFL) or 6 in the International English Language Testing System (IELTS).

This requirement may be waived for international students who:

- have earned a degree from an institution in a country where English is the official language;
- have successfully completed an undergraduate program in the United States in which English was the official or major language of instruction;
- can demonstrate a level of English proficiency deemed equivalent to a TOEFL score of 80 (internet-based test: IBT) through submission of evidence acceptable to the Institute.

International students who obtain a TOEFL (or equivalent) score between 57 and 80IBT may be admitted to a graduate degree program on the condition that they successfully complete an English program at the Institute. Upon successful completion of the approved English program, students are not required to submit a new TOEFL score.

POLYTECHNIC INSTITUTE OF NYU's ENGLISH PROGRAM

In certain cases, international graduate students may be required to attend an intensive English program at Polytechnic upon enrollment. Students may attend this program while taking a reduced graduate academic load of one to two courses a semester. Grades or credits obtained in courses related to this English program will not be included in the computation of the GPA or toward successful degree completion.

STATUS

Within the full-time and part-time classifications of graduate admission are three status groups: regular, conditional and special. A change in status from conditional to regular should be applied for when the conditions of admission are satisfied. A special student must file an application for graduate admission with the Office of Graduate Admissions.

Regular Status

A graduate degree or certificate applicant who is adequately prepared to begin the program applied for is assigned regular admission status upon the recommendation of the major department's faculty.

Conditional Status

Conditional status is assigned to an applicant for a graduate degree or certificate who is required to demonstrate additional ability to pursue the program for which he or she applied. Conditions may include taking introductory level or undergraduate courses, proof of degree completion taking intensive English courses, or attaining a specified grade-point average.

Special Admission Status

Special admission status is assigned to an individual requesting permission to register for one or two courses in a specific semester. A special (nondegree) student application must be submitted to the Office of Graduate Admissions. Included in this status are individuals seeking to take courses for professional advancement or personal development, but who do not want to earn a degree; and part-time degree applicants with incomplete admission files. A maximum of 6 credits or two courses may be taken in one semester and no more than 9 credits or three courses may be applied to a Polytechnic degree program. If such courses are applied toward a degree, they are considered as having been taken "in residence" at Polytechnic. A special student application must be filed each semester the individual remains in this status.

Permission to take courses as a special student does not imply admission to a degree program. Special students must hold a bachelor's degree from an institution acceptable to Polytechnic. Proof of degree is required.

READMISSION

Students who last attended Polytechnic within one year before the semester in which they seek to be readmitted and who have filed a formal leave of absence do not need formal readmission and are automatically permitted to register. Students who have not attended within the past year and did not file a formal leave of absence must apply for readmission; an application is available from the Office of Graduate Admissions.

Students who want to interrupt their studies must request a leave of absence for a specified time, usually not exceeding one year. Such requests, when approved by the Office of Graduate Academics (and the Office of International Students and Scholars for international students), constitute assurance of readmission to the degree program from which the leave was taken. Students must apply for readmission when absence exceeds the approved leave of absence.

CAREER MANAGEMENT CENTER

The Career Management Center and the NYU Wasserman Center for Career Development will connect you with leading companies that are searching for highly skilled, market-ready individuals prepared to take on the challenges and opportunities of the 21st century. Our offices help undergraduate and graduate students seek positions where their refined technical, analytical and communication skills can best be put to use.

CAREER COUNSELING AND CAEER DEVELOPMENT SEMINARS

Knowing how to conduct an internship or job search is key to landing the opportunity you want. Through one-on-one career counseling and group seminars, NYU-Poly students acquire effective job search skills designed to complement their successful in-classroom experiences. Writing an effective resume, preparing for a career fair and acing the interview are just some of the topics addressed by career center staff.

INTERNSHIP OPPORTUNITIES

Internships allow students to gain real-world experience, while giving employers a chance to identify future talent. Students are encouraged to participate in one or more internships before they graduate, demonstrating to employers NYU-Poly's high standards of excellence. These professional experiences give students an edge over the competition and have the potential to turn into full-time opportunities following graduation.

NYU CAREERNET, CAREER FAIRS AND ON-CAMPUS RECRUITING

NYU-Poly students can connect to NYU CareerNet, our online internship and job search engine. Using this valuable database, students can submit a cover letter and resume directly to employers. Additionally, internship and job seekers can meet with hiring companies at career fairs and even arrange on-campus interviews with these employers. Participating companies range from small entrepreneurial start-ups to mid-sized businesses to internationally recognized major corporations.

COMMUNICATION POLICY

In our on-going campaign to be environmentally aware by "going green" and to increase the safety, efficiency, and speed of our communication with students, NYU-Poly has instituted a communication policy in which NYU-Poly will no longer use paper communication with students.

All NYU-Poly students have a Polytechnic Institute of NYU e-mail account and, through the PeopleSoft Blackboard integration, access to MyPoly for institutional information concerning the classes for which they are registered and organizational information and services. Because of this robust electronic access, NYU-Poly faculty and administration will contact students with important information and notices electronically only through the various communication technologies and environments provided by the Institute.

To ensure that students both receive and are responsive to important notices from all departments and offices at NYU-Poly, students need to observe the following policy:

- The NYU-Poly e-mail account is a student's official point of contact. Students are expected to directly access this account at least once each school day.
- Students must be aware of notices posted on MyPoly. It is the student's responsibility to check this portal during the drop/add period of registration and regularly during the term in order to verify the accuracy of his/her schedule and to read any official institute notices. Schedules should be verified by students at least once during the first two weeks of the term and once after mid-semester. The Academic Calendar that delineates the different registration periods is also available on MyPoly. Students should be familiar with this calendar and follow it accordingly.
- Students are required to be aware of course-related information available on their course environment on Blackboard, such as course syllabi, resources, calendar, assignment expectations, special announcements, grades etc.

COUNSELING AND PSYCHOLOGICAL SERVICES(CAPS)

"Helping Students Achieve Maximum Potential"

CAPS offers free, confidential psychological services to all NYU-Poly students. College can be a stressful time, and students can face a range of difficulties that can interfere with their ability to succeed academically or function at their best. For example, many students struggle with concentration, test anxiety, sadness, lack of motivation and difficulties with family or friends that can interfere with their NYU-Poly experience. The CAPS staff is available to meet with students and help resolve these issues. Staff members provide information and support to help students solve problems, achieve goals and feel better.

Students can make an appointment by calling (718) 260-3456, emailing counseling@poly.edu or dropping by the center.

CAPS is open Monday through Friday, 9 a.m. to 5 p.m.

Throughout the year, CAPS offers workshops on meditation, stress reduction, relationships and getting a good night's sleep. Workshops are advertised on the CAPS website, in the Polytechnic calendar, and through campus e-mail blasts.

For more information about CAPS and its services, visit www.poly.edu/life/health/counseling. On the site, students also can link to a variety of online screenings to anonymously answer questions to determine whether they (or a fellow student) show signs of common mental-health problems like depression, anxiety, substance abuse or posttraumatic stress.

Updated information on participation in NYU-sponsored activities and services is available on the website.

FINANCIAL AID

UNDERGRADUATE FINANCIAL AID

NYU-Poly administers a broad range of scholarship and financial aid programs to assist students in pursuing their educational goals. To meet the total cost of education, students may draw upon such available sources as student income, family income, Institute grants and federal and state funding.

All financial aid is limited to the need of the student as determined by the federal government's need analysis calculation. Students receiving financial assistance from NYU-Poly must notify the Office of Financial Aid of all scholarships, loans and other forms of educational assistance from sources other than those directly administered by NYU-Poly.

The following are three basic types of financial aid:

1. **Scholarships and grants:** funds awarded to students based on academic ability and financial need that do not require repayment.
2. **Loans:** specific sums awarded to students with repayment conditions. Education loans generally have low-interest rates with extended repayment terms.
3. **Employment:** part-time and summer jobs either on- or off-campus.

Approximately 90% of NYU-Poly's undergraduate students receive aid, including scholarships, grants, work-study jobs and student loans.

Applying for Financial Aid

Incoming freshmen should file a Free Application for Federal Student Aid (FAFSA) during January. (Later applications will be considered on a rolling basis as funds are available.)

Transfer students should file a FAFSA by May 1.

Renewing Financial Aid

All currently enrolled students must reapply for financial aid annually by completing the Free Application for Federal Student Aid (FAFSA) before March 1st for the upcoming academic year to be considered for all types of aid. Students filling after March 15th will be considered late and may not qualify for all types of aid. Students are liable for any late fees assessed by Student Accounts due to late FAFSA filing.

The FAFSA is available for completion online at **www.fafsa.ed.gov.**

Before completing the FAFSA students should be sure to have a valid PIN number. This will serve as an electronic signature. To apply for a PIN number, visit **www.pin.ed.gov.**

Parents of dependent students are required to sign the FAFSA so they should also apply for a federal PIN number at www.pin.ed.gov. Dependent students who complete the FAFSA without a parent signature will be rejected by the processor. Financial aid cannot be awarded until the FAFSA is completed and approved by the processor.

Students should make sure that all required sections of the FAFSA are competed before submitting:

- Signed by student (and parent for dependent students);
- Enter the code for Polytechnic Institute of New York University – 002796;
- Include housing status – on campus, commuting or off campus;
- Include state residency information. New York Residents should utilize NYS TAP link to apply for NY State aid (www.tapweb.org).

FEDERAL CAMPUS-BASED PROGRAMS

Students eligible for a federal campus-based program must (1) show need, (2) be enrolled at least half time (the equivalent of at least six credits per semester) and (3) be either a U.S. citizen or an eligible non-citizen.

To apply for any of these programs, students must have been accepted to NYU-Poly and have filed a FAFSA. The Office of Financial Aid determines the awards.

To continue to receive an award, students must make satisfactory academic progress, provide the Office of Financial Aid with all requested documents and report any changes in their financial situation annually.

All campus-based programs are contingent on annual awarding by the federal government. Renewal of awards may be affected by overall government funding to the school.

Federal Supplemental Education Opportunity Grant (SEOG)

The Federal Supplemental Education Opportunity Grant (SEOG) is awarded to undergraduates with exceptional financial need. Qualified applicants receive between $500 and $3,000 a year. Students must file the FAFSA each year by March 15th to be reviewed for renewal. Renewal of awards is based on financial need and government funding.

Federal Perkins Loans (formerly National Defense Student Loans, NDSL)

Federal Perkins Loans are 5% interest loans awarded through the Office of Financial Aid. They are included as part of the financial aid package and range from $500 to $2,000 per year. Total undergraduate Perkins Loans may not exceed $20,000.

The repayment period and interest for Perkins Loans do not begin until nine months after a student graduates, withdrawals or drops to less than half-time enrollment.

Federal Work-Study Program

The Federal Work-Study Program provides part-time jobs for undergraduate students to help meet college-related expenses. The Office of Financial Aid determines eligibility. The Career Management Center arranges work schedules.

At NYU-Poly, the average federal work-study award is $1,500 per academic year. Jobs are arranged on-campus, along with community service opportunities. Most assignments average 10 to 15 hours a week, and the work schedule is adjusted to the student's and the employer's needs. The hourly rate varies depending on the position. Students are paid bi-weekly.

FEDERAL AND STATE SPONSORED PROGRAMS

Federal Pell Grants

The Federal Pell Grant is a need-based program. Awards are determined by the U.S. Department of Education according to an eligibility index and by the level of appropriations available. Grants are for study leading to a first bachelor's degree.

Eligible students must (1) be U.S. citizens or permanent residents, (2) make satisfactory academic progress and (3) meet federal need requirements.

Students apply for the Federal Pell Grant by completing a FAFSA. Students applying for financial aid at NYU-Poly (including Federal Direct Loans) are required to apply for a Federal Pell Grant.

Tuition Assistance Program (TAP)

The Tuition Assistance Program (TAP) attempts to minimize the difference in cost normally found between New York's public and independent colleges so that students may make their choices based on program characteristics alone and not the difference in cost.

The amount of TAP award depends on tuition charges and NYS net taxable income. Income is adjusted to reflect other family members enrolled full-time in postsecondary study.

Eligible students must (1) be New York State residents and U.S. citizens or permanent residents, (2) enroll full-time at an approved New York State post-secondary institution, (3) meet income requirements established by New York State, (4) complete a TAP application by May 1st for the current academic year and (5) not be in default on a federal or state student loan.

To apply for a TAP award, students should complete an Express TAP Application (ETA) at **www.hesc.com.**

If NYU-Poly's name does not appear on the TAP certificate, use the NYSHESC website at www.hesc.com to update the college code to 0610 which is the NYU-Poly code.

To continue to receive TAP benefits, students must demonstrate satisfactory academic progress. All TAP recipients must achieve a 2.0 cumulative GPA after the completion of three full-time semesters.

In addition, students must fulfill the following academic requirements:

1. Complete a minimum number of credits by the end of each term of full-time study;
2. Maintain a minimum cumulative grade-point-average. The table below provides the correspondence between TAP payment points and academic progress.

Academic Progress for TAP Purposes

TAP Payment	Min. Credits Completed in Prior Semester	Minimum Cumulative GPA
1	0	0.00
2	6	1.50
3	15	1.80
4	30	2.00
5	45	2.00
6	60	2.00
7	75	2.00
8	90	2.00

TAP Waiver: Students who do not meet the criteria as indicated on Requirements 1 and 2 may be eligible for a one-time TAP waiver. For appeal and consideration by the TAP Waiver Committee, students must file a TAP Waiver Form with the TAP certifying Officer in the Student Financial Services Office.

Aid for Part-Time Study (APTS)

The Aid for Part-Time Study (APTS) Program provides state grants to less than full-time students.

Eligible students must (1) be working toward an undergraduate degree as a part-time student, (2) be in good academic standing, (3) be a resident of New York State, (4) be either a U.S. citizen, permanent resident or refugee, (5) not have exhausted TAP or other New York State student financial aid eligibility for full-time study and (6) qualify under the New York State–mandated income requirements.

To apply, students should file an application with Student Financial Services no later than the second week of classes for the current semester. Students must apply each semester.

Vietnam Veterans Tuition Awards (VVTA) Supplement

In 1984, the New York State Legislature established the Vietnam Veterans Tuition Award program to provide tuition assistance for full-time or part-time undergraduate student for veterans who are residents of the state, who served in Indochina between February 28, 1961 and May 17, 1975, and who were discharged under honorable conditions or general discharge.

Since 1984, the program has been expanded to include veterans who served in the Persian Gulf on or after August 2, 1990 and in Afghanistan on or after September 11, 2001, and to provide awards for graduate as well as undergraduate study.

In 2008, the legislature further amended the law to also include "other eligible combat veterans." This group includes individuals who are New York State residents, who served in the armed forces of the United States in hostilities that occurred after February 28, 1961, as evident by their receipt of an Armed Forces Expeditionary Medal, Navy Expeditionary Medal, or Marine Corps Expeditionary Medal and who were discharged under honorable conditions, as noted above.

For full-time study, veterans are eligible for an award equal to the amount of undergraduate tuition for New York State residents charged by the State University of New York, or actual tuition charged, whichever is less.

For part-time study, awards are prorated by credit hour. Part-time study for Veterans Tuition Awards is defined as at least three, but fewer than 12, semester hours at degree-granting institutions.

Awards are available for up to four years of undergraduate study, or five years for enrollment in an approved five year program and up to three years of graduate study.

Higher Education Opportunity Program (HEOP)

HEOP is sponsored by New York State and Polytechnic for entering freshmen who meet special academic and economic criteria. All inquiries are administered directly through the Office of HEOP. Consult the "Admissions" section and Part 4 of this catalog for more information.

INSTITUTE SCHOLARSHIPS AND GRANTS

Polytechnic awards scholarships to freshmen with strong academic backgrounds for full-time study (12 credit hours a semester). Scholarships are offered through Polytechnic's PROMISE Fund, which administers more than 100 different programs. Students apply to the Office of Undergraduate Admissions through their application for admission. Awards may cover up to full tuition. Scholars must maintain a 2.5 or 3.0 cumulative GPA (depending on the award). Scholarships are not added to external scholarships nor coupled with multiple NYU-Poly scholarships.

Polytechnic awards the following scholarships:

PROMISE SCHOLARSHIPS

These scholarships are awarded in varying amounts, based on scholastic achievement. No award may be greater than the amount of tuition less any other aid for which students may be eligible. Scholars must maintain a 3.0 or 2.5 cumulative GPA. No separate application is required.

NYU-POLY GRANTS

These grants are awarded to students who demonstrate high financial need. Students apply directly to the Institute's Office of Financial Aid by completing a Free Application for Federal Student Aid (FAFSA).

MERIT-BASED SCHOLARSHIPS AND AWARDS

Honors Program Scholarship

Students accepted to the Honors Program will receive a scholarship awarded in variable amounts. Please see Part 4 of this catalog for information on the Honors Program and its requirements.

PROMISE Fund—Corporate and Individually Sponsored Scholarships

NYU-Poly scholarships are established through generous sponsors. Students are notified if their particular scholarship is corporate or individually donated.

The following is a list of current scholarships at Polytechnic:

Benjamin Adler Memorial Scholarship
Sidney G. Albert Scholarship
Alden Challenge Scholarship
Anthony Alonzo Scholarship
Alumni Scholarship
Joseph M. Amendolara Scholarship
Donald J. Amoruso Scholarship
George Bachman Scholarship
Paul C. Bauerle Memorial Scholarship
Beltran Family Endowed Scholarship
Orin Dodge Berry Scholarship

Bender-Fishbein Endowed Scholarship
Eugene Blank Scholarship
Blecker/Hinden Scholarship
Joseph Bommarito Scholarship
Rodney Brabson '32 Scholarship
R. Brown Scholarship
Joseph Bucich Scholarship
Dr. George Bugliarello Scholarship
Salvatore E. Cannizzaro Scholarship
L. F. Case Foundation Scholarship
George and Assunta Cha Scholarship
Chinese Institute of Engineers Endowed Scholarship
Kuilo Cheng Scholarship
J. B. Chittenden Scholarship
Claessens Family Scholarship
Arthur Clapp Scholarship
Philip Clark Scholarship
Class of 1942 Scholarship
Class of 1944 Scholarship
Class of 1960 Scholarship
Samuel and Grace B. Cohen Scholarship
Donald and Maria Cox Endowed Scholarship
Davis/Durborow/Brierly Scholarship Fund
Joseph D'Aprile Memorial Scholarship
DeWitt Scholarship
Willard H. Dickinson Scholarship
Herman Dock Scholarship
Peter Dollard Scholarship
Aaron and Simcha Dubitzky Scholarship
W. E. Duryea Scholarship
A. S. Dwight Scholarship
Eirich/Morawetz Scholarship
Burton Erickson Scholarship
Bernard Farkas Scholarship
I. W. Fay Scholarship
Federal Cyber Service Scholarship for Service
Fisher (estate of J.R. Fisher) Scholarship
Harold and Martha Forstrom Scholarship
Sidney and Katherine Friend/NACME Scholarship
W. L. Family Endowed Scholarship
Geiger–Fialkov Scholarship
Roger Gilmont Scholarship
Dr. Anthony B. Giordano Scholarship
Amir Gold Scholarship
Goldman Sachs and Company Scholarship
Harold and Helen Gottlieb Scholarship
Gordon Gould Scholarship
James Douglas Graham Scholarship
Ying Chavas Greene Scholarship
Francis and Mildred Hallenbeck Foundation Scholarship
William Randolph Hearst Scholarship
Charles J. Hinkaty '70, '72 Endowed Alfred Helwig Scholarship
Herbert Henkel Scholarship
Professor Hessel Award HTI Scholarship
F. M. Jabara Scholarship
Jephson Educational Trust Scholarship
William T. Hudtwalker Scholarship Endowed
James H. J. Hughes Award
Dr. Peter Kabasakalian Scholarship
Susan Kamen Scholarship
Jacob Kaplan Scholarship
The Harry S. and Toby Katz Scholarship
Ade Howe Kent Scholarship
Nathan Kleinman Scholarship
Kirk Scholarship
Ping Ku Scholarship
Eugene R. Kulka Scholarship
John F. Kunc Scholarship
Dr. Irving Kuntz Scholarship
Bernard and Pauline Lee Scholarship
Saul Leitner Scholarship
Dorothy Lemelson Scholarship
Alfred and Beatrice Lerner Memorial
Leona Levine Scholarship
Steve Levy Scholarship
Robert Linoki Memorial
Litton Industries Scholarship
Lockheed Martin Scholarship
Helen T. Lowe Scholarship
Lyons Scholarship
Maggio Scholarship
P.R. Mallory Memorial Scholarship
Dr. Ines Mandl '47 '49 Scholarship
Arthur C. and Elizabeth R. Martinez Endowed Scholarship
Raymond Mauro Scholarship
Stephen J. Meoli Memorial Scholarship
E. Mitchell Scholarship
Colonel Frank Mott Scholarship
Alfred B. Muscari Memorial Endowed Scholarship
NACME Block Grant Scholarship
Bonnie Nagler Scholarship
NEC Scholarship (in Dr. Sekimoto's honor)
NECA (Northeastern Chemical Association) Endowed Scholarship
William Nichols Scholarship
Nippon Electric Scholarship
Stanley Nisenson Memorial Scholarship
Nordheimer Scholarship
Theodore Nowak Scholarship
NSC–Eddie Mitchell Scholarship
NSS–Hughes Aircraft Co. Scholarship
Oceanic Scholarship
Dr. John C. Olsen Scholarship
Open Door Foundation Scholarship
Lilyan and Milton Oran Scholarship
Ruth and Richard Orford Scholarship
Dr. Donald Othmer Scholarship
PamAmSat Scholarship
Donald Pascal Scholarship
Rajendra Paul Scholarship
George S. Pearson Scholarship
Louis J. Pignatoro Memorial
G. Jeffrey Poletti Memorial Scholarship
Polytechnic 100 Scholarship
Polytechnic Fellows Scholarship
PROMISE Scholarship
Radio Club Scholarship
Bengt G. Ranby Scholarship
Dr. Julian R. Reasenberg Memorial Scholarship
Steve and Lee Rittvo Scholarship
Julian Rogoff Scholarship
Nicholas and Angelica Romanelli Scholarship
Myron Rosenthal Scholarship
Samuel Ruben Scholarship
Sidney J. Rubin Scholarship
Helena Rubinstein Foundation Fellowship
Richard and Emily Sbaschnig Scholarship
Dr. John P. Schaefer Endowed Trustee's Scholarship
Edward C. Schmidt Scholarship
Paul J. Schwanenflugel Scholarship
Dr. Sekimoto (NEC) Scholarship
Mitsuzo Shida Scholarship
Silleck Family Scholarship
Skeist Scholarship
James M. Smith Scholarship
Frank R. and Emily E. Stammer Scholarship
Michael Stock Scholarship
William Stolze Scholarship
Won Bong Sull Endowed Scholarship
Solon Summerfield Foundation Scholarship
Wai Nam Tam Scholarship
Arlene and Irving Tashlick Scholarship
Tau Beta Pi Scholarship
Arnold Thompson Scholarship
Guy Torre Memorial Book Scholarship
Robert Tsao Endowment Fellowship
USS Scholarship
Kenneth G. Van Wynen Scholarship
Dr. Ernst Weber Scholarship
Ernst and Sonya Weber Scholarship
Donald N. and Susan C. Weisstuch Scholarship
Williams Industries Inc. Endowed Scholarship
Warren E. Winsche Memorial Scholarship
William Wishnick Scholarship
WSTA Scholarship
Howard J. and Audrey R. Wulfken Scholarship
Frank and Iris Young President's Scholarship
Edward H. Zucker Scholarship

OTHER OPPORTUNITIES

Veterans Administration (VA) Educational Benefits

Eligible Veterans should apply through the Office of the Registrar. A summary of Veterans' benefits is available in the Office of the Registrar.

Students requesting VA benefits should notify the Office of the Registrar each semester after completing registration. Students must report interrupted attendance or termination of study. Details of NYU-Poly's requirements are given to all applicants. Please direct questions about veterans' benefits or paperwork to the Office of the Registrar either in person or by telephone.

COOPERATIVE EDUCATION PROGRAM (CO-OP)

Co-op is an alternative way to finance education by combining outside employment with college attendance in alternate semesters.

Contact the Career Management Center and Cooperative Education for more information.

GRANT AID TO NON-NEW YORK STATE RESIDENTS

Some state-aid programs frequently require that awarded funds be used within the state, while other programs sometimes allow funds to be used out of state. Residents of Pennsylvania, Rhode Island, Vermont or Washington, D.C., should contact the following agencies for more financial aid information:

Pennsylvania Higher Education
Assistance Agency
Education Building
Harrisburg, PA 17126

Office of Scholarships
Rhode Island Department of Education
199 Promenade Street
Providence, RI 02908

Vermont Student Assistance Corporation
156 College Street
Burlington, VT 05401

Washington, D.C. Grant Program
Educational Assistance Office
1329 E. Street NW
Room 1050
Washington, DC 20004

LOAN PROGRAMS

WILLIAM B. FORM FEDERAL DIRECT SUBSIDIZED LOAN

The Federal Direct Loan program allows students to borrow money to help meet the costs of college. Students borrow this money and on to go into repayment as long as they meet the program's academic requirements or until six months after they graduate or withdraw from school.

Eligible students must be (1) U.S citizen or permanent resident, (2) enroll for at least six credits per semester and matriculate, (3) make satisfactory academic progress, (4) demonstrate financial need as determined by the Free Application for Federal Aid (FAFSA).

Academic year loan limits are $3,500 for freshmen, $4,500 for sophomores and $5,500 for juniors and seniors. Interest is subsidized by the government and does not accrue as long as the student meets programs requirements.

To apply, students must complete the FAFSA each year. First time Direct Loan borrowers must also complete the Master Promissory Note and Entrance Counseling session (online).

When student borrowers graduate, withdraw from school or enroll less than half-time, they will be required to complete the Exit Counseling session (online). Borrowers must begin repaying the loan six months after graduating or withdrawing from school. Direct Lending offers many different repayment options. Deferments and forgiveness options are also available. Borrowers should contact Direct Lending regarding any repayment, deferment or forgiveness options.

Repayment of part or of the entire loan may be made in advance at any time without penalty.

WILLIAM B. FORM FEDERAL DIRECT UNSUBSIDIZED LOAN

The Federal Direct Unsubsidized loan is open to students who do not qualify for a subsidized loan (listed above). The same terms, conditions, annual borrowing limits apply. The only exception is that the borrower is responsible for interest that accrues while enrolled in school and during the six month grace period. Unpaid interest will be capitalized upon repayment after grace period.

In addition Independent students and dependent students, whose parents are unable to secure a PLUS loan, may apply for an additional $4000 annually at the freshmen and sophomore levels or $5000 annually at the junior and senior level.

Affective as of July 1, 2008, all students are eligible to borrow an additional $2000 under the unsubsidized program regardless of dependency.

FEDERAL DIRECT PARENT LOAN (PLUS)

Parents may borrow up to the full cost of attendance for each financially dependent student. A Free Application for Federal Student Aid (FAFSA) is required. Standard repayment begins within 60 days of receiving the final disbursement for the loan period. Deferment options are available so that repayment can be postponed until student graduates, withdraws or drops below half-time enrollment. Interest will accrue while in deferment. Parents must contact Direct Lending if they wish to defer.

Other Resources

Students should contact the Office of Financial Aid for information concerning financial aid programs available, the companies that sponsor them and the necessary application procedures.

PAYMENT PLANS

MONTHLY PAYMENT PLAN

A monthly payment plan spreads annual tuition charges over 10 months, beginning in July and ending in April. The monthly payment plan is interest-free, regardless of the balance, with a one-time enrollment fee accessed at the beginning of the plan. Monthly payment plans are also available on a semester basis.

DEFERRED-PAYMENT PLAN

Students who submit written proof of eligibility for tuition reimbursement from their employers will be allowed to defer payment until the end of the semester. Eligibility is contingent upon the signing of a promissory note, with a one-time enrollment fee accessed at the beginning of each semester. A valid credit card is required and will be billed if the company reimbursement is not received by the required deadline after the term.

THIRD-PARTY PAYMENT

Students receiving sponsorship from government agencies, employers or other organizations must provide the Institute with proof of coverage and permission to bill a third party. Students are required to pay or arrange for payment of any uncovered portion of the bill. Sponsorships are arranged between the student and a third party; students are responsible for NYU-Poly debt if the third party fails to pay.

Other Opportunities

Several scholarship programs, usually directed by local and civic organizations, are not based on need. High school guidance offices and the Internet are the best sources of information. Also, parents' places of employment sometimes sponsor programs for employees' children. These employer benefits are often full- or half-time tuition and sometimes based on merit or need.

IMPORTANT FINANCIAL AID POLICIES

- To be eligible for financial aid, students must enroll at least half-time per semester. However, all TAP grants and NYU-Poly scholarships and grants require full-time enrollment to qualify.
- Financial aid applicants (including Federal Direct Loan applicants) must apply for a Pell Grant and, in the case of New York residents, for TAP. NYU-Poly scholarships and grants, combined with Pell Grant and TAP awards, may not exceed tuition.
- Prospective students should not wait until their admission to apply for financial aid. These are concurrent processes. Applicants should make every effort to apply for admission and financial aid by the preferred application dates. Once students are admitted, they are reviewed for financial aid.
- Financial aid is renewable annually, based on the student's reapplication, continued demonstration of financial need where applicable and fulfillment of other requirements stipulated by the awards.
- Standards of achievement for scholarship maintenance are established each semester. Students who fall below the established criteria may appeal for a one-time grace period to restore their GPA. If they are unsuccessful, the scholarship is revoked. It will be reinstated when the student is again successful. Scholarships cannot be received retroactively. Scholarships can be renewed for eight semesters and are not available for summer terms.
- Since financial aid and scholarship funds administered by NYU-Poly are limited, students should be aware that it is unwise to enroll at NYU-Poly without financial aid support. They should not assume that financial aid will be available from NYU-Poly at a later date. Given the fixed amount of resources, NYU-Poly deems it unethical to withdraw support from students who have based attendance at NYU-Poly on the financial aid awarded them in order to release funds to assist new applicants. Funds from financial aid programs not administered by NYU-Poly, such as Pell Grants, TAP and the Direct Loan Program, are available to eligible students.
- Grants of Title IV Aid (Pell Grants, Supplemental Educational Opportunity Grant, College Work Study, Perkins Loan and Stafford Loan) are contingent upon provision of the following documents:

1. Properly signed Financial Aid Acceptance
2. Copies of students' and/or parents' IRS Form 1040 or 1040A/EZ, if requested
3. Proof of citizenship or permanent residency status, if requested
4. Selective Service Registration for males - born after 1960
5. Other requested documents

SATISFACTORY ACADEMIC PROGRESS

Students must meet the satisfactory academic progress requirements to qualify for all federal and institutional financial aid. Satisfactory academic progress has two-fold criteria. Students must have a certain cumulative grade point average (GPA) and must pass a certain percentage of the total credits they have attempted. Satisfactory academic progress requirements are listed online at www.poly.edu/financial-aid/sap.

A student who is not making satisfactory academic progress may request a one-time waiver of these requirements. Waivers are granted only in cases where the student has demonstrated that the academic progress criteria were not met due to extraordinary circumstances occurring in the student's life, generally beyond his/her control.

IMPACT OF WITHDRAWAL ON FINANCIAL AID

Students who receive Title IV federal aid and withdraw from all coursed prior to completing 60% of the term will have their aid pro-rated according to the Federal Return to Title Four (R2T4) calculation.

In accordance with federal regulations, students who withdraw from NYU-Poly and have credited to their tuition account Federal Title IV financial assistance (Direct Loans, Pell, SEOG, or Perkins Loans) will be subject to the Federal Refund Policy on the possible return of funds awarded.

The amount of the semester's unearned Federal Aid must be returned to its source. The amounts to be returned are based on the federal R2T4 calculation. When returning Title IV funds federally mandated priority listing will be used:

1. Federal Direct Unsubsidized Loan
2. Federal Direct Subsidized Loan
3. Perkins Loan
4. Federal Direct Parent Loan
5. Pell Grant
6. ACG
7. SMART Grant

If a student has an account balance resulting from these adjustments, the student is responsible for payment.

GRADUATE FINANCIAL AID

GRADUATE FELLOWSHIPS

Fellowships are available for study leading to master's and PhD degrees in engineering and science. They are awarded through the department in which applicants are enrolled, or to which they have applied. Entering students apply for a fellowship by completing the question on the Application for Graduate Admission form. Continuing students should consult their academic department.

RESEARCH FELLOWSHIPS

Students receiving research fellowships are assigned to research that fulfills the thesis requirement of the graduate curriculum in which they matriculate. They receive a living allowance and remitted tuition. Fellows must be registered as full-time students taking each semester nine or more credits, possibly including their thesis. Typically, funding comes from grants and contracts that faculty have secured from government agencies or industry. In these cases, the student's research is also reported to the funding agency or company as part of the grant or contract requirements.

INSTITUTE SCHOLARS

Institute scholars participate half time throughout the academic year in assignments from the department in which they matriculate. They receive a living allowance and up to 12 credits of tuition scholarship. Scholars must be registered as full-time students taking nine or more credits per semester, which may include their thesis. Students working toward a PhD must also complete the thesis requirement of the department and Institute.

SPECIAL FELLOWSHIPS

Individual departments administer special fellowships sponsored by industry and foundations, each with its own conditions, for students in the department. Contact departmental offices for information on special fellowships.

REDUCED TUITION PROGRAM FOR HIGH SCHOOL AND TWO-YEAR COMMUNITY COLLEGE TEACHERS

A reduced tuition program is offered for full-time high school and two-year community college teachers to encourage their pursuit of graduate studies at NYU-Poly. The program provides a 50% tuition reduction for graduate courses taken at any campus. Degree candidates and special students are eligible.

Prospective students must submit to the Office of Graduate Admissions written verification of employment as a full-time high school or college teacher, signed by the department head and an officer of the applicant's institution. Substitute, part-time, adjunct or temporary appointments are not valid. Only those holding full-time, permanent teaching appointments in a public or private secondary school or accredited two-year community college located in the New York metropolitan area are eligible to participate in this program.

This policy is not retroactive, and students may not participate in more than one tuition-reduction or remission program. This policy is subject to annual review.

WILLIAM D. FORM FEDERAL DIRECT SUBSIDIZED LOAN

Graduate Students may apply for a Federal Direct Subsidized Loan of up to $8,500 per academic year. Eligible students must (1) be U.S. Citizens or permanent residents, (2) enroll at least half-time per semester, (3) be matriculated, (4) make satisfactory academic progress and (5) demonstrate financial need. All applicants must complete a Free Application for Federal Student Aid (FAFSA) to determine need. All interest and principle payments are deferred as long as the student is enrolled for at least six credits per semester. Repayment begins six months after graduating, withdrawal or dropping to less than half time. Contact the Student Financial Services Office regarding interest rates and application process.

WILLIAM D. FORM FEDERAL DIRECT UNSUBSIDIZED LOAN

The Federal Direct Unsubsidized loan is open to students who do not qualify for the above subsidized loan. In addition, all graduate students may borrow up to an additional $12,000 annually. (Total amount of up to $20,500 may be borrowed per academic year.) The same terms and conditions as above apply with the exception that the borrower is responsible for interest that accrues while enrolled in school and during the six month grace period. Contact Student Financial Services regarding interest rates and application process.

GRADUATE FEDERAL DIRECT PLUS LOAN

Graduate students whose full cost of attendance is not covered by the William D. Ford Direct Loans may apply for the Graduate Direct PLUS loan. Students may apply for up to the full cost of attendance minus any financial aid. A FAFSA is required and the Direct Loans must be utilized before applying for the PLUS loan. The loan is not guaranteed and is subject to credit approval. Repayment can be deferred until graduation or withdrawal. Contact the Student Financial Services Office regarding interest rates and application process.

INSTITUTE COMPLIANCE AND OTHER GUIDELINES

POLYTECHNIC INSTITUTE OF NYU CODE OF CONDUCT

The Polytechnic Institute of NYU Code of Conduct, edited and administered by the Department of Student Development, notifies the NYU-Poly community of prohibited behavior and outlines the procedures to be followed in the event of a breach of the Code. This code is dedicated to protecting and promoting the academic enterprise and is indispensable in maintaining an academic environment conducive to teaching, learning and the development of individuals.

The complete Institute Code of Conduct is available to students and all members of the NYU-Poly community at www.poly.edu/academics/code-of-conduct. For further information, contact the Department of Student Development at (718) 260-3800 or visit Room 158 in the Jacobs Building.

INSTITUTE POLICY ON ACADEMIC DISHONESTY

All members of the community are expected to exhibit honesty, integrity and fairness in their academic work and interaction with others. The entire community shares the responsibility to secure and respect general conditions conducive to academic honesty. Individual academic departments may develop and publicize supplemental guidelines, in conformity with Institute policies, for academic competence and honesty appropriate to their fields of study. Academic dishonesty is treated as a moral and intellectual offense against the academic community and is not tolerated. Students are responsible for reading and familiarizing themselves with the Institute Policy on Academic Dishonesty. All members of the community are responsible for familiarizing themselves with the Institute's academic procedures, for preventing acts of academic dishonesty and for taking steps to prevent such acts from recurring.

Every student is expected to be familiar with, and abide by, the Institute Policy on Academic Dishonesty. The full policy is located at www.poly.edu/academics/code-of-conduct/academic-dishonesty.

THE POLYTECHNIC INSTITUTE OF NYU ANTI-HARASSMENT POLICY FOR EMPLOYEES AND STUDENTS

The Polytechnic Institute of NYU is committed to a work and learning environment in which all individuals are treated with respect and dignity. Each individual has the right to work and learn in a professional atmosphere that promotes equal employment and academic opportunities and prohibits discriminatory practices, including harassment. Therefore, NYU-Poly expects that all relationships among persons at the Institute (in the workplace and in the classroom) will be business-like and free of bias, prejudice and harassment.

For the complete Institute Anti-Harassment Policy for Employees and Students, please visit the NYU-Poly web site at www.poly.edu/academics/code-of-conduct/anti-harassment.

FAMILY EDUCATIONAL RIGHTS AND PRIVACY ACT (FERPA)

The Family Educational Rights and Privacy Act (FERPA) (20 U.S.C. § 1232g; 34 CFR Part 99) is a federal law that protects the privacy of student-education records. The law applies to all schools that receive funds under an applicable program of the U.S. Department of Education.

The procedures used by Polytechnic Institute of NYU to comply with the Family Educational Rights and Privacy Act (FERPA), also known as the Buckley Amendment are detailed below. Under FERPA, NYU-Poly students have certain rights regarding their education records. A student is defined as any individual who is or has been in attendance at NYU-Poly and regarding whom NYU-Poly maintains education records.

These rights include:

- The right to inspect and review the student's education records within 45 days of the day the Institute receives a written request for access. Students should submit the request to the Office of the Registrar that identifies the record to be inspected. The Institute official will arrange access and notify the student about when and where records may be inspected. If the records are not maintained by the Institute official to whom the request was submitted, that official shall advise the student of the correct official to whom the request should be addressed. The Institute has the right to prohibit students from reviewing and inspecting education records that include the financial records of their parents, as well as those records consisting of confidential letters and recommendation about their admission to the Institute, their application for employment or their receipt of an honor or honorary recognition.
- The right to request the amendment of education records that the student believes is inaccurate, misleading or in violation of his/her right to privacy. Students may ask the Institute to amend a record that they believe is inaccurate. They should write the Institute official responsible for the record, clearly identify the part of the record they want changed and specify why it is inaccurate. If the Institute is in agreement with the student's request to amend his/her record, the record in question will be amended accordingly and the student will be informed of the amendment in writing. If the Institute decides not to amend the record as requested by the student, the Institute will notify the student of the decision and advise the student of his/her right to a hearing on the request for amendment. Additional information about the hearing procedures will be provided to the student when notified of the right to a hearing.
- The right to consent to disclosures of personally identifiable information contained in the student's education records, except to the extent that FERPA authorizes the Institute to disclosure without the student's consent. Consent to disclosures of personally identifiable information must be done by the student in a written request to the Registrar's Office.
- The right to file a complaint with the U.S. Department of Education concerning alleged failures by the Institute to comply with the requirements of FERPA.
- Release of Information: Polytechnic must have written permission from the student to release any personally identifiable information from his/her education records. In addition, the Institute may disclose personally identifiable information, without consent, to the following parties or under the following conditions (34 CFR § 99.31):
  - School officials with legitimate educa tional interest in such information to

fulfill their professional responsibility. (A school official is a person employed by the Institute in an administrative, supervisory, academic or research, or support staff position [including law enforcement unit personnel and health staff]; a person or company with whom the Institute has contracted [such as an attorney, auditor or collection agent]; a person serving on the Board of Trustees; or a student serving on an official com mittee, such as a disciplinary or grievance committee, or assisting another school official in performing his or her tasks.)
- Other schools to which a student seeks enrollment
- Where disclosure is to certain federal, state and local authorities
- Where disclosure is in connection with financial aid for which the student has applied or received.
- Where disclosure is in connection with studies being conducted for or on behalf of the Institute.
- Where disclosure is made to accrediting organizations
- To comply with a judicial order or lawful subpoena
- Appropriate officials in cases of health and safety emergencies
- Information designated as "directory information"
- Where the information disclosed is the final results of a disciplinary hearing, and the disclosure is made to an alleged victim of a crime of violence or non-forcible sex offense.
- To parents or legal guardians regarding a violation of any federal, state, local law or Institute policy governing the use or possession of alcohol or a controlled substance if a student is under the age of 21 and if the Institute deter mines that the student has committed such violation.

FERPA permits the release of directory information to third parties outside Polytechnic without prior written consent, provided that students have received the opportunity to withhold such disclosure. Polytechnic reserves the right to disclose the following directory information related to a student without consent:
- Student's name
- Class year
- Major field of study, as well as similar information (e.g., title of master's or doctoral dissertation, distinguished academic performance)
- Participation in recognized activities and sports
- Dates of attendance and enrollment status (full-time, half-time or part-time) at NYU-Poly
- Degrees, honors

For more information on student rights regarding their education records, release of information, parental disclosure and directory information, please see the complete Institute Policy Regarding FERPA at www.poly.edu/academics/code-of-conduct/ferpa.

For questions about FERPA and an individual's rights as a student at Polytechnic Institute of NYU, please contact the Office of the Registrar.

INFORMATION TECHNOLOGY AND ELECTRONIC RESOURCES ACCEPTABLE USE POLICY

Information technology systems and electronic resources are provided with the understanding that the members of the Polytechnic community will use them with a sense of compliance/adherence to all applicable laws and regulations, mutual respect, cooperation and collaboration. These resources are finite, and must be shared with an understanding that with any established interconnection of electronic resources, the effect of one individual can have a dramatic effect on others within the network. As such, the use of the Polytechnic Institute of NYU network and electronic resources is a revocable privilege. All constituents will benefit if all users of the NYU-Poly electronic systems avoid any activities which cause problems for other users of the same systems. NYU-Poly reserves the right to monitor, limit and restrict electronic messages, network/systems traffic and the public or private information stored on computers owned, maintained, or managed by NYU-Poly. Computers not owned, maintained, or managed by NYU-Poly staff that abuse campus services may be denied access to campus resources. Email/voice mail, web pages, electronic data and digital content are subject to archiving, monitoring, or review, and/or disclosure by others than the intended recipient.

To that end, Polytechnic Institute of NYU expects that all individuals including, but not limited to, Institution students, faculty, and staff, using its electronic resources will abide by the Acceptable Use Policy found at www.poly.edu/academics/code-of-conduct/it-acceptable-use.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

Polytechnic Institute of NYU supports Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act. The Institute makes every effort to provide full and barrier-free program accessibility. The Institute also does not discriminate in its admissions practices and bases acceptance primarily on academic records.

NYU-Poly is committed to assisting students with disabilities in developing the personal and academic skills necessary to participate fully in student programs. To that end, the Institute provides services to students with disabilities based on individual needs. The Institute is particularly interested in helping these students to become effective self-advocates.

Accommodations for students with disabilities do not include the waiving of academic course requirements.

Although not every student with a disability requires accommodations, registering with the Department of Student Development is advised. More information regarding accommodations is available at www.poly.edu/disabilities.

ALCOHOL AND DRUGS

NYU-Poly, in compliance with New York State law, prohibits the unlawful possession, manufacture, use or distribution of alcohol and illicit drugs on its property or as part of any of its activities, unless otherwise noted. Violations of this policy will result in disciplinary actions under the Institute Code of Conduct. Furthermore, NYU-Poly will not protect those who violate these laws, nor will it interfere with law-enforcement agencies that pursue violators of these laws.

All student organizations or groups wishing to hold events where alcohol is served must obtain permission from the Dean of Student Affairs or designee, who will be solely responsible for making that decision and applying conditions and obligations for the event.

HEALTH AND ACCIDENT INSURANCE

NYU-Poly is concerned about student health and seeks to protect students against the high cost of medical care. Many students and their parents are unable to afford the added expense of an unexpected injury or sickness. To ensure all students are covered, the Institute requires that all students with 9 or more credits, or those who are considered full-time students, carry health insurance. If students do not have their own coverage, the Institute offers a plan to provide necessary health insurance. Part-time students also may enroll in accident and sickness coverage. To ensure that part-time students are covered at the start of the semester, they must complete the online enrollment information and mail the confirmation statement to the Institute's insurance broker. The broker will process the application and issue insurance cards.

Even students with private insurance plans may want to consider supplementing those plans, as many policies exclude or limit coverage. However, domestic students with comparable coverage may elect to waive the Institute-provided insurance plan by the designated deadlines. To do so, they need to provide information on current coverage to the insurance broker to ensure coverage is comparable.

Domestic students may waive out of the plan if they have comparable private insurance; NYU-Poly's carrier will review student waivers (applying for a waiver does not automatically waive someone out of the plan). The insurance carrier will contact students about any questions regarding a waiver. If students do not waive by the designated deadlines, they will be responsible for the fee.

All international students are required to be enrolled in the Institute-sponsored plan as part of their enrollment at NYU-Poly. They must complete insurance enrollment by the designated deadlines.

In addition, all full-time students (graduate and undergraduate) are covered by accident insurance.

IMMUNIZATION

New York State law requires students to show proof of immunity to measles, mumps and rubella. NYU-Poly complies fully with the provisions of this law. The law applies to all students (graduate and undergraduate) born on or after January 1, 1957.

Immunization status is checked as part of registration for new students. New first-year, transfer and graduate students who fail to comply (1) are barred from attending class (and are not entitled to any tuition refund); (2) do not receive grades; and (3) are denied further registration.

For forms or more information on this requirement, or to submit the required proof, please contact the Office of Undergraduate Admissions or the Graduate Center.

GUIDELINES ON STUDENT RELIGIOUS OBSERVANCES

The faculty of the Polytechnic Institute of NYU has adopted the following guidelines on student religious observances, as recommended by the Commission on Independent Colleges and Universities. The intent of these guidelines is to encourage independent colleges and universities to reasonably accommodate individual students' religious obligations and practices without penalty.

- Students will not be expelled or refused admission to the Institute if they are unable to participate in any examination, study or work requirement because of their religious obligations and practices.
- Students who are absent from school because of their religious obligations and practices will be given an opportunity to make up any examination, study or work requirement that was missed because of such absence.
- Students must notify their instructors and Student Development in writing, no later than the 15th day after the first day of the semester, that they will be absent from a class scheduled on a day that conflicts with their religious obligations and practices.
- In effecting these provisions, NYU-Poly's administration and faculty agree to exercise the fullest measure of good faith, and agree that students who follow these guidelines on religious observances will suffer no adverse or prejudicial effects.

STUDENT IDENTIFICATION

All students are required to carry and maintain at all times photo-identification cards issued by the Office of Facilities Management. ID cards must be presented and/or surrendered to any official of the Institute upon request.

The Institute uses a student ID number to identify a student's records (grades, accounts, etc.) from the time of the admission application process through the completion of his or her degree. This number is computer generated and used solely by NYU-Poly.

INTERNATIONAL STUDENTS AND SCHOLARS

Graduate and undergraduate international students come from more than 60 countries, make up 40 percent of the student body and are an integral part of the NYU Poly community. All new international students and visiting scholars (researchers and faculty) are required to report with immigration documents, including I-20s, DS-2019s and passports, to the Office of International Students and Scholars (OISS) immediately upon arrival. In addition, all new students and scholars must attend a mandatory orientation held at the start of every semester.

The office provides information and counseling regarding immigration compliance, travel, employment, acculturation, housing, health insurance and special events. International students, researchers and faculty may contact the office in person or by telephone, and are encouraged to attend on-site workshops offered at designated times during the academic year. All international students, research scholars and faculty are required to carry health insurance.

For additional information on admissions and academic requirements, please consult those sections dealing with undergraduate and graduate admissions and academic programs and policies.

STUDY ABROAD

The opportunity to study abroad provides students a chance to experience life in countries rich in history, culture and accomplishment. Immersion experience in another culture strengthens understanding of the world and appreciation of international contribution to knowledge. It offers an opportunity to learn how to cope in international environment and communicate across barriers of language, custom, geography and politics. Skills developed during this experience add an invaluable dimension to the quality of a well-rounded education that ultimately enhances professional and personal endeavors in the developing global community.

Students may apply for short-term study, a semester, or a full academic year abroad. Students may select from one of 50 institutions around the world with which Polytechnic has direct-exchange agreements, as well as NYU Study Abroad sites.

Participation in the study-abroad program is open to undergraduate and graduate students. Undergraduate students are eligible after one year of academic study so long as they maintain a 2.5 GPA. While these are the minimum Polytechnic requirements to participate in the program, host institutions will make their own determinations about admissibility.

Academic credits earned during study abroad are transferable to Polytechnic and may be applied to degree requirements subject to institute policies and the approval of the student's major department. For additional information contact OISS.

PROGRAMS AND SERVICES FOR FIRST-YEAR STUDENTS

FRESHMAN PROGRAMS

The Institute is committed to improving the persistence and performance of first-year students by helping them to acclimate to their intended academic discipline, its associative culture and student life at Polytechnic. Achieving this goal requires diverse and dynamic collaborative efforts with constituencies across the campus community. These systemic partnerships yield a greater sense of cohesion to the programs and services for first-year students.

Programs and services in this area include first-year advisement, faculty-student mentoring, early alert and academic probation initiatives, first-year instructors meetings and parent outreach.

ACADEMIC ADVISEMENT CENTER

The mission of the Academic Advisement Center (AAC) is to provide centralized advising for incoming, matriculated first-year students. The staff advises students on major requirements and Institute regulations and refers them to campus resources. In addition, academic advisers advocate for students with Polytechnic offices and help students deal with issues. The ultimate goal of the AAC is to empower students to make informed decisions about their academic careers.

FACULTY-STUDENT MENTORING

The purpose of the mentoring program is to provide first-year students with the academic capital needed to acclimate to the academic community, their intended major and future profession. Early and continuing contact with faculty allows students to form mutually beneficial relationships with faculty members during their first year of college. Understanding how to partner with faculty members is a skill that benefits students throughout their academic careers.

Benefits of the mentoring program for first-year students extend beyond connecting with faculty members at an earlier stage in their academic career.

Additional benefits include:

- Increased likelihood of persisting beyond the first year;
- Increased understanding of the intended major;
- Increased satisfaction with the college experience; and
- Improved communication and interpersonal skills.

Benefits experienced by the faculty include:

- Deeper understanding of the collective and individual concerns of first-year students;
- Increased visibility among the first-year students; and
- Improved access to and contact with students outside the classroom.

EARLY ALERT AND ACADEMIC PROBATION

Each semester requests are sent to first-year instructors asking for feedback on their students' academic progress. Students at risk of not passing their course(s), based on their current progress, are notified of their academic status and encouraged to meet with their instructor(s) and academic adviser to remedy the situation. At these meetings, students have the opportunity to think critically about the behaviors contributing to their status, while being invited to take advantage of the various support services to help them maximize their academic experiences.

All first-year, first-time probationary students must register for and pass SL 1020 Academic Skills Seminar. The course consists of eight one-hour sessions, which meet once a week, and is taught on a pass/fail basis. The seminar helps students learn to become more academically successful. The "Academic Probation" section of the catalog contains more information about this course.

FIRST-YEAR INSTRUCTORS

A meeting is held once a semester with a cross-section of the instructors teaching first-year courses and staff members from the academic support offices. These meetings inform participants of recent curriculum and instructional changes, academic policy updates and any modifications to the cadre of services offered by the academic support programs. In addition, these meetings act as a "pulse check" of the issues first-year students are encountering and how these challenges are expressed in academic and communal parts of the Institute.

PARENT OUTREACH

Educating parents on the academic experiences of first-year students is a critical step in forming an effective partnership between the Institute and family members. Parents Meetings are hosted each semester, providing family members with an opportunity to speak directly with faculty, administrators and students about the majors and support services available to students.

NEW STUDENT ORIENTATION

Polytechnic seeks to ease new students' transition to their new educational environment with a variety of programs that orient and welcome new students every semester. These programs are housed under the New Student Orientation (NSO) umbrella, and are a result of the collaborative efforts between Student and Academic Affairs. NSO programming covers a broad array of topics that not only help students gain a better understanding of student life in academic and social spaces, but also signals to the Institute the arrival of the newest members to the community.

REGISTRATION

During registration, students meet with their academic adviser who gives them academic advisement and approves their choice of courses. Students then register themselves online via Student Self-Service and pay tuition and fees to the Office of Student Accounts, all according to published deadlines. To receive academic credit, students are required to register each semester for every course, including theses, projects and guided studies. Class attendance without registration is not permitted.

ADVISEMENT FOR REGISTRATION

The academic advising process is the basis for student course selection and registration. Each academic department identifies faculty or professionals who serve as advisers to the students. Before registration, students must meet with their adviser and receive approval for their anticipated program of study. Students may obtain a list of advisers and their contact information from their respective departmental offices.

To ensure that students have met with their academic advisers before registration, the Registrar places an "academic hold" on the student's record. When students meet with their advisers, the holds are removed and students can register.

Approval to register for a course does not necessarily constitute approval to substitute that course for another course to satisfy a specific degree requirement. For example, approval to register for a guided readings course is not necessarily approval to substitute that course for another similar course prescribed in the curriculum. If the course is not normally used for that purpose, students should explicitly request such approval from the adviser. Such approval must be granted in writing and submitted to the Office of the Registrar.

Incoming first-year students may be required to take a mathematics diagnostic and/or English placement exam. These exams are free and used solely for advisement and course placement.

REGISTERING FOR CLASSES

Polytechnic offers two registration periods for each semester (detailed below). New freshmen entering in the fall semester register during the summer preceding their arrival on campus. New students and special students receive registration information from the Office of Undergraduate Admissions or the Graduate Center.

REGULAR REGISTRATION

All continuing, degree-seeking students (graduate and undergraduate) are expected to register for the next semester during the latter part of each ongoing semester. All students must take advantage of regular registration using Student Self-Service, the student online registration system. All students are encouraged to enroll early in the registration period to avoid being closed out of required courses. Registration dates for each semester are published by the Office of the Registrar. Payment of tuition and fees, or arrangement for payment, is due to the Office of Student Accounts no later than the published deadline.

LATE REGISTRATION AND ADD/DROP

The Late Registration and Add/Drop period begins on the first day of the term and ends on the published Add/Drop Deadline. A late fee is assessed to all continuing students who initially register during this period. Since Late Registration typically takes place after the tuition payment deadline, payment of tuition and fees is therefore due on the same day as registration during the Late Registration period. Students who do not complete registration by the end of the Late Registration and Add/Drop period will not be registered for that semester. After the Add/Drop Deadline, students seeking to register need to obtain special permission from the respective Associate Provost in addition to the course instructor(s). Such exceptions are rarely permitted, and must be submitted to the Office of the Registrar with the appropriate paperwork and signature approvals. A late fee will be assessed to all continuing and readmitted students for late registrations.

Additions or deletions to a student course schedule may be made according to the deadlines published in the Academic Calendar. These adjustments should be made online through Student Self-Service. A course dropped after the Add/Drop deadline is considered a Withdrawal, and such courses will remain on the student's transcript with a grade of "W" (which has no GPA penalty). Withdrawals should also be processed by the student online via Student Self-Service.

If a student drops or withdraws from a course, tuition charges are adjusted according to the Refund/Tuition Liability schedule published by Student Accounts.

RESIDENCE LIFE

A residence-life program is an integral part of college life and can greatly enhance students' college experience. Resident students become members of a supportive peer community in an academic environment that offers opportunities to fully develop academically and socially. Residence life helps students develop personal responsibility as it supports them in meeting their academic goals. The Polytechnic Institute of NYU is committed to providing safe and affordable housing for students interested in a residence-life experience.

Campus housing is available for all students. NYU-Poly does not provide housing for students' families. Inquiries about campus housing should be made to the Office of Residence Life at (718) 260-4160.

CAMPUS HOUSING FACILITY

On the Brooklyn campus, the Donald F. and Mildred Topp Othmer Residence Hall is a 20-story building that houses more than 400 students in two-bedroom suites and two-bedroom apartments with kitchenettes. Each room has Internet and cable TV ports. This innovative building is wireless and includes student lounges, study rooms, laundry facilities, outdoor space and 24-hour security. Two full-time professional residence-life staff members work with graduate and undergraduate student resident assistants and security personnel.

The Clark Residence is connected to the St. George Residence - Weller Building and Studio Building - and occupies the site of the former St. George Hotel in one of New York City's most desirable neighborhoods, Brooklyn Heights. Just one subway stop from lower Manhattan, the Clark Residence is within walking distance to NYU-Poly's MetroTech campus, shopping, dining on Montague Street and a short walk to the Brooklyn Promenade, home to breathtaking views of the Manhattan skyline.

Each single, double and triple fully-furnished room in the Clark Residence offers a TV, DVD player, high-speed internet, refrigerator, microwave and bathroom. The residence features lounges, a pool table, public computers, communal kitchens and a complimentary membership to the four-star Eastern Athletic Club.

CAMPUS HOUSING REQUIREMENTS

All students living on-campus are required to be full-time NYU-Poly students and Othmer residents are required to be on the Institute meal plan. For security purposes, all resident students are mandated to have a cell phone and sign-up for the Emergency Text Alert system (E2campus).

STATISTICS ON ENROLLMENT AND THE STUDENT BODY

ENROLLMENT 2010-2011

FALL 2010

	Undergraduate			Graduate			Total
	FT	PT	TOT	FT	PT	TOT	
Brooklyn	1695	73	1768	1503	854	2357	4125
Long Island	—	—	—	16	119	135	135
Westchester	—	—	—	11	83	94	94
Broad Street	—	—	—	52	26	78	78
Total	**1695**	**73**	**1768**	**1582**	**1082**	**2664**	**4432**

STUDENT BODY

FALL 2010

	Undergraduate		Graduate	
	Men	Women	Men	Women
Brooklyn	1424	344	1709	648
Long Island	—	—	116	19
Westchester	—	—	81	13
Broad Street	—	—	55	23
Total	**1424**	**344**	**1961**	**703**

STUDENT RETENTION

As required by the New York State Education Department Higher Education Data System, Polytechnic conducts a yearly cohort survival analysis. This study collects data for a group or cohort of first-time, full-time freshmen (students who never attended college before) who enter Polytechnic. The data measures retention patterns and indicates the time needed to complete undergraduate degrees at Polytechnic. For a cohort study of first-time full-time students who entered Polytechnic as freshmen in fall 2004, 38 percent received their Bachelor of Science degree within four years, 52 percent graduated in five years and 55 percent completed their degree within six years.

PERSISTENCE AND COMPLETION INFORMATION

First-time full-time undergraduate students continuing at the Institute, 2009-2010 to 2010-2011:

Institute-wide:	86%

ENROLLMENT BY RACIAL/ETHNIC STATUS (USING STANDARD FEDERAL CLASSIFICATIONS)

	Undergraduate Students	Graduate Students
Asian, Pacific Islander	31.4%	9%
Caucasian	27.4%	14.8%
Black, non-Hispanic	9%	4.8%
Hispanic	12%	2.7%
Native American	0.2%	0%
International*	10.7%	55%
Unknown	9.3%	13.7%

**International students come from more than 57 countries.*

STUDENT DEVELOPMENT: ACTIVITIES, ADVOCACY, LEADERSHIP

DEPARTMENT OF STUDENT DEVELOPMENT

The Department of Student Development is a part of the Division of Student Affairs and is concerned with the holistic education and development of all Polytechnic students, inside and outside the classroom. The department helps students to assemble their educational, personal and professional development puzzle—from orientation to commencement. Student Development provides a variety of programs and support that enhance the first-year student transition, develop student leadership excellence, promote campus community citizenship, foster campus-wide diversity awareness and provide general student advocacy.

NEW STUDENT PROGRAMS

NYU-Poly seeks to ease the transition for students into their new environment with a variety of programs designed to orient and welcome new students. These programs are generally held before the fall and spring semesters.

New Student Orientation (NSO)

Orientation is designed with a variety of offices throughout the Institute and student Orientation Leaders to welcome all new students to the Polytechnic community and to introduce them to the various campus offices, programs and resources that lead to student success.

New Student Orientation introduces new students to the NYU-Poly community and offers opportunities for incoming first-year and transfer students to complete their enrollment activities well before classes begin. Students will receive the information and tools needed to successfully acclimate to the NYU-Poly environment and become an active member of the academic community. Orientation programs are designed around the objectives of familiarizing students with their intended major; increasing understanding of the first-year curriculum and its connection to the academic discipline; and familiarizing new students with critical on-campus first-year support networks.

The overall goal is to create a sense of excitement and enthusiasm around the students' majors, while demystifying preconceived notions about majors and college life. The program is coordinated by a team of administrators, faculty and students who welcome new students to the NYU-Poly community.

New Student Convocation

New Student Convocation is the first major academic program new students experience as members of the Polytechnic community. At convocation, new students are inducted into the NYU-Poly academic community and pledge to abide by the Institute Code of Conduct, refrain from academic dishonesty, respect intellectual property, participate actively in their education and uphold the exemplary reputation of the NYU-Poly alumni.

New Student Camp Experience (NSCE)

All new first-year and transfer students are invited to attend an overnight trip to a campsite in upstate New York. The New Student Camp Experience (NSCE) is offered during the week before classes begin and helps new students make friends, become comfortable with their new classmates and meet some key administrators and student leaders who will be vital to their success at NYU-Poly. The NSCE is considered one of the most memorable highlights of the NYU-Poly experience.

SERVICES FOR STUDENTS WITH DISABILITIES

Polytechnic Institute of NYU supports Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act. In this regard, it makes every effort to provide full and barrier-free program accessibility.

NYU-Poly is committed to assisting students with disabilities in developing the personal and academic skills necessary to participate fully in student programs. To that end, services are provided to students with disabilities based on individual needs. The Institute is particularly interested in helping students to become effective self-advocates.

Accommodations for students with disabilities do not include the waiving of academic course requirements.

Students with disabilities are encouraged to register with the Department of Student Development whether or not services are requested. If necessary, students can request services by meeting with Student Development staff and submitting supporting documentation. Visit the NYU-Poly web site at www.poly.edu/disabilities for more details.

STUDENT ACTIVITIES AND LEADERSHIP DEVELOPMENT

Student activities are an integral part of the educational process. Participation in student activities fosters the development of leadership and interpersonal skills. NYU-Poly believes that student activities broaden the academic experience. The Institute encourages every student to take part actively in co- and extracurricular student activities, which promote and produce a balanced educational experience. The NYU-Poly website offers updated information on participation in NYU-sponsored activities and services.

STUDENT COUNCIL

The Student Council is the undergraduate student voice and governing body at NYU-Poly. The Council is the umbrella organization for all student clubs and organizations. It is responsible for administering student activities fees, social and cultural programming and other co- and extracurricular activities.

STUDENT CLUBS, ORGANIZATIONS AND FRATERNITIES

There are more than 45 student organizations, honors societies and fraternities at NYU-Poly. Each group is responsible for fulfilling the purposes of the organization as set forth in its constitution, charter or business plan. Student organization documents are filed with the Office of Student Activities and the Student Council. New groups and organizations can be created by complying with the procedures set by the Student Council. The Student Council and Department of Student Development publish a list of student organizations at the beginning of each academic year.

Professional and technical societies are established in conjunction with various academic departments to enhance the curricula at NYU-Poly. These student chapters are branches of national parent organizations. In chapter meetings, members hear distinguished guest speakers, plan field trips, read professional papers and work on technical projects. As a part of the clubs and organization framework under the auspices of the Student Council, these chapters are

funded, in part, by student activities fees.

NYU-Poly has student organizations to suit almost every interest, whether social, intellectual, religious, musical, cultural or athletic. Many of the organizations have long and distinguished histories.

NYU-Poly has four social and service fraternities. These organizations hold an impressive array of social functions for their members and serve the NYU-Poly community through blood donation drives, annual charity drives, athletic tournaments, parties and more.

For a listing of current student clubs and organizations and fraternities, visit www.poly.edu/life/clubs/student.

ORIENTATION LEADER PROGRAM

The Orientation Leader Program is comprised of upper-level, enthusiastic student volunteers who want to share their love of NYU-Poly with new students. Orientation Leaders (OLs) are selected during the spring semester and train to run new student orientation programs (include the New Student Camp Experience—NSCE). More information about the OL Program can be found at www.poly.edu/life/student/leadership.

PEER COUNSELOR PROGRAM

The Peer Counselor Team is a group of upper-level students who assist first-year students in making the transition from high school to college. The program includes extensive leadership training during summer months with in-service training throughout the academic year. The Peer Counselor interview and selection process occurs early each spring semester for the following academic year. More information about the Peer Counselor Program can be found at www.poly.edu/peer-counselors.

Other Programs

The Student Development also coordinates or assists with other programs such as health fairs, graduation fairs, the annual Poly Pride Day celebration, Commencement and the Commencement and Achievement Awards Ceremony.

STUDENT ADVOCACY

The Department of Student Development plays a vital role in supporting and encouraging students who are faced with challenging situations during their student careers. It is one of several places where students can get confidential help. As student advocates, the staff of the Department of Student Development works with various other offices to help students solve problems and develop self-advocacy skills.

ABSENCE NOTIFICATION TO FACULTY

It is important for instructors to know when students are experiencing difficulty that might interfere with their studies. However, it is also important that student personal issues be kept confidential. Therefore, Student Development is designated to receive documentation regarding private matters. Documentation is required for an official verification notice to be sent to instructors. The notice informs the instructor that necessary documentation has been received but does not disclose personal details. Notification can be provided for the following extenuating circumstances: death in the family, medical conditions and illnesses, other emergencies and situations, and representing the NYU-Poly at conferences.

STUDENT GRIEVANCES AND COMPLAINTS

Student Development is one of the offices where student grievances and complaints are heard and action is taken on behalf of students.

Student Misconduct and Academic Dishonesty

Incidents of student misconduct and academic dishonesty are reported to Student Development for review and action according to the Institute Code of Conduct and other Institute policies.

The Institute Code of Conduct, edited and administered by the Department of Student Development, gives notice to the NYU-Poly community of prohibited behavior and outlines the procedures to be followed in the event of a breach of this code. This Code protects and promotes the academic enterprise and is indispensable in maintaining an academic environment conducive to teaching, learning and the development of individuals.

The Institute Code of Conduct is available to students and all members of the Polytechnic community at www.poly.edu/academics/code-of-conduct. For further information, contact Student Development at (718) 260-3800.

TUITION AND FEES

Up-to-date and detailed information on tuition and fees as well as announcements of cost changes can be obtained from the Office of Student Financial Services before the start of each semester and on the office's website www.poly.edu/life/student-resources/financial. Tuition rates are set by the NYU-Poly Board of Trustees. Because of economic conditions and inflationary costs, the Institute reserves the right to change tuition charges and fees when it is deemed necessary. NYU-Poly is mindful of the economic challenges of attending a first-rate private school such as NYU-Poly; accordingly, the Institute will continue to make every effort to keep cost increases to the lowest possible level consistent with maintaining educational quality.

Undergraduate Tuition:

Full-time (12-20 credits*) per semester	$17,552
Credits in excess of 20 credits, per credit	$1,116
Part-time (less than 12 credits), per credit	$1,116

**All credits in excess of 20 are charged at the per credit rate.*

Undergraduate Institute Fee:

Full-time (12 credits or more), per semester	$590
Part-time (6-11 credits), per semester	$368
Part-time (less than 6 credits), per semester	$215

Graduate Tuition:

per credit	$1,194

Graduate Institute Fee:

Full-time (9 credits or more), per semester	$580
Part-time (6 credits,) per semester	$385
Part-time (3 credits), per semester	$204

Executive Format MS Programs:

Management of Technology*, per semester	$12,500
Technology and Information Systems Management*, per semester	$12,500
Information Systems Engineering, per semester	$10,882

NYU-ePoly (Online Learning):

ePoly Tuition, per credit	$1,194
ePoly Institute Fee, per semester	$220

**All credits in excess of 9 are charged at the per credit rate.*

Other Fees:

Alumni Audit Fee, per course	$615
Graduate Application Fee:	
Hardcopy	$75
Online	$75
Undergraduate Application Fee	$50
Credit by Examination Fee, per credit (undergraduate only)	$80
Diploma Replacement Fee	$50
Doctoral Dissertation Microfilm Fee	$75

Monthly Late Payment Fee:

Balances under $5,000	$50
Balances of $5,000 or more	$100
Late Registration Fee *Charged to all students who register on or after the first day of classes.*	$150
Maintenance of Studies (Graduate students only) *Students are not required to pay tuition but pay the Graduate Institute fee for 3 credits*	$198
Undergraduate Orientation Fee, one-time fee	$150
TMS enrollment fee	$90
Tuition deferment fee	$150
Tuition deposit	$300
Tuition deposit - HEOP Students	$200

Housing:

Dorm Deposit	$400
International Dorm Deposit	$1,000

Othmer Residence:

Suite, per semester	$3,975
Meal plan (Suite), additional per semester	$1,065
Apartment, per semester	$5,500
Meal-plan (Apartment), additional per semester	$800

Clark Residence:

Single, per semester	$7,925
Double, per semester	$6,500
Large Double, per semester	$6,780
Lofted Triple, per semester	$4,780
Triple, per semester	$4,890

‡NYU-Poly reserves the right to change tuition charges and fees when it is deemed necessary.

PAYMENT OF TUITION AND FEES

Each semester, tuition and fee payments are due in full from all students at the time of registration. NYU-Poly reserves the right to de-register students from classes and deny access to campus buildings if payment or payment arrangements are not made at the time of registration. Payment in full refers to various methods, used alone or in combination, including cash, check, money order, financial aid, grants and loans or tuition arrangements authorized by the Office of Student Financial Services. Evidence of financial aid must be presented to the Office of Student Financial Services in order to use the anticipated aid to satisfy tuition costs.

Tuition must be paid in full, including disbursement of loans and all other aid, to receive permission to register for the next semester. Students participating in a payment plan or the graduate deferment plan must pay in full according to the rules of the plan. NYU-Poly reserves the right to withhold transcripts, diplomas and other services, including registration and participation in graduation activities, from students whose financial obligations have not been fully met.

E-BILLING

Polytechnic Institute of New York University no longer sends paper tuition statements. All registered students must log into CASHNet via https://commerce.cashnet.com/polypay in order to view their electronic tuition statements.

TUITION MANAGEMENT SYSTEMS (TMS) PAYMENT PLAN

The Institute provides monthly, by-semester and yearly payment options. The monthly tuition payment plan is available through Tuition Management Systems, an independent agency. Specific information about these plans is outlined on our website www.poly.edu/life/student-resources/financial.

SEMESTER PAYMENT PLAN (TMS)

Tuition bills are posted on a semester basis. After deducting all forms of scholarships, grants and loans for the semester, students must pay the remaining tuition balance in full at the beginning of each term. Students who use semester-payment plan do not incur finance charges.

MONTHLY PAYMENT PLAN (TMS)

A monthly payment plan spreads annual tuition charges over 10 months, beginning in July and ending in April. The monthly payment plan is interest-free, regardless of the balance amount, with a one-time enrollment fee assessed annually at the beginning of the plan. Monthly payment plans are also available on a semester basis. The enrollment fee is the same as for the Annual Plan.

GRADUATE TUTION DEFERMENT

Students who submit written proof of eligibility for tuition reimbursement from their employers will be allowed to defer payment until the end of the semester. Eligibility is contingent upon the signing of a promissory note, with a deferment fee assessed at the beginning of each semester.

THIRD PARTY PAYMENT

Students receiving sponsorship from government agencies, employers or other organizations must provide the Institute with proof of coverage and permission to bill a third party. Students are required to pay or arrange for payment of any uncovered portion of the bill. Sponsorships are arranged between the student and a third party; students are responsible for Institute debt if the third party does not make payment. Third parties are billed at the beginning of the semester, and payment is due upon receipt of the bill.

DROP/WITHDRAWAL POLICY

TUITION LIBAILITY

Upon selecting and reserving courses, students are responsible for all tuition and fees associated with that registration. Students must officially drop or withdraw from classes to remove or reduce tuition liability. Liability will not be voided automatically for non-attendance or non-payment.

REFUND/TUITION LIABILITY

This section pertains to all students, regardless of the payment method or the manner of covering tuition costs. Once registered, students must officially drop or withdraw from classes to be eligible for applicable tuition refund or to avoid responsibility for payment of charges already assessed. The Institute Fee is nonrefundable as of the first day of the semester. This applies regardless of whether or not classes have been attended. Recipients of financial aid who incur a tuition liability after registration because of a reduction in the aid or a withdrawal from class will personally be responsible for payment of that liability to the Institute. All tuition liability includes collection fees.

Refund Schedule

The refund schedule applies only during the first four weeks of the semester. It is based on calendar dates, not on the number of class sessions held or attended. The official withdrawal date is the date the withdrawal form (available in the Registrar's Office) is received in the Office of the Registrar, not the last date of class attendance.

Whenever a student drops or withdraws from a course or from all courses, tuition charges are adjusted according to the above Refund/Tuition Liability schedule, provided that (1) the withdrawal notice is filed within the refund period, (2) it is submitted in writing to the Office of the Registrar and (3) the withdrawal lowers the student's program to fewer than 12 credits.

Impact of Withdrawal on Financial Aid

In summer 2000, Polytechnic adopted a new Federal Refund Policy to comply with new federal regulations (section 668.22) of the Higher Education Amendments of 1998. In accordance with federal regulations, students who withdraw from the Institute and have credited to their tuition account Federal Title IV financial assistance (Federal Stafford Loan, Federal Parent Loan for Undergraduate Students, Federal SEOG, Federal Perkins Loan or Federal Pell Grant) will be subject to the Federal Refund Policy on the possible return of Title IV funds awarded. In addition, the amount of refundable institutional charges will be determined according to the Institute policy.

The amount of the semester's unearned Federal Title IV aid must be returned to its source. The amounts to be returned to the Federal Programs vary according to the type of program, the total amount to be returned, and the government's determination of the order in which aid is returned to the programs. If a student has an account balance resulting from these adjustments, the student is responsible for payment.

When returning Federal Title IV aid, federally mandated priority listing will be used:

1. Federal Direct Unsubsidized Student Loan Program
2. Federal Direct Subsidized Student Loan Program
3. Perkins Loan
4. Federal Parent Loan for Undergraduate Student (PLUS)
5. Federal Pell Grant
6. Supplemental Educational Opportunity Grant (SEOG)
7. ACG
8. SMART

The calculation for impact of withdrawal on financial aid is the same for all students. The determination of tuition refund is based on length of attendance.

Drop/Withdraw:
Prior to and including the first seven (7) days of the semester – 0% Liability
Drop/Withdraw: 1st Week – 10% Liability
Drop/Withdraw: 2nd Week – 25% Liability
Drop/Withdraw: 3rd Week – 50% Liability
Drop/Withdraw: 4th Week – 75% Liability
Drop/Withdraw: 5th Week and beyond –100% Liability

Refund Appeals

Appeals for an exception to the refund schedule must be submitted in writing to the Office of Student Accounts, along with documentation supporting the request. Students are expected to be aware of the Institute refund policy and withdrawal procedures; lack of knowledge is insufficient reason for making or granting an appeal.

PART 2

ACADEMIC DEPARTMENTS

DEPARTMENT OF APPLIED PHYSICS

Head: Lorcan M. Folan

MISSION STATEMENT

The NYU-Poly Department of Applied Physics is committed to providing high-quality introductory-, intermediate- and advanced-level physics courses as services to the Institute's engineering and science departments. The major programs train new generations of physicists who apply the tools of physics to contemporary problems to benefit all. The department, collaborating closely with other departments, employs physics knowledge and techniques to enable engineering research and education, and serve as a catalyst for research in other scientific fields.

PHYSICS: THE FUNDAMENTAL SCIENCE

Physics is the science devoted to the study and understanding of nature. It traces its history back to Aristotle and derives its name from the Greek words for nature and natural. Physics is often said to be the most fundamental science which deals with the constituents, properties and evolution of the entire universe, on all length and time scales. Other branches of science focus on smaller domains, but physics provides the foundation for all of them.

CONTACT INFORMATION

Polytechnic Institute of NYU
Six MetroTech Center
Brooklyn, NY 11201
Tel: (718) 260-3072
Fax: (718) 260-3139
E-mail: physics@poly.edu
Web: www.poly.edu
/academics/departments/physics/

DEGREES OFFERED

The department offers Bachelor and Master of Science degrees in Physics, and a dual major degree in Mathematics and Physics, administered in cooperation with the Department of Mathematics. Students may elect to take a minor in Physics or elect a concentration or minor in Nuclear Science and Engineering, administered in cooperation with the Department of Mechanical Engineering.

FACULTY

PROFESSORS

Stephen Arnold, University and Thomas Potts Professor
PhD, City University of New York
Microparticle Photophysics, Whispering Gallery Mode Biosensing, Organic Molecular Crystals

Kurt H. Becker, Professor
Dr. rer. net., Universität des Saarlandes, Saarbrücken, Germany
Atomic, Molecular, and Chemical Physics; Plasma Physics; Development of New Experimental Techniques and Processes

Hong-Liang Cui, Professor
PhD, Stevens Institute of Technology
Applied physics/optics

Erich E. Kunhardt, Professor
PhD, Polytechnic Institute of New York
Low temperature plasma physics, device physics

Edward L. Wolf, Professor
PhD, Cornell University
Experimental condensed matter physics superconductivity; nanophysics and nanotechnology; electron tunneling spectroscopy

ASSOCIATE PROFESSOR

Lorcan M. Folan, Associate Professor, Department Head
PhD, Polytechnic University
Spectroscopic characterization of aerosol particles; optical properties of micro-cavities; energy transfer in condensed matter; electron capture beta decay

INDUSTRY PROFESSORS

Victor Y. Barinov, Industry Associate Professor
PhD, Academy of Science of the Ukraine

Valery A. Sheverev, Industry Professor, Director of Physics Laboratory Program
PhD, Leningrad State University

Vladimir I. Tsifrinovich, Industry Associate Professor
DSc, Kirensky Institute of Physics, Academy of Science, USSR

LECTURERS

S. John DiBartolo, Lecturer
PhD, University of Virginia

David T. Mugglin, Lecturer
PhD, Lehigh University

INSTRUCTOR

Vladimir Ostrovsky, Instructor
DSc, Kiev Institute of Physics, Academy of Science, USSR

ADJUNCT FACULTY

Akhil Lal, Adjunct Professor
PhD, Polytechnic University

Alex Kattamis, Adjunct Assistant Professor
PhD, Princeton University

EMERITUS FACULTY

Deo C. Choudhury
Professor Emeritus
PhD, University of California

Hellmut J. Juretschke
Professor Emeritus
PhD, Harvard University

OTHMER–JACOBS DEPARTMENT OF CHEMICAL AND BIOLOGICAL ENGINEERING

Head: Walter Zurawsky

MISSION STATEMENT

The mission of the Othmer-Jacobs Department of Chemical and Biological Engineering is to provide undergraduate and graduate programs that meet the present needs of NYU-Poly students and prepare them to enter careers in their chosen profession. In both teaching and research the department focuses constantly on the fundamental principles of the discipline and innovation so that NYU-Poly graduates are well prepared to succeed in industrial, government and academic careers, or to pursue further educational opportunities.

THE DEPARTMENT

Founded in 1905 as the Department of Chemistry and Chemical Engineering, the department has a long-standing tradition of excellence and innovation in teaching and research. Chemical engineering traditionally has focused on the chemical and physical transformations of raw materials into valuable and useful products. In recent years, the field has evolved to encompass biological processes and biological systems that range from enhanced drug delivery and protein engineering to the production of bulk chemicals from renewable bio-resources.

Chemical and biomolecular engineers are essential to meet 21st-century challenges. In addition to their traditional roles in chemical processing, these engineers will be prime leaders in the emerging and new technologies, including developing and producing alternative energy and fuels, producing commodity and specialty chemicals from renewable, biological sources, and developing new health-care systems and materials.

Chemical and biomolecular engineering education at NYU-Poly focuses on basic principles rather than narrow specialization in the firm belief that this approach allows for the broadest range of opportunities. Graduates are employed in the petrochemical industry, food processing, bulk- and fine-chemical production and in pharmaceuticals. Still others find NYU-Poly's broad and versatile education to be an excellent background for employment in the financial and banking industries and in patent law. Career paths and possibilities are almost limitless.

Department faculty members are leading educators and researchers. Research at NYU-Poly ranges from the dynamics of macromolecules and biological sensors to protein design and engineering, and is supported by government and industrial grants. To meet industry needs, the department offers evening graduate courses and part-time study.

CONTACT INFORMATION

Polytechnic Institute of NYU
Six MetroTech Center
Brooklyn, NY 11201
Tel: (718) 260-3470
Fax: (718) 260-3125
E-mail: zurawsky@poly.edu
Web: www.poly.edu/academics/departments/chemical

DEGREES OFFERED

Bachelor of Science
- Chemical and Biomolecular Engineering

Master of Science
- Chemical Engineering

Doctor of Philosophy
- Chemical Engineering

UNDERGRADUATE PROGRAM

The undergraduate program in chemical and biomolecular engineering provides a sound foundation in science and engineering. This foundation includes thorough instruction in physics, chemistry, biology and mathematics—all essential to understanding physical, chemical and biological processes and operations. This foundation supports a strong, integrated set of courses in chemical and biological engineering, including engineering thermodynamics, reaction kinetics, process dynamics and transport processes.

The undergraduate program leads to a Bachelor of Science in Chemical and Biomolecular Engineering and is accredited by the Accreditation Board of Engineering and Technology (ABET). The undergraduate curriculum enables graduates to select professional careers from an extremely broad spectrum of opportunities or to enroll in graduate or medical school.

GRADUATE PROGRAMS

The department offers programs leading to the MS and PhD in Chemical Engineering. These programs strongly emphasize the processing and properties of synthetic and biological polymers, optimization of chemical and biological processes, alternative energy resources, and a variety of topics that combine engineering with biology and medicinal sciences, protein engineering and bio-sensing.

FACULTY

PROFESSOR

Jovan Mijovic, Professor of Chemical Engineering
PhD, University of Wisconsin at Madison
Relaxation dynamics in synthetic and biological complex systems, modeling of processing of polymers

ASSOCIATE PROFESSORS

Rastislav Levicky, Donald F. Othmer Associate Professor of Chemical Engineering
PhD, University of Minnesota
Biological polyelectrolytes, biosensors and bio-diagnostics

Edward N. Ziegler, Associate Professor of Chemical Engineering
PhD, Northwestern University
Kinetics and reactor design, air pollution control, fluidization

Walter Zurawsky, Department Head of Chemical and Biological Engineering, Associate Professor of Chemical Engineering
PhD, University of Illinois
Plasma polymerization, mass transfer in membranes

ASSISTANT PROFESSOR

Jin Ryoun Kim, Joseph J. and Violet J. Jacobs Assistant Professor of Chemical Engineering
PhD, University of Wisconsin at Madison
Protein engineering, structure and properties of proteins

RESEARCH FACULTY

Leonard Stiel, Research Professor of Chemical Engineering
PhD, Northwestern University

FACULTY EMERITI

Robert C. Ackerberg, Professor Emeritus of Chemical Engineering
PhD, Harvard University

Robert F. Benenati, Professor Emeritus of Chemical Engineering
PhD, Polytechnic Institute of Brooklyn

AFFILIATED FACULTY

Stephen Arnold, Institute Professor and Thomas Potts Professor of Physics
PhD, City University of New York
Microparticle photophysics, optics

Bruce A. Garetz, Professor of Physical Chemistry
PhD, Massachusetts Institute of Technology
Laser spectroscopy, laser light scattering, non-linear optics, laser-induced nucleation and multiphoton processes

DEPARTMENT OF CHEMICAL AND BIOLOGICAL SCIENCES

Head: Bruce Garetz

MISSION STATEMENT

The mission of the Department of Chemical and Biological Sciences is to develop graduates capable of contributing to the advancement of the chemical and biological sciences. The department strives to be at the forefront in selected research areas, and its rigorous educational programs are designed to produce graduates who are well grounded in the fundamentals of their chosen discipline, skilled in state-of-the-art techniques and able to understand the importance of new developments in their discipline in a global and societal context.

THE DEPARTMENT

The Department of Chemical and Biological Sciences recognizes the unique importance of chemistry and biology among the sciences. Chemistry has been called the central science because it interfaces with so many of the natural sciences, but biology is emerging as the enabling science for the 21st century. To face the demands and challenges in modern industry, the department offers educational and research programs that focus on novel molecules and advanced materials properties. The undergraduate Biomolecular Science Program prepares students to enter the workforce in an array of fields that include tissue, protein, genetic and metabolic engineering, drug delivery for cancer and AIDS treatment, DNA on a chip, biological weapons and sensors, pharmaceuticals and cosmetics, biomaterials and biocatalysis, petroleum engineering, alternative energy sources and microelectronics. The graduate programs focus on advanced research in those areas. Job-growth rates in these fields are the highest in the technical professions. The department's faculty comprises leading educators and active researchers. Research activities are supported by both government and industrial cooperation. To meet the needs of industry, the department offers evening courses, part-time study opportunities, and on-site research in the industrial workplace.

CONTACT INFORMATION

Polytechnic Institute of NYU
Six MetroTech Center
Brooklyn, NY 11201
Tel: (718) 260-3750
Fax: (718) 260-3676
E-mail: bgaretz@poly.edu
Web: www.poly.edu/academics/departments/chemical-bio-sciences

DEGREES OFFERED

Bachelor of Science
- Biomolecular Science

Master of Science
- Biomedical Engineering
- Biotechnology
- Biotechnology and Entrepreneurship
- Chemistry

Doctor of Philosophy
- Materials Chemistry

Graduate Certificates
- Bioinstrumentation
- Biomedical Materials

UNDERGRADUATE PROGRAMS

The BS in Biomolecular Science provides a modern exposure to the chemical and biological sciences. Students select their curriculum to prepare them for careers in medicine, dentistry, osteopathy, veterinary medicine, podiatry, optometry, chemistry, biology or biotechnology.

GRADUATE PROGRAMS

The MS in Chemistry and the PhD in Materials Chemistry are designed to provide students with a broad competence in the chemical sciences. The MS in Biomedical Engineering, the MS in Biotechnology and the MS in Biotechnology and Entrepreneurship offer students training in technologies at the interface between chemistry and biology. In addition to offering fundamental courses, the department offers a series of advanced specialized courses that focus on new materials and techniques. Students can focus on the synthesis of novel molecules, polymers and biomaterials, the characterization of these materials or the evaluation of the performance of products developed from these materials. On-site research and electives in other disciplines like management are encouraged for part-time students.

FACULTY

PROFESSORS

Stephen Arnold, University and Thomas Potts Professor of Physics
PhD, City University of New York
Optics, biophotonics, microparticle photophysics (www.poly.edu/microparticle), physical virology, organic solid-state physics

Mary K. Cowman, Professor of Biochemistry
PhD, CaseWestern Reserve University
Biophysical chemistry of macromolecules in solution, on surfaces and in crowded environments. Structure, biological function and medical applications of the polysaccharide hyaluronan. Development of improved biomedical materials. Atomic force microscopy methods for the imaging and physical characterization of single biological macromolecules and nanoparticles. Macromolecular crowding in polymer solutions.

Bruce A. Garetz, Department Head and Professor of Physical Chemistry
PhD, Massachusetts Institute of Technology
Laser spectroscopy, laser light scattering, nonlinear optics, laser-induced nucleation and multiphoton processes

Mark M. Green, Professor of Organic Chemistry
PhD, Princeton University
Stereochemistry of synthetic and biologically interesting polymers and liquid crystals. Discovering the principles of organic chemistry by studying the complex industrial and biological phenomena arising from these principles as a new learning method

Richard A. Gross, Herman F. Mark Professor, Director: NSF Center on Biocatalysis and Bioprocessing of Macromolecules
PhD, Polytechnic University
Biocatalysis, biobased materials, biosurfactants, polymer synthesis

Kalle M. Levon, Professor of Chemistry
DrAgr, University of Tokyo (Japan)
Phase separation in polymer blends and solutions, conducting polymers

Iwao Teraoka, Professor of Polymer Chemistry
PhD, University of Tokyo (Japan)
Photonic molecular sensors, whispering gallery modes

Abraham Ulman, Professor of Chemistry, Founding Director, Bar-Ilan Institute of Nanotechnology
PhD, The Weizmann Institute (Israel)
Self-assembled monolayers, surface engineering and nanotechnology

ASSISTANT PROFESSOR
Jin Kim Montclare, Assistant Professor of Biological Chemistry
PhD, Yale University
Protein design and engineering

INDUSTRY PROFESSORS
Victor Barinov, Industry Associate Professor of Physics
PhD, Academy of Science of the Ukraine
Electroactive gels, mechanics of polymer networks, interface separation

Gene R. DiResta, Industry Professor of Bioengineering
PhD, Polytechnic Institute of New York
Orthopaedic biomechanics, transport phenomena of solid tumors, mathematical modeling of physiologic systems

Evgeny Vulfson, Industry Professor of Biotechnology
PhD, Moscow State University
Biotechnology

INSTRUCTORS
Tommy S. Lee, Instructor of Biology, MPhil, New York University

Abhijit Mitra, Instructor of Chemistry
PhD, Columbia University

LECTURERS
Janice Aber, Lecturer of Chemistry
PhD, Polytechnic University

Charles P. Martucci, Lecturer of Chemistry
PhD, Columbia University

Myron I. Pollack, Lecturer of Chemistry
PhD, New York University

RESEARCH FACULTY
Yoshiyuki Okamoto, Research Professor and Director of the Polymer Research Institute
PhD, Purdue University
Organic and polymer synthesis, characterizations and applications

Eli M. Pearce, University Research Professor
PhD, Polytechnic Institute of Brooklyn
Polymer synthesis and degradation

Arnost Reiser, Distinguished Research Professor of Chemistry
DrIng, University of Prague (Czech Republic)
Polymer photochemistry, photoresists, image science

Edward D. Weil, Research Professor in Polymer Research Institute
PhD, University of Illinois
Additives for polymers, flammability

FACULTY EMERITI
Ernest Loebl, Professor Emeritus of Physical Chemistry
PhD, Columbia University

Herbert Morawetz, University Professor Emeritus of Polymer Chemistry
PhD, Polytechnic Institute of Brooklyn

Norman C. Peterson, Professor Emeritus of Physical Chemistry
PhD, Iowa State University

Nancy M. Tooney, Associate Professor Emerita of Biochemistry
PhD, Brandeis University

DEPARTMENT OF CIVIL ENGINEERING

Interim Head: Lawrence Chiarelli

MISSION STATEMENT

The mission of the Department of Civil Engineering is to produce graduates capable of contributing to and advancing the practice of civil engineering and its sub-disciplines.

THE DEPARTMENT

The Department of Civil Engineering mission involves its faculty in a wide variety of state-of-the-art research and in the development of innovative curricula for the civil engineers of the 21st century.

Research is focused on developing and implementing intelligent infrastructure-monitoring technologies, including smart materials, and optimizing infrastructure system planning, design, operation and management. Sustainability is a critical objective function and overarching theme.

Through the department's involvement in local, regional and national issues, students are exposed to a daily laboratory of infrastructure issues and projects all around them. The department participates in four major interdisciplinary research centers: The Urban Infrastructure Institute, the Urban Utilities Institute, the Transportation Research Institute and the Urban Security Initiative. Department research covers a broad range of topics, including highway capacity and level of service, remote monitoring of infrastructure elements and use, management of urban utilities, intelligent transportation systems technologies, construction materials properties and monitoring, urban infrastructure security and construction operations.

Faculty members teach undergraduate and graduate courses. The curriculum exposes students to instructors in the forefront of their fields; men and women who frequently work on projects and topics of current interest, often within the region. The full-time faculty is augmented by excellent adjunct faculty who teach specialty courses in areas of their expertise, bringing a strong practical element to the classroom.

Programs are well-rounded and balanced. They combine all necessary theoretical elements with a strong emphasis on design and application. Graduates are well-versed in state-of-the-art techniques and develop the skills needed to become leaders in the profession. Among these skills are the ability to communicate effectively in oral and written form and the ability to understand the context of civil engineering projects in a complex society.

CONTACT INFORMATION

Polytechnic Institute of NYU
Six MetroTech Center
Brooklyn, NY 11201
Tel: (718) 260-3220
Fax: (718) 260-3433
E-mail: cee@poly.edu
Web: www.poly.edu/academics/departments/civil

CIVIL ENGINEERING PROFESSION

Civil engineers are responsible for planning, designing, constructing, maintaining and operating today's infrastructures. These areas cover a wide range of urban and regional systems and functions, including buildings, roads, bridges, airports, rail systems, dams, irrigation systems, water supply systems, environmental ecosystems and solid- and liquid-waste treatment and disposal systems and processes. The civil engineer practices in a broad and exciting field with a major impact on society in general and on its infrastructure environment in particular.

Modern civil engineering also deals with rapidly expanding information technologies. These technologies monitor, control, operate and manage complex infrastructure systems. From smart buildings to remote monitoring of transportation, water supply, sewage and other infrastructures, the modern civil engineer applies information technologies to improve the quality of the infrastructure environment.

DEGREE PROGRAMS

The department's undergraduate programs deliver a broad civil-engineering background to the engineer beginning a professional career. Graduate programs allow students to specialize in particular areas or sub-disciplines and to pursue general graduate work across several different areas. The department offers the following degree and certificate programs:

Bachelor of Science
- Civil Engineering
- Construction Management

Master of Science
- Civil Engineering
- Construction Management
- Environmental Engineering
- Environmental Science
- Transportation Management
- Transportation Planning and Engineering
- Urban Systems Engineering and Management

Doctor of Philosophy
- Civil Engineering
- Transportation Planning and Engineering

Advanced Certificates
- Construction Management*
- Executive Construction Management (Exec 21)
- Traffic Engineering
- Transportation Management and Economics
- Transportation Planning

**Offered in conjunction with the Department of Management*

Undergraduate Minor
- Construction Management

Specific information on each of these programs is found in the programs section of this catalog.

FACULTY

PROFESSORS

John C. Falcocchio, PE, Professor of Transportation Planning and Engineering, Executive Director of the Urban Intelligent Transportation Systems Center
PhD, Polytechnic Institute of Brooklyn
Travel demand forecasting, transportation system evaluation, planning and management

Fletcher H. (Bud) Griffis, PE, Professor of Civil Engineering, Construction Management Program Director, Director of Center for Construction Management Technology
PhD, Oklahoma State University
Building Information Modeling (BIM), model-based simulation, applications of operations research principles to construction, magnetic levitation (Maglev) transportation systems, dredging and dredged material disposal, infrastructure design, construction and management, engineering economics

Magued G. Iskander, PE, Professor of Civil Engineering, Coordinator of Graduate Programs in Civil Engineering
PhD, University of Texas at Austin
Foundation engineering, marine geotechnology, pile foundations, alternative foundations, geotechnical instrumentation and monitoring, transparent soils

Ian Juran, Professor of Civil Engineering, Executive Director of Urban Infrastructure Institute, Director of the Urban Utilities Center
PhD, DSc, University of Paris IV, École Nationale de Ponts et Chaussées (France)
Geotechnical engineering, soil improvement technologies, geosynthesis engineering, in-situ soil testing, urban systems engineering and management

Mohammad Karamouz, PE, Research Professor of Environmental Engineering
PhD, Purdue University
Environmental system management, surface and ground water hydrology, decision support systems (DSS), disaster management and urban water systems

Roger P. Roess, Professor of Transportation Engineering
PhD, Polytechnic Institute of Brooklyn
Highway capacity and level-of-service analysis, traffic control and operations, public transportation operations, transportation economics, engineering pedagogy

INDUSTRY PROFESSORS

Lawrence Chiarelli, PE, Esq., Department Head and Industry Professor of Construction Management, Construction Management Program Director, Associate Director of the Center for Construction Management Technology
JD, Brooklyn Law School
ME, The Cooper Union
Construction law, risk management, program and construction management; structural engineering and cost estimating

Anne Dudek Ronan, PE, Industry Professor of Civil Engineering
PhD, Stanford University
Water resources engineering, groundwater flow and transport modeling, numerical modeling uncertainty, climate adaptation

ASSOCIATE PROFESSORS

Masoud Ghandehari, Associate Professor of Civil Engineering
PhD, Northwestern University
Mechanics of fracture, durability of concrete structures, structural materials

Elena S. Prassas, Associate Professor of Transportation Engineering, Director of Transportation Programs
PhD, Polytechnic University
Traffic engineering, software systems and simulation for transportation applications, transportation economics, AI application

INDUSTRY ASSOCIATE PROFESSORS

Andrew J. Bates, Industry Associate Professor of Construction Management, USAF Ret.
PhD, Polytechnic Institute of NYU
Strategic planning and construction operations, risk analysis, statics

Mohsen Hossein, Industry Associate Professor of Civil Engineering
PhD, McGill University
Geotechnical engineering, environmental geotechnology, environmental impact assessment

José M. Ulerio, Industry Associate Professor of Transportation Engineering
MS, Polytechnic University
Transportation and traffic engineering; collection, handling and analysis of large-scale transportation data bases; highway capacity and quality of service analysis; travel demand forecasting; geometric design of highways

LECTURER

Roula Maloof, Lecturer of Civil Engineering
PhD, Polytechnic Institute of New York
Non-destructive evaluation, fracture mechanics, finite element analysis, stress analysis

ADJUNCT LECTURERS

Construction Management and Engineering

Peter Amato, Adjunct Lecturer of Civil Engineering
MS, John Jay College
President, Site Safety, LLC

Ralph D. Amicucci, CCIM, CPM, Adjunct Lecturer of Civil Engineering
MS, New York University
MBA, Iona College

Pooyan Aslani, Adjunct Lecturer of Civil Engineering
PhD, Polytechnic University
Resource-constrained scheduling, building information modeling (BIM), risk analysis

Anthony F. Caletka, PE, CCM, CFCC, Adjunct Lecturer of Civil Engineering
BS, Syracuse University
Managing Director, Capital Projects & Infrastructure, PricewaterhouseCoopers

John F. Caruso, Adjunct Lecturer of Civil Engineering
BS, City College of New York
Principal, John F. Caruso Consultant

Salvatore Castelli, Adjunct Lecturer of Civil Engineering
MS, Manhattan College
Project Manager, G.S. Engineering, P.C.

March W. Chadwick, AIA, LEED AP
M.Arch., Georgia Institute of Technology
Principal, M.Arch Architects

Dominick J. Fickeria, Adjunct Lecturer of Civil Engineering
MS, Manhattan College
Vice President, Director of Construction Management, URS Corp.

Robert N. Harvey, PE, Adjunct Lecturer of Civil Engineering
MS, Massachusetts Institute of Technology
Executive Director, Lower Manhattan Construction Command Center

Robert Maffia, PE, Adjunct Lecturer of Civil Engineering
MBA, Columbia University
Senior Director, Construction Management, Real Estate Development and Facilities, NYU Langone Medical Center

Michael P. Meehan, Adjunct Lecturer of Civil Engineering
MS, New York Institute of Technology
Consolidated Edison Company of New York (Ret.)

Lewis Mintzer, Adjunct Lecturer of Civil Engineering
MBA, Pace University
Director of Marketing, URS Corp.

Robert Otruba, PE, Adjunct Lecturer of Civil Engineering
BS, Syracuse University
University Director, Forensic and Litigation Consulting, FTI

Ronald J. Pennella, Adjunct Lecturer of Civil Engineering
MS, Polytechnic University
Project Executive, StructureTone Inc.

Patrick Prancl, PE, Adjunct Lecturer of Civil Engineering
PhD, City University of New York
Project Manager, El Sol Contracting and Construction Corp.

Salvador Rozenberg, RPA, Adjunct Lecturer of Civil Engineering
EMBA, University of New Haven
Principal, Transaction Maintenance Company

Joel Sciascia, Esq., Adjunct Lecturer of Civil Engineering, JD, Fordham Law School
MS, Arizona State University, Del Webb School of Construction
General Counsel, Pavarini McGovern LLC

Jeffrey S. Seigel, Esq., Adjunct Lecturer of Civil Engineering
JD, Pace University School of Law
Director Business Development and Marketing, Pavarini/StructureTone

Jerome White, PE, Adjunct Professor of Civil Engineering
BS, Polytechnic University
President, Jerome B. White PC

James Vandezande, AIA, Adjunct Lecturer of Civil Engineering
BS, New York Institute of Technology
Senior Associate, HOK

Exec 21 Program in Construction Management

Mark A. Bloom, Esq., Adjunct Lecturer of Civil Engineering
JD, Fordham University School of Law
Partner, Arent Fox LLP

Albert DiBernardo, Adjunct Lecturer of Civil Engineering
MS, Polytechnic University
Principal, Weidlinger Associates

Peter M. Chorman, AIA, LEED AP, Adjunct Lecturer of Civil Engineering
BS, New York Institute of Technology
Vice President, Jones Lang LaSalle America's, Inc.

Joseph M. Giglio, Adjunct Professor of Civil Engineering
PhD, Northeastern University
Senior Academic Specialist; Executive Professor of General Management
Northeastern University
Vice-chairman, Hudson Institute

Francis J. Lombardi, PE, Adjunct Lecturer of Civil Engineering
MS, Columbia University
Chief Engineer, Port Authority of New York and New Jersey (Ret.)

John E. Osborne, Esq., Adjunct Lecturer of Civil Engineering
JD, University of South Carolina Law Center
Partner, John E. Osborne, PC

Raymond R. Savino, Adjunct Lecturer of Civil Engineering
MBA, Bernard Baruch College
Chief Financial Officer, The DeMatteis Organizations

Luis M. Tormenta, PE, Adjunct Lecturer of Civil Engineering
BCE, Manhattan College
Vice-chairman and Chief Executive Officer, LiRo Group

Louis A. Tucciarone, Adjunct Lecturer of Civil Engineering
MSCE, University of California at Berkeley
Senior Vice-President, URS Corp.

Lou Venech, Adjunct Lecturer of Civil Engineering
BA, Columbia College
General Manager, Transportation Policy & Planning, Port Authority of New York and New Jersey

Environmental and Water Resources Engineering

Raoul Cardenas Jr., Adjunct Professor of Environmental Engineering
PhD, New York University

Joon Om, Adjunct Lecturer of Civil Engineering
PhD, Polytechnic University

Sungho Yoon, Research Scientist, Adjunct Professor of Civil Engineering
PhD, Polytechnic University

Structural and Geotechnical Engineering

Walid Aboumoussa, PE, Adjunct Professor of Civil Engineering
PhD, Polytechnic Institute of NYU
Partner, Antonucci & Associates, Architects & Engineers, LLP

Weihua Jin, PE, Adjunct Professor of Civil Engineering
PhD, Columbia University
Chief Scientist, IceStone, LLC

J. Jong Lou, PE, Adjunct Professor of Civil Engineering
PhD, Northwestern University
President, J.J. Lou Associates LLPC

Sri K. Sinha, PE, Adjunct Lecturer of Civil Engineering
MS, Polytechnic University
Director of Plant Improvements and Asset Management, Lucius Pitkin Inc.

Alfonso Whu, Adjunct Lecturer of Civil Engineering
MS, Polytechnic University

Transportation and Highway Engineering

Andrew Bata, Adjunct Professor of Civil Engineering
MS, Northwestern University
New York City Transit Authority

Philip A. Habib, PE, Adjunct Professor of Transportation Engineering
PhD, Polytechnic Institute of New York
President, Philip A. Habib Associates

Michael Horodniceanu, PE, Adjunct Professor of Transportation Engineering
PhD, Polytechnic Institute of New York
President, MTA Capital Construction Company

Richard Malchow, Adjunct Professor of Transportation Engineering
MS, Union College
Vice President, Management and Budget, Urbitran Associates

Raman Patel, Adjunct Lecturer of Transportation Engineering
PhD, Polytechnic University

Genaro Sansone, Adjunct Lecturer of Transportation Engineering
MBA, Iona College
New York City Transit Authority

FACULTY EMERITI

Alvin S. Goodman, PE, Professor Emeritus
PhD, New York University

Alan H. Molof, Professor Emeritus
PhD, University of Michigan

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Head: Keith Ross

MISSION STATEMENT

The Department of Computer Science and Engineering is committed to preparing undergraduate and graduate students for leadership roles in professional and research activities in the information-technology sector. The department fosters an environment that encourages lifelong learning in the Information Age. Graduates lead and grow in diverse working environments and apply the theories and skills of computer and information science to real-world problems. Toward this end, the department conducts state-of-the-art research in theoretical and applied computer science and maintains strong educational programs that emphasize breadth and depth in technical knowledge and proficiency in spoken and written communication skills. The environment encourages Invention, Innovation and Entrepreneurship (i^2e).

THE DEPARTMENT

Computers are now used in practically every area of human endeavor and are radically changing both the way people live and how they view the limits of human capabilities. Job opportunities in computer science and engineering are challenging and diverse. According to the U.S. Bureau of Labor Statistics, current job growth in computer science is among the highest of any technical profession.

NYU-Poly's Department of Computer Science and Engineering offers programs leading to the BS, MS and PhD in Computer Science, and the MS in Information Systems Engineering and Cyber Security. The department offers joint programs with the Department of Electrical and Computer Engineering, leading to the BS and MS in Computer Engineering and the MS in Telecommunication Networks. The department also offers an advanced certificate in software engineering and cyber security.

The Department of Computer Science and Engineering is active in research in several key areas of computer science. The department's research strengths are in these areas: Internet and Web research, which includes peer-to-peer networking; cloud services and networking; Web search, Web mining and social networks; multi-player games and online virtual worlds. Cyber security is one of the most important areas of computer science and engineering at NYU-Poly. Cyber security includes vulnerability analysis; peer-to-peer security; multimedia forensics; biometrics; watermarking and digital rights management; wireless security; steganography; fault-tolerant distributed cryptography; and usable security; graphics, visualization. Vision and image processing has revolutionized the world of technology. It includes computer graphics and visualization; computer vision; and image processing. Lastly, theoretical computer science includes data structures; computational geometry; computational learning theory and combinatorial optimization and approximation algorithms.

The faculty works closely with NYU-Poly's Center for Advanced Technology in Telecommunications (CATT) and has relationships with industries that support research and activity in their special interests.

NYU-Poly has been designated as a Center of Excellence for Information Assurance Education for research by the National Security Agency (NSA) and operates the Scholarship for Service Program (SFS) in Information Assurance.

The department provides students with a wide variety of advanced computer and software systems. These support PC and UNIX technology along with highly distributed networks. The department has four dedicated computer-science laboratories (virtual lab) for upper-level undergraduate students. They are the Software Engineering Laboratory, Parallel and Distributed Systems Laboratory, Visualization and Graphics Laboratory and Computer System and Security Integration Laboratory. Multimedia and Web-based laboratories are also available.

CONTACT

Polytechnic Institute of NYU
Five MetroTech Center
Brooklyn, NY 11201
Tel: (718) 260-3440
Fax: (718) 260-3609
E-mail: cis@poly.edu
Web: www.poly.edu/academics/departments/computer

DEGREES OFFERED

Bachelor of Science
- Computer Engineering*
- Computer Science

Master of Science
- Computer Science
- Cyber Security
- Information Systems Engineering

Doctor of Philosophy
- Computer Science

Graduate Certificates
- Cyber Security
- Information Security Professional
- Information Systems Administration
- Software Engineering

** Offered in conjunction with the Department of Electrical and Computer Engineering.*

UNDERGRADUATE PROGRAMS

For undergraduates, the department offers two degrees: a Bachelors of Science in Computer Science (BS CS) and a Bachelors of Science in Computer Engineering (BS CompE). The Bachelor of Science in Computer Science is a rigorous program that not only covers fundamental computer science subjects, such as object-oriented programming, computer architecture and operating systems, but also provides a number of exciting avenues for specialization including computer and online game development, cyber security, Internet/web systems and applications, bioinformatics, graphics and vision, digital media and management and entrepreneurship. Strong students can also apply to the BS/MS Program where it's possible to earn the BS and MS in computer science at the same time.

The department jointly administers the Bachelors of Science in Computer Engineering with the Department of Electrical and Computer Engineering. It draws on the two departments' strengths to provide a focus on computer system design with integrated understanding of computer hardware and software.

MASTER'S PROGRAMS

The MS in Computer Science permits students to take courses either on a full-time or part-time basis. The curriculum has been designed for maximum flexibility. It includes fundamental courses in computer science as well as electives in specialized advanced courses on topics including computer and network security, distributed systems and networking, computer graphics, databases and web search technology. By electing the masters-thesis option, students may also pursue research with faculty members who are internationally recognized in their fields.

The MS in Cybersecurity is a new and highly innovative program that provides students with the critical knowledge and skills to become experts in cybersecurity, the science of protecting vital computer networks and electronic infrastructures from attacks. The program responds to the growing demand for security specialists in industry as well as government organizations. The department also offers MS degrees in Information Systems Engineering and System Integration.

PhD PROGRAM

The PhD program develops graduate skills in a broad range of areas as well as expertise in one or more specific areas and the ability to think critically and conduct independent research. Outstanding PhD students are advised to apply for financial aid in the form of teaching assistantships, research assistantships or partial-tuition remission.

MS IN INFORMATION SYSTEMS ENGINEERING

The information systems engineering program educates industry people facing the challenges and opportunities of integrating computers and communication systems. The program combines courses from electrical engineering, computer science and management; the emphasis is on information- systems engineering. Polytechnic offers this program only at its Westchester campus, where courses are in executive format and classes meet every other weekend for two full days, Friday and Saturday.

SOFTWARE ENGINEERING CERTIFICATE

The advanced certificate in software engineering comprises a series of five graduate-level courses to give students the knowledge and skills needed to compete successfully in the software-development arena. Students who want to continue their studies can apply these courses to the MS program in computer science.

CYBER SECURITY CERTIFICATE

The graduate certificate allows technical professionals to obtain key bodies of knowledge and specialization in cyber security. Students acquire an understanding of various technologies in emerging areas of security such as computer and network security, digital forensics, cryptography and biometrics. Students who want to continue their studies can apply all courses taken toward the MS program in computer science.

FACULTY

PROFESSORS

Boris Aronov, Professor of Computer Science and Graduate Director
PhD, Courant Institute of Mathematical Sciences, New York University
Algorithms, computational and combinatorial geometry

Phyllis G. Frankl, Professor of Computer Science
PhD, New York University
Software analysis and testing

K. Ming Leung, Professor of Computer Science
PhD, University of Wisconsin
Scientific computing, computer simulation, neural networks

Nasir Memon, Professor of Computer Science
PhD, University of Nebraska
Data compression, image and video processing, computer security, multimedia computation and communication

Keith W. Ross, Department Head and Leonard J. Shustek Distinguished Professor of Computer Science
PhD, University of Michigan
Computer networking, Internet research, multimedia networking, scholastic modeling

ASSOCIATE PROFESSORS

Yi-Jen Chiang, Associate Professor of Computer Science
PhD, Brown University
Computer graphics: out-of-core scientific visualization, isosurface extraction, surface simplification, virtual reality, air traffic control. Computer algorithms: I/O algorithms, computational geometry, graph algorithms, approximation algorithms, data structures

Lisa Hellerstein, Associate Professor of Computer Science
PhD, University of California at Berkeley
Computational learning theory, machine learning, algorithms, complexity theory, discrete mathematics

John Iacono, Associate Professor of Computer Science
PhD, Rutgers–The State University of New Jersey
Computational geometry, data structures, algorithms

Katherine Isbister, Associate Professor of Digital Media and Computer Science and Engineering
PhD, Stanford University
Social psychological and affective approaches to human computer interface, with special attention to games and other leisure and social technologies; embodied conversational agents and computer game characters

Torsten Suel, Associate Professor of Computer Science
PhD, University of Texas at Austin
Design and analysis of algorithms, database systems, parallel computation, experimental algorithmics

Joel Wein, Associate Professor of Computer Science
PhD, Massachusetts Institute of Technology
Scheduling, parallel and distributed computing, combinatorial optimization, data mining, algorithms

Edward K. Wong, Associate Professor of Computer Science
PhD, Purdue University
Computer vision, image analysis, pattern recognition, computer graphics

Nitesh Saxena, Assistant Professor of Computer Science
PhD, University of California, Irvine
Computer and network security, applied cryptography

INDUSTRY FACULTY

Robert J. Flynn, Industry Professor and Director of CSE Programs—Westchester Graduate Center
PhD, Polytechnic Institute of New York
Computer architecture, operating systems

Haldun Hadimioglu, Industry Professor of Computer Science
PhD, Polytechnic University
Computer architecture, parallel processing, reconfigurable systems and application specific processors

Stuart A. Steele, Associate Department Head of Computer Science and Engineering and Industry Professor
PhD, Pennsylvania State University
Software engineering and management, programming languages

John B. Sterling, Industry Associate Professor
MS, New York University
Game programming, software development

Fred J. Strauss, Industry Associate Professor and Director of CSE programs in Melville Campus—Long Island
MS, Polytechnic Institute of New York
Software engineering, project management, distributed systems

RESEARCH FACULTY

Gad M. Landau, Research Professor of Computer Science
PhD, Tel-Aviv University (Israel)
Serial and parallel algorithms for problems related to strings, computation biology, pattern recognition, communication networks

INSTRUCTORS

Evan Gallagher, Instructor of Computer Science
MS, New York University

Daniel Katz-Braunschweig, Instructor of Computer Science
MS, Iona College

FACULTY EMERITI

Henry Ruston, Professor Emeritus of Electrical Engineering and Computer Science
PhD, University of Michigan

Martin L. Shooman, Professor Emeritus of Electrical Engineering and Computer Science
DEE, Polytechnic Institute of Brooklyn

Richard Van Slyke, Professor Emeritus of Electrical Engineering and Computer Science
PhD, University of California at Berkeley
Combinatorial optimization especially applied to telecommunications systems, distributed optimization

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

Head: H. Jonathan Chao

MISSION STATEMENT

The department's mission is to engage students who seek educational achievement as the nation enters a new age with new demands and opportunities. The goal is to provide students with a broad- based education for electrical- and computer-engineering careers. Polytechnic students gain the skills to become creative leaders in their professional careers with the passion and desire to discover, invent, innovate, apply and advance new science and technology to solve the world's most critical problems.

THE DEPARTMENT

Electrical and computer engineers—whose technical skills have produced innovations in telephones, electric power systems, rapid transit, radio, television, medical electronics, computers, microelectronics, the Internet and wireless communications—have contributed more to the quality of 20th-century life than any other profession. Twenty-first century engineering innovation will be equally exciting.

The Department of Electrical and Computer Engineering is well respected worldwide for its major contributions to the profession and its tradition of teaching and research excellence. Polytechnic electrical and computer engineering graduates are prominent in university faculties, industrial labs and company boardrooms, spanning the range of the electrical, electronic and information-technology industries.

The department enters the 21st century with strong teaching and research programs in the most exciting digital-age fields: the Internet, wireless communications, computers, multimedia signal processing, robotics, automatic control and electric-power generation and distribution.

In the intimate Polytechnic environment, students benefit from frequent access to faculty members and laboratories at the forefront of innovation. In the spirit of entrepreneurship, Polytechnic's infrastructure encourages faculty and students to transfer their inventions to industry and to start their own companies.

The department hosts the Center for Advanced Technologies in Telecommunications (CATT), a New York State–sponsored research center, and the Wireless Internet Center of Advanced Technology (WICAT), a National Science Foundation Industry/University Cooperative Research Center. Together, these centers greatly strengthen the department in telecommunication networks and in wireless-communications research and education.

CONTACT

Polytechnic Institute of NYU
Five MetroTech Center
Brooklyn, NY 11201
Tel: (718) 260-3590
Fax: (718) 260-3906
E-mail: eceinfo@poly.edu
Web: www.poly.edu/academics/departments/electrical/

THE PROFESSION

The rapidly growing profession of electrical engineering has evolved from its early beginnings in electric- power generation and distribution through the development of radio, television, control and materials to computers, telecommunications and health care. In the last century, electrical engineers have created advances in power distribution, computers and communications that have changed the world. Their inventions have made the world a smaller, safer place and allow for immediate reporting and images from distant places that make world events part of daily life.

While electrical engineering undergraduate and graduate students concentrate on areas of electrical science, graduates apply their training to diversified fields such as electronic design, bioengineering, city planning, astronautics, radio astronomy, system engineering, image processing, telemetry, the Internet, computer design, management and patent law. As students mature and realize their abilities, they may choose professional lives in engineering, government, or education.

The expertise of Polytechnic's electrical engineering faculty covers a wide range of fields. Principal areas of teaching and research are microelectronic devices and systems; computer engineering; telecommunications; speech and image processing; electro-optics and electroacoustics; microwave engineering; wireless communications; power systems and energy conversion; plasma science and engineering; and systems and control engineering.

Additional information about electrical engineering careers can be found online at www.ieee.org/organizations/eab/studentcareers.htm.

DEGREES OFFERED

The Department of Electrical and Computer Engineering offers the following degree and certificate programs. Separate sections of this catalog present the objectives, requirements, advising resources and courses for individual programs.

Bachelor of Science*
- Computer Engineering**
- Electrical Engineering
- Electrical and Computer Engineering (dual major)

Master of Science
- Computer Engineering**
- Electrical Engineering
- Electrophysics
- Systems Engineering
- Telecommunication Networks**

Master of Engineering
- Interdisciplinary Studies in Engineering (Wireless Innovation***)

Doctor of Philosophy
- Electrical Engineering

Graduate Certificates
- Computer Engineering**
- Image Processing
- Telecommunication Network Management
- Wireless Communications
- Power electronics and systems
- Power-systems management

**Accredited by the Accreditation Board for Engineering and Technology (ABET).*
***Offered in cooperation with the Department of Computer Science and Engineering.*
****Offered in cooperation with the Department of Management and the Department of Computer and Science and Engineering.*

GRADUATE CERTIFICATE PROGRAMS

The department offers advanced certificate programs on current themes. Programs recognize students for successful completion of four graduate courses (12 credits) in areas of interest to working engineers. More details are available below in sections about related certificate programs. Courses completed for an advanced certificate apply toward a master's degree in a related field. Students should consult the department's graduate manual and website for the latest program list, which emphasizes current technology trends.

SPECIAL UNDERGRADUATE OPTIONS

The BS/MS Option: This program is available to exceptional undergraduate students, enabling them to earn both bachelor's and master's degrees in as little as four years.

Possible BS/MS combinations include BS in Electrical or Computer Engineering with a MS in Electrical Engineering, Telecommunications Networks, Computer Engineering or Computer Science.

Dual Major: A student can earn a Bachelor of Science degree in Electrical and Computer Engineering by completing 142 credits.

Minors: A student can earn a minor in Electrical or Computer Engineering. See the relevant program descriptions.

STUDENT ORGANIZATIONS

Polytechnic students may join student chapters of these professional organizations: the Institute of Electrical and Electronics Engineers (IEEE) and Eta Kappa Nu, the Electrical Engineering Honor Society.

SPECIALTY LABS

The department keeps pace with dynamic advances in electrical and computer engineering by maintaining state-of-the-art laboratories for instruction and experimentation. Laboratory courses combine lectures, experiments and project work. These courses also provide students with a rich set of elective choices, opportunities to work on senior projects with faculty researchers, valuable hands-on experience to enhance and supplement material taught in lecture classes, and forums to practice their oral and written communication skills.

The Wireless Lab provides formal experiments, lectures and project work on state-of-the-art, commercial spread-spectrum wireless access systems, including bit-error rate analysis and UHF channel propagation measurements.

The Multimedia Lab offers students hands-on experience to acquire, process and transmit voice, audio, image and video signals to create multimedia documents and to configure networked multimedia applications.

The Local Area Networks Lab includes a set of weekly experiments using Linux-based terminals, Ethernet LANs, routers and bridges and associated software with which to conduct a variety of LAN/WAN experiments and projects.

The High-Speed Networking Lab, equipped with various equipment and tools, allows faculty and students to build hardware prototypes (VLSI/FPGA chips and PCB) and software test bed to demonstrate their research concepts in high-performance routers, network security and network on chip.

The VLSI Design Lab treats Very Large-Scale Integrated-circuit design, performance analysis and circuit characterization, using industry-standard VLSI CAD tools and hardware-description languages such as VHDL. Students study the design of CMOS logic, standard cells, gate arrays and mixed-signal (analog/digital) circuits.

The Electric Power Laboratory fosters education and research for undergraduate and graduate studies. Equipment includes modern data-acquisition equipment, smart-power supplies and loads, digital meters, computers, power transformers and classical rotating machine pairs for dynamic testing and loading. In addition, static converters are available for experiments on Smart Grid and Distributed Resources, such as solar and fuel cells, wind power and variable-speed drives.

The Control/Robotics Lab provides a variety of experiments and project work focusing on feedback control, data acquisition and computer control.

The Microwave Lab treats the design, fabrication and testing of passive and active circuits and antennas using modern CAD and measurement software and hardware.

CENTER FOR ADVANCED TECHNOLOGY IN TELECOMMUNICATIONS

Through the New York State Center for Advanced Technology in Telecommunications (CATT), electrical and computer engineering faculty collaborate with industry in research, education and technology transfer in telecommunications and information systems. CATT is distinguished for its innovations in many fast-moving areas, including broadband networks, peer-to-peer networking, switch design and implementation, security hardware, ad-hoc wireless networks, cellular networks, wireless local area networks, software design and reliability, search engine technology, network design tools, traffic planning and capacity engineering, image and video coding and transport.

WIRELESS INTERNET CENTER FOR ADVANCED TECHNOLOGY

The Wireless Internet Center for Advanced Technology (WICAT) is a National Science Foundation center organized under its Industry/University Cooperative Research program. Polytechnic Institute is the lead site for WICAT, which includes sites at the University of Virginia, Auburn University and Virginia Tech. WICAT collaborates with more than 30 industry partners to overcome technical challenges and create new applications for the future Internet. In the future, the majority of devices will be mobiles that connect wirelessly. Institute research gives companies a crystal ball with a view of the future. Industry collaboration maximizes the practical value of new knowledge created at the WICAT universities.

FACULTY

PROFESSORS

Steve Arnold, University and Thomas Potts Professor of Physics (Joint appointment with Department of Physics)
PhD, City University of New York
Microparticle photophysics, photonic atom biosensors

Frank A. Cassara, Professor of Electrical and Computer Engineering, Director of Long Island Graduate Center
PhD, Polytechnic Institute of Brooklyn
Electronic circuits, wireless communication systems

David C. Chang, Professor of Electrical and Computer Engineering, Chancellor
PhD, Harvard University
Electromagnetics, microwave integrated circuits

H. Jonathan Chao, Professor of Electrical and Computer Engineering, Department Head
PhD, The Ohio State University
Network security, high-performance routers, network on chip

Zhong-Ping Jiang, Professor of Electrical and Computer Engineering
PhD, École des Mines de Paris (France)
Control systems, complex networks

Ramesh Karri, Professor of Electrical and Computer Engineering
PhD, University of California, San Diego
VLSI, CAD, computer engineering

Farshad Khorrami, Professor of Electrical and Computer Engineering
PhD, The Ohio State University
Robotics, control systems

Spencer P. Kuo, Professor of Electrical and Computer Engineering
PhD, Polytechnic Institute of Brooklyn
Plasmas and electromagnetics

I-Tai Lu, Professor of Electrical and Computer Engineering
PhD, Polytechnic Institute of Brooklyn
Electromagnetics, acoustics, wireless communication

Shivendra S. Panwar, Professor of Electrical and Computer Engineering, Director of the New York State Center for Advanced Technology in Telecommunications, Director of Wireless Internet Center for Advanced Technology
PhD, University of Massachusetts, Amherst
Communication networks

S. Unnikrishna Pillai, Professor of Electrical and Computer Engineering
PhD, University of Pennsylvania
Signal processing and communications

Yao Wang, Professor of Electrical and Computer Engineering
PhD, University of California, Santa Barbara
Image and video processing, computer vision, medical imaging

Zivan Zabar, Professor of Electrical and Computer Engineering
Sc.D., Technion - Israel Institute of Technology
Electric power systems, electric drives, power electronics

ASSOCIATE PROFESSORS

Dariusz Czarkowski, Associate Professor of Electrical and Computer Engineering
PhD, University of Florida
Power electronics and systems, electric drives

Nirod K. Das, Associate Professor of Electrical and Computer Engineering
PhD, University of Massachusetts
Electromagnetics, antennas, microwave integrated circuits

Francisco de Leon, Associate Professor of Electrical and Computer Engineering
PhD, University of Toronto (Canada)
Power-system analysis, distributed generation systems, smart grid

Elza Erkip, Associate Professor of Electrical and Computer Engineering
PhD, Stanford University
Wireless communication, communication theory, information theory

Sundeep Rangan, Associate Professor of Electrical and Computer Engineering
PhD, University of California, Berkeley
Wireless communication, signal processing and estimation, information theory

Ivan W. Selesnick, Associate Professor of Electrical and Computer Engineering
PhD, Rice University
Signal processing

Peter Voltz, Associate Professor of Electrical and Computer Engineering
PhD, Polytechnic Institute of New York
Communications and signal processing

ASSISTANT PROFESSORS

Helen Li, Assistant Professor of Electrical and Computer Engineering
PhD, Purdue University
VLSI and circuit design, computer architecture, memory technology and design, microelectronics and nanotechnology

Yong Liu, Assistant Professor of Electrical and Computer Engineering
PhD, University of Massachusetts, Amherst
Communication networks

Garrett S. Rose, Assistant Professor of Electrical and Computer Engineering
PhD, University of Virginia
VLSI, Nanoelectronics, low-power circuit design

INDUSTRY FACULTY

N. Sertac Artan, Industry Assistant Professor of Electrical and Computer Engineering
PhD, Istanbul Tech. University (Turkey)
High-speed network security

Matthew Campisi, Industry Assistant Professor of Electrical and Computer Engineering
MS, Polytechnic University
Signal processing, medical imaging

Michael Knox, Industry Associate Professor of Electrical and Computer Engineering
PhD, Polytechnic University
Wireless communications, RF and microwave components, analog-circuit design

Kang Xi, Industry Assistant Professor of Electrical and Computer Engineering
PhD, Tsinghua University (China)
High-speed networking

RESEARCH FACULTY

Thanasis Korakis, Research Assistant Professor
PhD, University of Thessaly (Greece)
Wireless networks

Pei Liu, Research Assistant Professor
PhD, Polytechnic University
Wireless Communications and Networks

Mohamed Zahran, Research Associate Professor
PhD, University of Maryland at College Park
Computer architecture, memory-hierarchy for multicore/manycore processors

Yang Xu, Research Assistant Professor
PhD, Tsinghua University (China)
High-speed networking

ADJUNCT FACULTY

Walid Ahmed, Adjunct Lecturer
PhD, Queens University (Canada)

Barbaros Aslan, Adjunct Lecturer
PhD, Cornell University

Eric Brendel, Adjunct Lecturer
MS, Pennsylvania State University

Mark Cavallaro, Adjunct Lecturer
MBA, Iona College

Tapan Chakraborty, Adjunct Lecturer
PhD, Rutgers University

Robert DiFazio, Adjunct Lecturer
PhD, Polytechnic University

Gusteau Duclos, Adjunct Lecturer
PhD, Polytechnic University

Barbara Gates-Karnik, Adjunct Lecturer
PhD, Fletcher School of Tufts University

Jalal Gohari, Adjunct Lecturer
BS, The City University of New York

Donald Grieco, Adjunct Lecturer
MBA, Long Island University, CW Post
MS, Polytechnic Institute of Brooklyn

Ian Harris, Adjunct Lecturer
M.Sc, Herriot-Watt University (Scotland)

Noah Jacobsen, Adjunct Lecturer
PhD, University of California, Santa Barbara

Lurng-Kuo Liu, Adjunct Lecturer
PhD, University of Maryland

Xiaoqiao Meng, Adjunct Lecturer
PhD, University of California, Los Angeles

Paul Moon, Adjunct Lecturer
PhD, University of Manitoba (Canada)

Hyung Myung, Adjunct Lecturer
PhD, Polytechnic University

Charles Perng, Adjunct Lecturer
PhD, University of California, Los Angeles

Richard Stern, Adjunct Lecturer
MS, Polytechnic University

George Sullivan, Adjunct Lecturer
MS, Polytechnic University

Dong Sun, Adjunct Lecturer
PhD, Stevens Institute of Technology

Sindhu Suresh, Adjunct Lecturer
PhD, Polytechnic Institute of NYU

Chin-Tuan Tan, Adjunct Lecturer
PhD, Nanyang Technological University (Singapore)

Gerald Volpe, Adjunct Lecturer
PhD, New York University

David Wang, Adjunct Lecturer
PhD, Polytechnic University

Fred Winter, Adjunct Lecturer
PhD, Polytechnic University

Catherine Zhang, Adjunct Lecturer
PhD, Harvard University

Li Zhang, Adjunct Lecturer
PhD, Columbia University

Zhenqxue Zhao, Adjunct Lecturer
PhD, Polytechnic University

FACULTY EMERITI

David J. Goodman, Professor of Electrical and Computer Engineering
PhD, Imperial College, University of London (England)

Leonard Bergstein, Professor Emeritus of Electrical Engineering
PhD, Polytechnic Institute of Brooklyn

Henry L. Bertoni, Professor Emeritus of Electrical Engineering
PhD, Polytechnic Institute of Brooklyn

Leo Birenbaum, Associate Professor Emeritus of Electrical Engineering and Electrophysics
MS, Polytechnic Institute of Brooklyn

Donald Bolle, Professor Emeritus of Electrical Engineering, Emeritus Provost
PhD, Purdue University

Joseph J. Bongiorno, Jr., Professor Emeritus of Electrical Engineering
DEE, Polytechnic Institute of Brooklyn

Robert Boorstyn, Professor Emeritus of Electrical Engineering
PhD, Polytechnic Institute of Brooklyn

Edward S. Cassedy, Professor Emeritus of Electrical Engineering
DrEng, Johns Hopkins University

Bernard R. S. Cheo, Professor Emeritus of Electrical Engineering
PhD, University of California at Berkeley

Douglas A. Davids, Associate Professor Emeritus of Electrical Engineering
PhD, Johns Hopkins University

Rudolf F. Drenick, Professor Emeritus of Electrical Engineering
PhD, University of Vienna (Austria)

Herman Farber, Associate Emeritus Professor of Electrophysics
MEE, Polytechnic Institute of Brooklyn

Richard A. Haddad, Professor Emeritus of Electrical Engineering
PhD, Polytechnic Institute of Brooklyn

Donald F. Hunt, Professor Emeritus of Electrical Engineering
BS, University of Pennsylvania

Ludwik Kurz, Professor Emeritus of Electrical Engineering
EngScD, New York University

James T. LaTourette, Professor Emeritus of Electrophysics
PhD, Harvard University

Nathan Marcuvitz, University Professor Emeritus
DEE, Polytechnic Institute of Brooklyn

Maurice C. Newstein, Professor Emeritus of Electrophysics
PhD, Massachusetts Institute of Technology

Arthur A. Oliner, Professor Emeritus of Electrophysics
PhD, Cornell University

Istvan Palocz, Professor Emeritus of Electrical Engineering and Electrophysics
PhD, Polytechnic Institute of Brooklyn

Philip E. Sarachik, Professor Emeritus of Electrical Engineering
PhD, Columbia University

Harry Schachter, Professor Emeritus of Electrical Engineering
PhD, Polytechnic Institute of Brooklyn

Benjamin Senitzky, Professor Emeritus of Electrophysics
PhD, Polytechnic Institute of Brooklyn

Sidney S. Shamis, Professor Emeritus of Electrical Engineering
MS, Stevens Institute of Technology

Leonard G. Shaw, Professor Emeritus of Electrical Engineering
PhD, Stanford University

Jerry Shmoys, Professor Emeritus of Electrical Engineering
PhD, New York University

Theodore Tamir, University Professor Emeritus
PhD, Polytechnic Institute of Brooklyn

Wen-Chung Wang, Professor Emeritus of Electrical Engineering and Electrophysics
PhD, Northwestern University

Gerald Weiss, Professor Emeritus of Electrical Engineering
DEE, Polytechnic Institute of Brooklyn

Dante C. Youla, University Professor Emeritus
MS, New York University

DEPARTMENT OF FINANCE AND RISK ENGINEERING

Head: Charles S. Tapiero
Deputy Head: Barry Blecherman

MISSION

The Department of Finance and Risk Engineering creates world-class research and degree programs bridging theory and practice in our disciplines.

THE DEPARTMENT

The Department of Finance and Risk Engineering (FRE) is a diversified research and degree granting department—the second in the U.S. to provide the MS degree in Financial Engineering—providing a broadly based education in corporate and computational finance and financial markets, risk finance (including credit risk, insurance and financial risk engineering) and technology and algorithmic finance. The department's mission is to provide the talent and excellence needed by financial services industries and their many associated professions.

The department's educational and MS-degree-granting programs, research and extracurricular activities seeks to bridge theory and practice and meet the many and complex challenges that the financial engineering professions are confronted with now and in the future. Graduates may assume diversified employment positions in the many facets that make up the financial engineering profession. Trading desks, hedge fund and investment managers, CFOs, quantitative professionals, insurance firms, financial technology managers as well as financial and specialized risk managers define the broad set of professions that are open to NYU-Poly's graduates in financial engineering.

The department's curriculum combines a rigorous vision of economics, finance, applied quant finance, actuarial science and financial technology in their theoretical and practical setting in a global world and global financial markets.

In addition, the department provides interdisciplinary certificate and opportunities to combine studies, such as computer science, mathematics and engineering with financial management and technology and risk engineering.

The department is based both in Brooklyn at the MetroTech Center and in Wall Street, in the midst of the world's leading financial center. Our MS degrees and certificates offer specialization tracks spanning Corporate and Financial Markets (CM), Computational Finance (CF), Technology and Algorithmic Finance (TAF), and Risk Finance (RF) emphasizing the convergence of credit risk, insurance and financial risk management.

The department is staffed by a number of leading academics and practitioners, both nationally and internationally, and boasts a number of outstanding affiliated professors and cutting-edge traders, hedge funds managers and academics turned practitioners by the lure of Wall Street. This combination of talent, theoretically and practically based, national and international, provides a first-rate education embedded in answering the real needs of the financial services sector that recognizes the continuous growth of finance, financial insurance and risk engineering, technology, financial engineering and management in an increasingly global world. In addition, the department has a Research Institute that emphasizes specialized research areas and provides a public service. These include:

- Research focusing on of the many issues that transpired following the financial credit crisis, incomplete markets finance (including rare, Black Swans and uncommon risks finance, financial regulation, leverage, liquidity and corporate structure, real finance and business policy, alternative and behavioral finance as well as topical projects pursued by students and faculty.
- Research on Algorithmic Trading, emphasizing trading platforms and software development and the management of financial technology. The institute is a research hub as well as a laboratory for generating new ideas in computer science and finance. The Institute undertakes collaborative research projects to provide ideas, methods and tools with scholarly and practical applications with the purpose of opening greater opportunities for our students when they graduate.
- Research in corporate finance, liquidity management and the many facets of theoretical and applied finance.

The department operates in close collaboration with NYU's other educational programs (such as the Financial Mathematics program at the Courant Institute of Mathematical Sciences) as well as a number of universities in Europe and China. Collaborative agreements will allow some students to visit other similar programs and profit from more diversified cultures and experiences that are essential today in a more global financial environment.

CONTACT

Polytechnic Institute of NYU
Six MetroTech Center
Brooklyn, NY 11201
Tel: (718) 260-3561
Fax: (718) 260-3355
Web: www.poly.edu/academics/departments/finance

THE PROFESSION

Financial engineering is driven by financial practice to bridge means and ends and to reconcile the theoretical foundations of financial economics with the reality of financial markets. Finance is about money and therefore, all problems that can be transformed to a real or to a synthetic financial money framework can profit by the extent to which money is used and exchanged. It is in such a perspective, that many economic and engineering problems can be conceived as "financial engineering problems." This conception of financial engineering underpins the NYU-Poly Institute programs in finance. In this spirit, our goal and objectives pertain to trading, speculating, investing, pricing and corporate and risk management but also to pricing and managing the risks of infrastructure, the environment and business management. In this sense, financial engineering as with all technology and scientific based professions is a "work in progress," whose purpose is to present and communicate with practitioners and financial engineering students to better prepare their entering the world of finance. We meet the challenges of financial markets—in analysis, pricing, trading and investing—for technology managers and computational finance engineers in fast-moving, highly rewarding careers that create value enabled by finance, technology and computational mathematics.

DEGREES OFFERED

Master of Science in Financial Engineering

Tracks

- Corporate and Financial Markets
- Computational Finance
- Technology and Algorithmic Finance
- Risk Finance (Credit Risk, Financial Insurance and Financial Risk Management)

Graduate Certificates

- Financial Engineering
- Financial Information Services and Technology Management
- Risk Management

Classrooms

Manhattan Location
55 Broad Street, Lower Concourse
New York, NY 10004

GRADUATE AND CERTIFICATE PROGRAMS

THE MASTER OF SCIENCE PROGRAM

The Master of Science in Financial Engineering (FE) is a 33-credit program designed to provide the skills required to operate at the cutting-edge of financial engineering in today's financial services industry. Separate tracks make it possible to pursue careers in financial markets and corporate finance, in financial technology, in computational finance or in risk finance. The program is rigorous, demanding and selective.

Graduates of the Financial Markets and Corporate Finance Track are expected to seek positions in financial management groups, on trading and arbitrage desks, in product structuring groups, in derivatives groups, in investment banking departments and in the information-technology firms that support the trading operations of financial institutions.

Graduates of the Technology and Algorithmic Finance Track are actively involved in the development and implementation of the entire spectrum of algorithmic trading strategies, software applications, databases and networks used in modern financial services firms. The techniques it applies bridge computer science and finance to prepare graduate to participate in large-scale and mission-critical projects. Applications include high frequency finance, behavioral finance, agent-based modeling and algorithmic trading and portfolio management.

The Computational Finance Track emphasizes both financial quantitative theory and practice, bridging the two and using both the fundamental concepts of finance and the stochastic and optimization methods and software in finance. This track is meant for those individuals with a strong desire to become quantitative financial managers or to pursue applied finance research interests in cutting-edge investment science, trading and in financial risk management. Techniques such as quantitative finance, financial econometrics, stochastic modeling, simulation and optimization are part of a set of financial tools applied to the many problems of derivatives and options finance, arbitrage trading algorithms, asset pricing, credit risk and credit derivatives, developing new derivative products and the many areas where quant finance has a contribution to make. Graduates of the Computational Finance Track will be qualified to work in pricing financial risk and their management, in credit risk and their derivatives, in cutting-edge institutions, in quant hedge funds and in research and advanced product development departments of financial and consulting firms.

Graduates of the Risk Finance Track will have the qualification and abilities to become responsible specialists for positions in finance, credit granting firms, banks and insurance companies, as well as obtain the knowledge needed to face the upcoming complex problems arising by the increased use and centrality of financial insurance products (contributing to the development of complex financial products and a convergence) of finance and insurance. The complementary actuarial profession is a discipline that uses tools from statistics, probability theory and finance to analyze and solve practical problems in insurance and financial risk management. Actuaries assemble and analyze data to estimate the probability and likely cost of an event such as death, sickness, injury, disability or loss of property. Courses in risk finance provide the background for the first four actuarial examinations supervised by the Society of Actuaries and the Casualty Actuarial Society and cover additional educational experience requirements. The department both supports and encourages students in their preparation for and the acquisition of such certificates as these are important elements in job-seeking in the insurance-quant sector.

NYU-Poly's Master of Science in Financial Engineering brings together four key areas: finance and related business disciplines, quantitative analysis (mathematics and statistics), information technology (telecommunications and computer science) and management. In addition, it provides an opportunity to attend to the many areas of business and management where finance is an essential element.

The financial and practical component of the educational program has been further strengthened by developing a large and versatile body of adjunct faculty consisting of leading financial market practitioners from major Wall Street firms and international professors' affiliates. These adjunct faculty members work closely with NYU-Poly's full-time faculty emphasizing both applied and theoretical research in bringing to financial engineering students a greater sensitivity to the needs and the demands of financial markets and the management of financial services and institutions.

ADMISSIONS

The Master of Science in Financial Engineering at Polytechnic Institute is very highly selective. All applicants must present transcripts from all colleges and universities they have attended as well as GRE (Graduate Record Exam) or GMAT (Graduate Management Admission Test) test scores; there are no exceptions to this rule. (Please note that the department strongly prefers GRE scores over GMAT scores.) Applicants who have undergraduate average above 3.0 or a master's degree and also have a GRE or GMAT quantitative score that is superior and a verbal score that shows competence in English are considered for admission. Completed applications must be received by Polytechnic by April 1 for consideration for the fall semester or by October 15 for consideration for the spring semester.

For the GRE or GMAT, the institution code is 2668; a department code is not necessary. Additionally, the applicant must have sufficient proficiency and aptitude in mathematics. This may be demonstrated by grades earned in relevant course work and/or standardized examinations. This criterion is not entirely objective and will be established by the Academic Director. Applicants who meet the above criteria are by no means guaranteed admission, which is also based on a competitive performance of applicants.

Two letters of recommendation are also required for admission. The student must demonstrate a proficiency in the English language as measured by verbal scores on the GRE or GMAT or successfully complete a series of ESL courses in order to commence formal study.

The Graduate Certificates associated with the Financial Engineering Program have the same application requirements and prerequisites as the Master of Science degree.

Applicants requesting admission for study only in a particular course or group of courses are given Special or Visiting Student Status, which permits registration, generally for a limited duration, in those courses indicated by the approval of admission. Registration is limited to 6 credits per semester. If additional courses are desired after the end of the specified period, a new admission request must be filed through the admissions office. Special Status students who later apply for and are accepted to the master's or certificate program may transfer up to 9 credits taken while on Special Status. Special Status students are expected to complete the GRE or GMAT exam before applying for admission to MS FE or any associated Graduate Certificate. The GPA earned as a Special Status student will be used as part of the admissions decision in place of the undergraduate GPA.

Individuals interested in applying for admissions to either the Master of Science in Financial Engineering or the Graduate Certificate Program please visit the Graduate Admissions website page at www.poly.edu/graduate. The site has a downloadable application and information on tuition and financial aid.

UNDERGRADUATE MINOR

The Department of Finance and Risk Engineering offers an Undergraduate Minor in Finance. The intent of this program of study is to allow NYU-Poly undergraduate students in the sciences and engineering to leverage their mathematical talents in a selected number of appropriate courses. For more information on the Finance Minor, contact Prof. Barry Blecherman at (718) 260-3398 or blecherman@poly.edu.

FACULTY

PROFESSORS

Charles S. Tapiero, The Morton and Angela Topfer Distinguished Professor in Financial Engineering and Technology Management, Department Head of Finance and Risk Engineering
PhD, New York University
MBA New York University
B. App. Science (Electrical Engineering), Polytechnique-University of Montreal
Financial engineering, business and operations risks engineering and management

Nassim Nicholas Taleb, Distinguished Professor of Risk Engineering
PhD, University of Paris (Paris 9 Dauphine), MBA, Wharton School, University of Pennsylvania
Domestication of the unknown, philosophy of chance, uncertainty and probability

ASSISTANT PROFESSOR

Philip Maymin, Assistant Professor of Risk Engineering
PhD, University of Chicago
Alternative and behavioral finance

INDUSTRY FACULTY

Franziska Berger, Industry Assistant Professor of Mathematics and Financial and Risk Engineering
PhD, Munich University of Technology
Discrete mathematics

Barry S. Blecherman, Industry Professor of Financial Engineering
PhD, Wharton School of the University of Pennsylvania
Information economics and strategy, decision theory, business negotiations

Fredrick Novomestky, Industry Professor of Financial Engineering
PhD, Polytechnic Institute of Brooklyn
Asset/liability modeling and management, evolutionary computational algorithms for mathematical optimization, multiple criteria decision making models, quantitative investment strategy

RESEARCH FELLOW

Anne Zissu, Research Fellow
PhD, The Graduate School and University Center of the City University of New York
Corporate finance, risk management, securitization

ADJUNCT FACULTY

Sassan Alizadeh, Adjunct Associate Professor of Financial Engineering
PhD, Wharton School of the University of Pennsylvania
Term-structure model, quantitative trading strategies

Lucas Bernard, Adjunct Associate Professor of Financial Engineering
PhD, The New School for Social Research
Credit derivatives, corporate finance

Paul Biederman, Adjunct Associate Professor of Financial Engineering
PhD, New School University
Financial market regulation, industry economic analysis

Robert Biolsi, Adjunct Associate Professor of Financial Engineering
PhD, City University of New York
Innovation, equity prices and commodity diversification, electricity deregulation

Jean-Carlo Bonilla, Adjunct Associate Professor of Financial Engineering
MS, Polytechnic University
Quantitative methods in finance

Peter Cai, Adjunct Associate Professor of Financial Engineering
PhD, Pennsylvania State University
Trading, hedge funds and risk engineering

Raphaelle Chappe, Adjunct Associate Professor of Financial Engineering
JD, New York University School of Law
Taxation and regulation in finance

Rohan Douglas, Adjunct Associate Professor of Financial Engineering
BSc, Sydney University (Australia)
Market theory, credit derivatives

Roy Freedman, Adjunct Associate Professor of Financial Engineering
PhD, Polytechnic Institute of New York
Evolutionary information technology, quantitative methods in finance, artificial intelligence

Sebastien Galy, Adjunct Associate Professor of Financial Engineering
PhD, Concordia University
Dynamic asset pricing, option pricing

Barry Guttenplan, Adjunct Associate Professor of Financial Engineering
MPhil, Yale University
Taxation and finance, credit derivatives

Thomas Hutchinson, Adjunct Associate Professor of Financial Engineering and Management
MA, McMaster University (Canada)
Investment banking, financial economics

Maureen Koetz, Esq., Adjunct Associate Professor of Financial Engineering
JD, Washington College of Law
Environmental finance

Andrew Kalotay, Adjunct Associate Professor of Financial Engineering
PhD, University of Toronto
Debt management, valuation of bonds, interest-rate derivatives and mortgage-backed securities

Victor Makarov, Adjunct Associate Professor of Financial Engineering
PhD, Academy of Sciences - Moscow
Value at risk, financial regulation

Steven Mandel, Adjunct Associate Professor of Financial Engineering
PhD, New York University
Risk management, portfolio optimization, return attribution

Ingrid Marshall, CPA, Adjunct Associate Professor of Financial Engineering
MBA, St. John's University
Corporate financial accounting

Anthony Pepennella, Adjunct Associate Professor of Financial Engineering
Florida State University, Financial and Operations Principal: Series 24, NASD Registered Representative: Series 7, NASD
Financial accounting, financial statement analysis

Ronald T. Slivka, Adjunct Associate Professor of Financial Engineering
PhD, Wharton School of the University of Pennsylvania
Quantitative approaches to derivative securities valuation and applications, quantitative investment strategies

Richard Van Slyke, Adjunct Associate Professor of Financial Engineering
Professor Emeritus of Computer Science
PhD, University of California, Berkeley
Financial risk optimization

Charles Stone, Adjunct Associate Professor of Financial Engineering
PhD, City University of New York
Editor of The Financier and The Securitization Conduit

Kimberly Swain, Adjunct Associate Professor of Financial Engineering
BA, University of Texas, Austin, Series 7 and 63
Infrastructure finance

Daniel Totouom-Tangho, Adjunct Associate Professor of Financial Engineering
PhD, École des Mines Paris, Polytechnique-Paris
Financial modeling, stochastic calculus

Edward Dean Weinberger, Adjunct Associate Professor of Financial Engineering
PhD, Courant Institute of Mathematical Sciences, New York University
Credit risk measurement and management

INTERNATIONAL PROFESSORS ASSOCIATES

Alain Bensoussan, Polytechnic University of Hong Kong and University of Texas, Dallas

Ron Kennett, University of Torino, Italy and KPA-Israel

Konstantin Kogan, Bar Ilan University, Israel

W.K. Li, The University of Hong Kong

Bertrand Munier, ENSAM and the University of Paris I, France

Claude Pondhaven, University of Paris II, France

Fabrizzio Ruggieri, Center for National Research, Milan, Italy

Aimme Scannavino, University of Paris II, France

Lorne Switzer, Concordia University, Montreal, Canada

Pierre Vallois, University of Nancy, France

GENERAL ENGINEERING

GOALS AND OBJECTIVES

A prime mission of Polytechnic's first-year college experience is to teach students how to learn. Students will be equipped for life in our rapidly changing world, where it is especially true in the science and engineering studies that education is a lifetime commitment. Polytechnic's first-year curriculum emphasizes learning by doing through the repeated application of new concepts and skills in practical situations of increasing complexity and sophistication. Faculty leadership of learning by doing involves mentoring of individual students, exploring different learning styles, encouraging working in teams on real professional problems, and modeling what it means to be a superb professional and an involved citizen.

REQUIRED COURSES

All first-year students, including transfer students with fewer than 6 credits, are required to enroll in EG 1001, the Engineering and Technology Forum course. Students majoring in engineering and technology disciplines will also enroll in EG 1003, a hands-on engineering analysis and design course in their first semester of study at Polytechnic. In this course, students engage in relevant engineering design projects.Through active involvement and teamwork, students follow practices and approaches used in industry and research entities to solve real-world engineering problems.

EG 1001 Engineering and Technology Forum *1: 0: 0: 1*

In this course, the notions of invention, innovation and entrepreneurship (i^2e) are brought to the forefront of students' educational experience in an effort to introduce undergraduates to elements of a research-intensive institution and encourage intellectual and scholarly interaction with their peers and faculty. This course includes presentations and discussions on emerging and exciting topics by leading engineers, scientists, inventors and entrepreneurs discussing case studies on innovations, inventions and entrepreneurship as well as relevant contemporary and emerging environmental-, economic-, global-, energy- and health-related topics. The course exposes students to an array of collegiate academic skills such as the elements of a research-intensive institute, information-technology resources and ethics in science and engineering, as well as discussions of student life–related topics and issues.

EG 1003 Introduction to Engineering and Design *.5: 2.5: 2: 3*

This course introduces selected aspects of the history, philosophy, methodology, tools and contemporary topics in engineering. Also included are basic engineering experimentation and data analysis, a team-design project and analysis and presentation of engineering data and designs.

FACULTY

INDUSTRY PROFESSORS

Gunter Georgi, PE, Industry Professor, Director of General Engineering
ME, Columbia University
MSME, Columbia University
BSME, Cooper Union

Dimitri James Cordista, Industry Assistant Professor
BSIE, Polytechnic University

David Lefer, Industry Professor, Director of the Engineering and Technology Forum
MS, Columbia University

DEPARTMENT OF MATHEMATICS

Head: Erwin Lutwak

The Department of Mathematics is committed to excellence and innovation in the teaching and research of mathematics. Current active areas of research include geometric analysis, differential topology and partial differential equations. The bachelor's, master's and doctoral degree programs provide both a solid foundation in mathematics and extensive exposure to how mathematics is used in practice. Half of a mathematics major's courses are taken in other departments. The department also offers a complete spectrum of undergraduate and graduate courses.

MISSION STATEMENT

The mission of the Department of Mathematics is to develop and implement innovative teaching strategies designed to help each student understand fundamental mathematical concepts and to use these concepts to excel in subsequent science and engineering courses.

Students taking departmental courses become confident in their abilities to reason rigorously, use the language of mathematics properly, write and speak about mathematical ideas precisely and concisely and appreciate the amazing power of mathematics to describe phenomena in the world. Students learn how to use mathematical software as a tool in the study and application of mathematics.

THE DEPARTMENT

The department offers BS, MS and PhD degrees, with a strong interdisciplinary focus. The BS in Mathematics, for instance, has an optional concentration in physics. The MS in Mathematics focuses on strong abstract and quantitative reasoning abilities. The PhD in Mathematics encourages work applying advanced mathematics in other disciplines, with the major adviser from those disciplines.

To support its academic quality and to strengthen interdisciplinary work, the department's research excels in the areas of convex geometry and the analysis of nonlinear partial differential equations arising from gauge field theory.

DEGREES OFFERED

Bachelor of Science
- Mathematics

Master of Science
- Mathematics

Doctor of Philosophy
- Mathematics

CONTACT

Polytechnic Institute of NYU
Six MetroTech Center
Brooklyn, NY 11201
Tel: (718) 260-3850
Fax: (718) 260-3660
E-mail: chair@math.poly.edu
Web: www.math.poly.edu

FACULTY

PROFESSORS

Monika Ludwig, Professor of Mathematics
PhD, Technische Universität Wien
Convex geometry, valuations, geometric and analytic inequalities

Erwin Lutwak, Professor of Mathematics, Department Head
PhD, Polytechnic Institute of New York
Geometric analysis

Edward Y. Miller, Professor of Mathematics
PhD, Harvard University
Differential topology

Deane Yang, Professor of Mathematics
PhD, Harvard University
Geometric analysis

Yisong Yang, Professor of Mathematics
PhD, University of Massachusetts at Amherst
Partial differential equations, mathematical physics

Gaoyong Zhang, Professor of Mathematics
PhD, Temple University
Geometric analysis

ASSOCIATE PROFESSORS

Kathryn Kuiken, Associate Professor of Mathematics
PhD, Polytechnic Institute of New York
Complex analysis, group theory

Joel C. W. Rogers, Associate Professor of Mathematics
PhD, Massachusetts Institute of Technology
Partial differential equations, fluid mechanics, numerical methods

INDUSTRY FACULTY

David V. Chudnovsky, Distinguished Industry Professor of Mathematics
PhD, Institute of Mathematics, Ukrainian Academy of Science
Theoretical mathematics: number theory, partial differential equations, Hamiltonian systems. Mathematical physics: field theories, quantum systems. Computer science: computer algebra and complexity, large-scale numerical mathematics, parallel computing and digital signal processing

Gregory V. Chudnovsky, Distinguished Industry Professor of Mathematics
PhD, Institute of Mathematics, Ukrainian Academy of Science
Number theory: analytic number theory, diophantine approximations and transcendence theory. Mathematical physics: nonlinear equations, quantum and classical fields. Computer science: computer algebra and complexity, large-scale numerical mathematics, parallel computing and digital signal processing

ASSISTANT PROFESSOR

Franziska Berger, Assistant Professor
PhD, Munich University of Technology
Discrete mathematics

TEACHING FACULTY

Vanita Khosla, Instructor
MS, Polytechnic Institute of NYU
Calculus, precalculus

Harvansh Manocha, Industry Professor of Mathematics
PhD, Panjab University (India)
Lie groups and special functions

Luciano Medina, Instructor
MS, Polytechnic Institute of NYU
Partial differential equations and mathematical biology

Arman Mimar, Instructor
PhD, Columbia University
Number theory, arithmetic geometry

Jinghua Qian, Instructor
PhD, Tufts University
Probability and stochastic process, statistics

Tom Pranayanuntana, Instructor
PhD, Polytechnic University
Matrix inequalities, discrete convexity and convex geometry

Lindsey Van Wagenen, Senior Lecturer
PhD, Columbia University
Applied physics

ADJUNCT FACULTY

Michel Lobenberg, Adjunct Professor
PhD, Columbia University
Banach spaces, probability and stochastic processes, mathematical physics

Sudhakar Mishra, Adjunct Professor
PhD, City University of New York
Algebraic topology, computational number theory, statistical and mathematical modeling, fuzzy set theory, diagnostic pattern recognition, proteomics

Jiazu Zhou, Research Professor
PhD, Temple University
Convex geometry, integral geometry

ADJUNCT INSTRUCTORS

Irina Bronstein
MS, Donetsk University

Amakoe Gbedemah
MA, Queens College

Daniel Khachatorian
BS, Polytechnic Institute of NYU

Rachel Jacobovits
MS, Polytechnic University

Liana Lazarashvili
MS, Georgian Academy of Science

Vaishali Prabhu
PhD, Karnatak University

Abraham Sher
ME, City College of New York
MA, Brooklyn College

Hanna Ulman
BA, Hebrew University
Teaching Certificate, Tel Aviv University

Fang Zhao
MS, Polytechnic University

FACULTY EMERITI

Heinrich Guggenheimer
Leon Herbach
Harry Hochstadt
Burton Lieberman
Clifford W. Marshall
Lesley Sibner
Andrew J. Terzuoli
Hermann Waldinger
Georges Weill
Erich Zauderer

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

Head: George Vradis

MISSION STATEMENT

The mission of the Department of Mechanical and Aerospace Engineering is to prepare students for careers in mechanical and related engineering disciplines for professional development, life-long learning and contributions to society. Furthermore, the department adds value to the student's market and career potential by emphasizing an understanding of the physical world through projects, tools and practice, and by providing the foundation tools for innovation, invention and entrepreneurship.

THE DEPARTMENT

The Department of Mechanical and Aerospace Engineering is an ideal destination for U.S. and international students interested in joining a dynamic department that offers educational and research opportunities in traditional and emerging areas of mechanical engineering. The department not only stresses creativity and innovation, but also emphasizes fundamental understanding of the underlying sciences, design methodologies and economic and social impact of engineered products. Polytechnic graduates hold leadership positions worldwide in careers spanning academia, industry and governmental and non-governmental organizations in both the engineering and other professional fields.

The undergraduate mechanical engineering curriculum balances fundamental science and engineering principles and engineering practice. Courses emphasize engineering-science fundamentals and computer applications that employ modern engineering tools. The program heavily emphasizes laboratory experience, engineering design and student participation in research programs.

Graduate studies provide a broad understanding of the mechanical engineering field combined with a deep understanding of one of its sub-disciplines, while they promote interdisciplinary studies, student professional development and lifelong learning skills. Traditional and emerging mechanical engineering-related areas of study are available. Program flexibility allows students to satisfy intellectual interests and pursue professional goals. Coursework and research opportunities are available in areas that include dynamical and complex systems, controls, composite materials and nano-materials, biomimetics, lasers and optical sensors, fluid mechanics and energy systems and fire research. State-of-the-art laboratory and computational facilities support the educational and research enterprise, while the low faculty-to-student ratio warranties the development of close student-faculty ties the graduate program's relatively small size allows students to form close relationships with faculty Adviser, greatly strengthening and enriching the students' experience and intellectual growth.

Students are encouraged to join Polytechnic's student chapters of the American Society of Mechanical Engineers (ASME), American Institute of Aeronautics and Astronautics (AIAA), National Society of Black Engineers (NSBE), Engineers Without Borders (EWB), Society of Women Engineers (SWE) and Society of Automotive Engineers (SAE), as well as honor societies, Pi Tau Sigma for mechanical engineers and Tau Beta Pi for engineers in general.

Polytechnic students benefit significantly from participation in cutting-edge research (funded by government, industry and not-for-profit organizations), access to state-of-the-art laboratories, collaboration with a faculty that cares greatly for students and devotes its energy to their growth, and living in one of the world's greatest cities.

THE PROFESSION

Mechanical engineers design, build and maintain the products and processes that define industrial and post-industrial societies. In its early days, mechanical engineering emerged as the discipline dedicated to producing power and building the first industrial machines. Mechanical engineering has evolved to the broadest of all engineering disciplines. Today, mechanical engineers are prime movers of innovation and invention in a wide range of dynamic and continually evolving industries. These industries include power production and aerospace, robotics and manufacturing, transportation and communication, electronics and mechatronics, and biotechnology and biomimetics. Mechanical engineers also have a long tradition of leadership in helping to develop and safeguard the natural environment by creating breakthroughs in such areas as resource conservation, improved efficiency of energy-consuming devices, development of codes for a safer technological environment, and new green-energy sources. The breadth of their training allows some mechanical engineers to apply their training to the diversified fields of computer engineering, nanotechnology, software development, financial engineering, bioengineering, astronautics, systems engineering, corporate management, law and medicine. As Polytechnic graduates mature and realize their abilities, their professional lives may center on engineering research, government, business, education or entrepreneurship.

CONTACT INFORMATION

Polytechnic Institute of NYU
Six MetroTech Center
Brooklyn, NY 11201
Tel: (718) 260-3160
Fax: (718) 260-3532
E-mail: MAE@poly.edu
Web: www.poly.edu/academics/departments/mechanical/

DEGREES OFFERED

The department offers degree programs in mechanical engineering at the Bachelor of Science, Master of Science and Doctor of Philosophy levels. The undergraduate Bachelor of Science program is accredited by the Engineering Accreditation Commission (AEC) of the Accreditation Board of Engineering and Technology (ABET). The doctoral degree is approved by the New York State Doctoral Program Review.

The objectives of the undergraduate mechanical-engineering program are for its graduates to: 1) engage in, and advance in, professional careers in mechanical or related engineering, or other career paths that include industry, academia and governmental or non-governmental organizations, and 2) seek continuous professional development and life-long learning through graduate-school studies, continuing-education credits and professional registration.

The department offers BS, MS and PhD degrees in mechanical engineering. Specific information about these programs may be found in the programs section of the catalog.

Bachelor of Science
- Mechanical Engineering
- Mechanical Engineering with minor in Aerospace Engineering

Master of Science
- Mechanical Engineering with concentrations in mechanics and structural systems, controls and dynamic systems and fluid dynamics and thermal systems

Doctor of Philosophy
- Mechanical Engineering with concentrations in aerospace engineering, materials engineering, mechanics and structural systems, controls and dynamic systems and fluid dynamics and thermal systems

FACULTY

PROFESSORS

Vikram Kapila, Professor of Mechanical Engineering
PhD, Georgia Institute of Technology
Linear/nonlinear control, distributed spacecraft formation flying and attitude control, mechatronics

Sunil Kumar, Professor of Mechanical Engineering
PhD, University of California at Berkeley
Thermal fluid sciences, applied mathematics

Said Nourbakhsh, Professor of Materials Science
PhD, Leeds University (England)
Phase transformation, electron microscopy, composite and smart materials, ferroelectric thin films

Michael J. Shelley, Professor of Mechanical Engineering and Lilian and George Lyttle Professor of Applied Mathematics at Courant Institute of Mathematical Sciences at New York University
PhD, University of Arizona
Fluid dynamics, computational physics, numerical analysis

ASSOCIATE PROFESSORS

Salvatore Grimaldi, Associate Professor of Mechanical Engineering and Associate Professor of Applied Hydrology at Universita degli Studi della Tuscia
PhD, Universita di Roma "La Sapienza"
Applied and statistical hydrology, GIS terrain analysis, tracer methods for hydrological applications

Nikhil Gupta, Associate Professor of Mechanical Engineering
PhD, Louisiana State University
Micro- and nano-composite materials/mechanics

Iraj M. Kalkhoran, Associate Provost of Undergraduate Academics and Associate Professor of Aerospace Engineering
PhD, University of Texas at Arlington
Gas dynamics, high-speed flows, wind tunnel testing, shock tubes

Maurizio Porfiri, Associate Professor of Mechanical Engineering
PhD, Virginia Polytechnic Institute and State University
Dynamics, vibrations, computational mechanics, robotics

Richard S. Thorsen, Associate Professor, Vice President Emeritus and Senior Advisor to the President
PhD, New York University
Heat transfer, energy systems, solar and nuclear energy

George Vradis, Associate Professor of Mechanical Engineering and Department Head
PhD, Polytechnic University
Computational fluid dynamics and heat transfer, energy systems

ASSISTANT PROFESSORS

Remi Dingreville, Assistant Professor of Mechanical Engineering
PhD, Georgia Institute of Technology
Theoretical and computational mechanics, multi-scale modeling, advanced materials

Joo Kim, Assistant Professor of Mechanical Engineering
PhD, The University of Iowa
Multibody dynamics, optimization theory, robotic manipulation, bioengineering

Sean Peterson, Assistant Professor of Mechanical Engineering and Assistant Professor of Mechanical & Mechatronics Engineering at University of Waterloo, Canada
PhD, Perdue University
Fluid mechanics, bio-fluid mechanics, energy harvesting

INDUSTRY AND RESEARCH PROFESSORS

Joseph Borowiec, Industry Associate Professor
PhD, Polytechnic Institute of New York
Finite elements method, structural mechanics, design

Annalisa Scacchioli, Visiting Assistant Professor of Mechanical Engineering
PhD, University of L'Aquila (Italy)
Automatic control, automotive systems

Peter S. Walker, Research Professor of Mechanical Engineering and Research Professor of Orthopedic Surgery at New York University Hospital for Joint Diseases
PhD, University of Leeds
Orthopedics, minimally invasive surgery

ADJUNCT FACULTY

Nicholas Dizinno
MS, Polytechnic University
Computer-aided design

Mehdi Naraghi
PhD, Polytechnic Institute of New York
Thermal and fluid systems

Sang-Hoon Lee
PhD, Polytechnic University
Measurement systems and automatic control

Nguyen Q. Nguyen
PhD, Polytechnic Institute of NYU
Mechanics of materials, sensors

Kee M. Park
PhD, Stevens Institute of Technology
Machine design

Iskender Sahin
PhD, Virginia Polytechnic Institute and State University
Thermal and fluid systems

Paul Sutton
JD, Brooklyn Law School
Intellectual property, intersections of law, engineering and business

Ali Vedavarz
PhD, Polytechnic University
Energy systems, green energy, HVAC

FACULTY EMERITI

Philip Abrami, Professor Emeritus
MS, Polytechnic Institute of Brooklyn

Vito D. Agosta, Professor Emeritus
PhD, Columbia University

Anthony E. Armenakas, PE, Professor Emeritus
PhD, Columbia University

William B. Blesser, Professor Emeritus
MEE, Polytechnic Institute of Brooklyn

Irving B. Cadoff, Professor Emeritus
DEngSc, New York University

Louis S. Castleman, Professor Emeritus
ScD, Massachusetts Institute of Technology

John R. Curreri, Professor Emeritus
MEE, Polytechnic Institute of Brooklyn

Carmine D'Antonio, Professor Emeritus
MMetE, Polytechnic Institute of Brooklyn

Jerome M. Klosner, PE, Professor Emeritus
PhD, Polytechnic Institute of Brooklyn

Harold Margolin, Professor Emeritus
DEngSc, Yale University

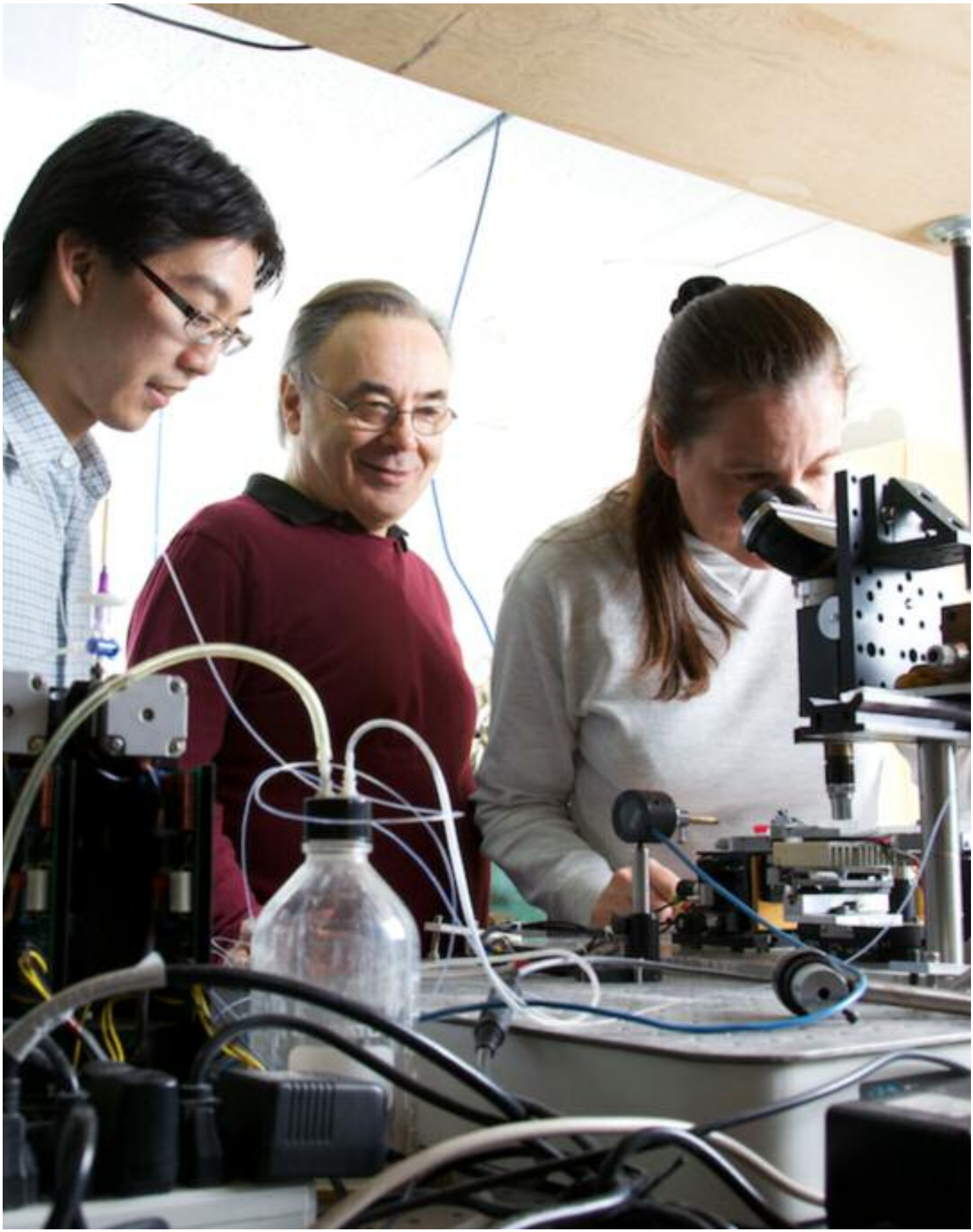
William R. McShane, PE, Professor Emeritus
PhD, Polytechnic Institute of New York

Gino Moretti, Professor Emeritus
PhD, University of Turin (Italy)

Sharad A. Patel, Professor Emeritus
PhD, Polytechnic Institute of Brooklyn

Bernard W. Shafer, PE, Professor Emeritus
PhD, Brown University

William P. Vafakos, PE, Professor Emeritus
PhD, Polytechnic Institute of Brooklyn
JD, Brooklyn Law School



DEPARTMENT OF TECHNOLOGY, CULTURE AND SOCIETY

Head: Kristen Day

MISSION STATEMENT

The interdisciplinary Department of Technology, Culture and Society (TCS) focuses on critical engagement with technology and science through research and teaching. This mission is fulfilled in part by undergraduate degree programs, including Integrated Digital Media, Science and Technology Studies and Sustainable Urban Environments, and by graduate programs in Integrated Digital Media, History of Science and Technology and Environment-Behavior Studies. The department is also responsible for NYU-Poly's core curriculum in humanities and social sciences, which gives students a breadth of knowledge and perspective necessary for careers in technology and the sciences.

DEPARTMENT: UNDERGRAD CLUSTER CURRICULUM: CORE REQUIREMENTS

THE CLUSTER CONCEPT

TCS offers humanities and social sciences elective courses that understand the relations among science, technology and society from three general approaches and modes of inquiry: Culture, Arts and Media; Science, Technology and Society; and Society, Environment and Globalization (see below). This integrated approach to science, technology and the humanities and social sciences provides engineering and science majors with a concrete and focused foundation for their fields. The humanities and social sciences clusters are:

CULTURE, ARTS AND MEDIA (CAM)

The CAM cluster explores how cultural practices and artifacts in a wide range of media reflect, influence and interact with developments in science and technology. Courses are based on philosophy, media studies, music, literary studies, art history, rhetoric and anthropology.

SCIENCE, TECHNOLOGY AND SOCIETY (STS)

STS cluster courses explore the interrelationships among science, technology, culture and society. STS unites and investigates a myriad of disciplines, including history, philosophy, rhetoric, literary studies and sociology. The questions posed are: How do science and technology shape society? How do social processes frame scientific and technological enterprises? What is the relationship between the content of scientific and technological knowledge and the social and intellectual context in which it is created?

SOCIETY, ENVIRONMENT AND GLOBALIZATION (SEG)

Courses in this cluster address the way the critical areas of society, environment and globalization are interlinked in the way they affect the experience of modern life. Coming from the complementary perspectives of the humanities and social sciences, SEG courses provide students with a broad and multicultural perspective on how environmental issues and global exchange in this "flat world" are changing society, here and across the world.

Required Courses for Fulfilling the First-Year Writing Requirement (Two courses, 6 credits):

(i) *Fall:* **EN 1013W** (or **EN 1013H** or **EN 1033W**) – College Writing Workshop. Taught by EN faculty and adjunct faculty.

(ii) *Spring*: **HuSS 1023W** (or **EN 1203H** or **EN 1233W**) - First-Year Writing Seminar. This writing-intensive course, taught by humanities and social sciences faculty, examines variable topics (the non-ESL versions). This course (a) introduces students, in a small-seminar format, to core questions relating science and technology to the humanities and social sciences, (b) provides students with intensive practice in college-level writing, research and critical-thinking skills and (c) exposes first-year students and senior humanities and social sciences faculty to each other in a small, intimate learning environment.

Humanities and Social Sciences Elective Requirement (Six courses, 18 credits)

Students may choose six courses from any humanities and social sciences cluster. These six electives can be within a single cluster or across multiple clusters. For optimal breadth of experience, students are encouraged to take humanities and social sciences electives across clusters and/or across disciplines within a cluster. These six humanities and social sciences electives must satisfy the following constraints:

(a) At least one of these six must be a 3xxx/4xxx level humanities and social science elective.

(b) At least one of these six must be a writing-intensive humanities and social science elective, labeled by "W."

COURSE TYPES

TCS offers four types of undergraduate courses, as well as graduate courses.:

First-Year Writing Courses are required for all students in Bachelor of Science programs. They count toward the school's general-education requirement and the state's Liberal Arts and Science requirement, and help meet requirements of the Accreditation Board for Engineering and Technology (ABET).

Humanities and Social Sciences Electives are open to all Bachelor of Science students, subject to prerequisites. They count toward the school's general-education requirement and the state's Liberal Arts and Science requirement, help meet ABET requirements and fulfill the Polytechnic mandate of a technology- and science-focused curriculum. Electives may be chosen from any CAM, STS or SEG cluster.

Writing-Intensive Humanities and Social Sciences Electives are writing-intensive humanities and social sciences courses designated with a "W" and open to all Bachelor of Science students, subject to prerequisites. Electives may be chosen from a CAM, STS or SEG cluster. Writing-intensive courses require:

(i) A minimum of 15 pages of formal writing, not including informal writing and in-class exams;
(ii) Explicit writing instructions;
(iii) At least one formal written assignment that incorporates instructor response and student revision.

Studio Electives are creative practice courses in art and design disciplines, open to all Bachelor of Science students, subject to prerequisites. These courses may NOT be taken as humanities and social sciences electives to satisfy general-education humanities and social sciences requirements, but may be taken as technical or free electives.

N.B.: Courses that carry the following prefixes may NOT be used to fulfill the general humanities and social sciences requirements: DM (digital media).

INSTITUTES AFFILIATED WITH THE DEPARTMENT OF TECHNOLOGY, CULTURE AND SOCIETY

BROOKLYN EXPERIMENTAL MEDIA GARAGE (BXmC)

BXmC at NYU-Poly is truly experimental; it is the creative/research arm of NYU-Poly's art and technology programs. BXmC works with the hard core of New York's experimental multimedia scene: installation and performing artists, programmers and interaction designers and architects. BXmC develops new kinds of partnerships to create new genres and applications, especially those that need underlying technologies of the future such as: extreme modification of an open-source game engine, purpose-built multi-touch screen for music performance, peer-to-peer 3D streaming, live HD video switching using off-the-shelf components, a new high-performance VJ application to facilitate extension and reconfiguration on the fly…these are BXmC.

CITE GAME INNOVATION LAB

Digital games have permeated our everyday lives and are driving technological and media innovation forward at a tremendous pace. Engaging in the core challenges that are driven by game development and design requires interdisciplinary skills and a rigorous empirical and experimentally-minded approach. The Game Innovation Lab is an exciting, dynamic and flexible space for research and learning that takes games as an innovation challenge. Core research and teaching activities are grounded in computer science, engineering, and user experience, with participation of researchers and educators from other allied disciplines. Sample projects in the Lab include user interface innovation (sensor-based tracking, multi-touch), network and video quality research, and research on games for learning.

CONTACT INFORMATION

Polytechnic Institute of NYU
Six MetroTech Center
Brooklyn, NY 11201
Tel: (718) 260-3231/3039

DEGREES OFFERED

Bachelor of Science

- Integrated Digital Media
- Science and Technology Studies
- Sustainable Urban Environments

Graduate Certificates

This certificate is awarded for successful completion of a 15-credit graduate-level sequence. Students must take two core courses and three electives. Certificates are offered in the following disciplines:

- Environment-Behavior Studies
- History of Science and Technology
- Integrated Digital Media

Master of Science

- Environment-Behavior Studies
- History of Science and Technology
- Integrated Digital Media

MINORS

Integrated Digital Media

Requirements: 15 credits of DM courses, of which 6 are at the 3xxx level or above.

Science and Technology Studies

The minor in STS required 16 credits consisting of:

1. Seminar requirement: STS 3003 (3 credits).
2. Project requirement: STS 4401, Independent Study (1 credit): A written or oral presentation planned in consultation with an STS faculty adviser. This presentation analyzes the student's own senior project in their major from an STS perspective (such as social, philosophical, political, aesthetic).
3. Elective requirement: Remaining credit requirements (12 credits) must be satisfied by courses chosen from the STS electives list.

Requirements 1 and 2, and one of the STS electives (requirement 3) must be taken at NYU-Poly; the remaining elective requirements may be met with transfer credits.

The minor is open to all majors. For engineering or natural science majors, benefits of an STS minor include:

- An understanding of the conceptual, historical and cultural foundations of your major field.
- A rigorous humanistic education essential to the practice of science and engineering in our global society.
- Writing and communication skills that employers seek.

For other majors, benefits of an STS minor include:

- Exposure to key subjects in science and engineering fields and their impact on society, at a broad conceptual, year non-trivial, level.
- An appreciation of the problem-solving techniques and practiced that scientists and engineers engage in.
- Critical reasoning and analytical skills that employers seek.

Sustainable Urban Environments

The minor in SUE requires 15 credits consisting of at least two courses from the SUE core and three courses from any of those offered in the concentration. The minor in SUE is open to all majors.

Other Humanities and Social Sciences Minors

A minor can be obtained in any humanities and social sciences discipline for which there is an adequate number of courses. Such a minor consists of 15 credits in that discipline, unless otherwise specified. Consult the TCS department for information about which specific disciplines offer sufficient and appropriate courses, and further details of specific minor requirements.

FACULTY

PROFESSORS

Kristen Day, Professor of Urban Planning and Department Head
PhD, University of Wisconsin, Milwaukee
Urban design and behavior, design of urban environments for equity, health and well-being

Jean Gallagher, Professor of English
PhD, City University of New York Graduate Center
Feminist theory, 19th- and 20th-century American literature, composition and rhetoric

Myles W. Jackson, Dibner Family Professor of History and Philosophy of Science and Technology, Director of Science and Technology Studies, and Professor of the History of Science and Technology at the Gallatin School of Individualized Study, New York University
PhD, Cambridge University
History of 18th- and 19th-century German and British science and technology, gene patenting and intellectual property in the United States and Europe, bioethics

Sylvia Kasey Marks, Professor of English
PhD, Princeton University
Shakespeare, Samuel Richardson, the 18th- and 19th-century British novel, public speaking, expository writing

Richard E. Wener, Professor of Environmental Psychology
PhD, University of Illinois at Chicago
Environmental psychology

ASSOCIATE PROFESSORS

Jonathan Bain, Associate Professor of Philosophy of Science
PhD, University of Pittsburgh
Quantum theory, philosophy of space and time

Teresa Feroli, Associate Professor of English
PhD, Cornell University
Renaissance literature, Shakespeare, women's studies

Lowell L. Scheiner, Associate Professor of Humanities and Communications
MS, Columbia University Graduate School of Journalism
MA, Columbia University
Technical writing, journalism

Jonathan Soffer, Associate Professor of History
PhD, Columbia University
JD, University of Denver
Twentieth-century American political and foreign-relations history, urban history with a specialization in the history of New York City since 1945

Romualdas Sviedrys, Associate Professor of History of Technology
PhD, Johns Hopkins University
Technology forecasting and technology assessment, history of technology and science

ASSISTANT PROFESSOR
Luke Dubois, Assistant Professor of Digital Media
PhD, Columbia University
Computer music, real-time multimedia

INDUSTRY FACULTY
Jerry MacArthur Hultin, Industry Professor of Law, Management and Public Policy; President of Polytechnic Institute of NYU
JD, Yale University
Innovation management, global development, modern university education, technology policy

Carl Skelton, Industry Professor of Digital Media, Director of BXmC
MVA, University of Alberta (Canada)
Digital media

Harold P. Sjursen, Industry Professor of Philosophy
PhD, New School University
History of philosophy, ethics, philosophy of science and technology

INSTRUCTORS
Allan Goldstein, Instructor of English
BA, University of Denver
English as a second language, developmental writing, writing nonfiction/personal experience writing, intellectual disability advocate

Christopher Leslie, Instructor of New Media and Science and Technology Studies
PhD, City University of New York Graduate Center
History of media and technology, science of difference, science fiction

James P. Lewis, Instructor of Psychology
MA, Stony Brook University
Humanistic psychology

Elisa Linsky, Instructor of Technical Communications
MS, Polytechnic Institute of NYU
Technical writing, technical presentations, writing across the curriculum

Alan M. Nadler, Instructor of English
MFA, Columbia University
Contemporary poetry, the European novel

LECTURER
Alph Edwards, Lecturer of English
MA, Hunter College
Developmental writing

Donald S. Phillips, Lecturer of Psychology
BS, Polytechnic University
Experimental and physiological psychology, physical anthropology, paleontology

AFFILIATED PROFESSOR
Katherine Isbister, Associate Professor of Digital Media and Computer Science and Engineering, Director of CITE Game Innovation Lab
PhD, Stanford University
Social psychological and affective approaches to human-computer interface, with special attention to games and other leisure and social technologies; embodied conversational agents and computer-game characters

FACULTY EMERITI
Lester Bumas
John G. Cavanna
Wolhee Choe
Duane DeVries
Anne Eisenberg
Marvin Gettleman
Helmut Gruber
Louis Menashe
David Mermelstein
F. David Mulcahy
Bernard Rechtschaffen
Thomas B. Settle

HUMANITIES AND SOCIAL SCIENCES ELECTIVES LIST

First-Year Writing Courses

EN 1013H	Honors Program College Writing Workshop
EN 1013W	College Writing Workshop
EN 1033W	College Writing Workshop for ESL Students
EN 1080W	Introduction to College Writing for ESL Students
EN 1090W	Introduction to College Writing
EN 1203H	Honors Program First-Year Writing Seminar
EN 1233W	First-Year Writing Seminar for ESL Students
HuSS 1023W	First-Year Writing Seminar

Cluster 1: Culture, Arts and Media (CAM)
Courses in the CAM cluster explore how cultural practices and artifacts in a wide range of media reflect, influence and interact with developments in science and technology. Courses are based on the disciplines of philosophy, media studies, music, literary studies, art history, rhetoric and anthropology.

CAM Humanities and Social Sciences Electives: The following satisfy a humanities and social sciences elective:

AH 2113	Art History as Techné
AH 3113	Contemporary Art, Electronic Art and Technology
AH 4911/2/3	Special Topics in Art History
AN 2383	Jade, the Stone of Heaven
AN 2883	The Upper Paleolithic and the Evolution of Modernity
CAM 200x	Special Topics in Culture, Arts and Media
CAM 300x	Special Topics in Culture, Arts and Media
EN 2123	Technologies of Literary Production
EN 2133/W	The Invention of the Word
EN 2143/W	Machines Made of Words I
EN 2153/W	Inventing America: Nation, Culture, Self
EN 2163	Shakespeare and the Creative Imagination
EN 2173/W	The World's Greatest Journeys
EN 2183/W	The Novella: Between the Short Story and the Novel
EN 2193/W	The Rise of the Graphic Novel
EN 3133	Machines Made of Words II
EN 4911/2/3	Special Topics in Literature
HI 3403	History of Political Technology
MD 2163/W	Media Studies 1
MD 2213/W	Cinema 1895–1950
MD 2263/W	Digital Humanities
MD 3163/W	Media Studies 2
MD 3213/W	Cinema 1948–Present
MD 4163/W	Media Studies 3
MD 4911/2/3	Special Topics in Media Studies
MU 2113	Western Music Theory
MU 2213	Non-Western Music Appreciation
MU 3113	Music Since 1900
MU 3133	Music Theory for Songwriters
MU 3213	The Musical Instrument
MU 3313	Phonography
MU 4113	Musical Informatics
MU 4313	Psychoacoustics
MU 4211/2/3	Special Topics in Music
PL 2013/W	Ancient Greek Philosophy
PL 2023/W	Early Modern Philosophy in Europe
PL 2113/W	Philosophy of Religion
PL 3103	Philosophy East and West
PS 3693	Humor and Modern Media

CAM Courses That Do Not Satisfy a Humanities and Social Sciences Elective:
The following are Studio Electives (S) and/or Core Courses in the Integrated Digital Media major (C).

DM 1113	Audio Foundation Studio (S)
DM 1123	Visual Foundation Studio (S)
DM 2113	Sound Studio 1 (S)
DM 2123	Cinema Studio 1 (S)
DM 2133	3D Graphics Studio (S)
DM 2143	Interaction Design Studio 1 (S)
DM 2153	Game Development Studio 1 (S)
DM 2183	Digital Photography Studio 1 (S)
DM 2193	Web Studio 1 (S)
DM 3113	Sound Studio 2 (S)
DM 3123	Cinema Studio 2 (S)
DM 3133	3D Graphics Studio 2 (S)
DM 3143	Interaction Design Studio 2 (S)
DM 3153	Game Development Studio 2 (S)
DM 3173	Visualization and Simulation Studio (S)
DM 3183	Digital Photography Studio 2 (S)
DM 3193	Web Studio 2 (S)
DM 3213	Computer Music Studio (S)
DM 4003	Digital Media Senior Project (S/C)
DM 4023	Digital Media Internship (S/C)
DM 4113	Sound Studio 3 (S)
DM 4123	Cinema Studio 3 (S)
DM 4133	3D Graphics Studio 3 (S)
DM 4143	Interaction Design Studio 3 (S)
DM 4153	Game Development Studio 3 (S)
DM 4193	Web Studio 3 (S)
DM 4911/2/3	Special Topics in Digital Media (S)
DM 4903/4/5/6	Digital Media Undergraduate Thesis (S/C)

Cluster 2: Science, Technology and Society
Courses in the STS cluster explore the interrelationships between science and technology and between science and society. STS unites a myriad of disciplines, including history, philosophy, rhetoric, literary studies and sociology, to investigate these interrelationships. How do science and technology shape society? How do social processes frame scientific and technological enterprises? What is the relationship between the content of scientific and technological knowledge and the social and intellectual context in which it is created?

STS Humanities and Social Sciences Electives:
The following satisfy a humanities and social sciences elective:

HI 2203/W	Medieval Technology
HI 2213	History of Aviation and Aviation Technology
HI 2223/W	Physics and Society
HI 2233	Introduction to the History of Technology
HI 2243/W	The History of Light
HI 2253/W	From Heat Engines to Black Holes
HI 2263	The Ship
HI 3303	Science and Technology as a Strategic Resource in World War II
HI 3413	History of Intellectual Property in America
PL 2003	Symbolic Logic
PL 2103/W	Philosophy of Science, Technology and Society in China and India
PL 2143	Ethics and Technology
PL 2203	Philosophy of Technology
PL 2253/W	Science and Pseudoscience
PL 2273/W	Space and Spacetime
PL 2283/W	Philosophy of Relativity
PL 2293/W	Philosophy of Quantum Mechanics
PL 3003	Metalogic
PL 3203/W	Philosophy of Technology: The Critique of Heidegger
PL 3213	The Phenomenon of Life
PL 3253/W	Philosophy of Science
PL 3263/W	Physics, Information and Computation
PS 2613	Psychology of the Internet
PS 2643	Creativity and Innovation
PS 2663	Intelligence: Real and Artificial
PS 3603	Psychology of Internet Security
STS 2003/W	Science, Technology and Society
STS 2113/W	History and Philosophy of Internet Technology
STS 2133/W	Perspectives on Science and Technology Reporting
STS 2143/W	Public Policy Issues in Telecommunications
STS 2153	Addressing Public Policy Issues in the Sciences, Engineering and Medicine
STS 2163	Science Fiction
STS 2233/W	Magic, Medicine and Science
STS 2253/W	Biology and Society
STS 2263/W	Rhetoric of Science
STS 2273/W	Science and Sexuality
STS 2313	It's About Time
STS 2323	Dinosaurs: Resurrecting an Extinct Species
STS 2333	Evolution
STS 2343	Imaging the Past
STS 2353	Origin of Life
STS 241x	Special Topic in STS, variable credit
STS 3003/W	Seminar in Science and Technology Studies
STS 3163	Science and Technology in the Literary Sphere
STS 3173	Hypermedia in Context STS 3243/W Humans, Machines and Aesthetics
STS 3263/W	Science and Difference
STS 340x	Independent Study in STS, variable credit
STS 341x	Special Topic in STS, variable credit
STS 3013	Directed Study in STS
STS 4003	STS Internship/Study Abroad
STS 4014	STS Capstone Project

STS Courses That Do Not Satisfy a Humanities and Social Sciences Elective:
The following are core courses in the Science and Technology Studies major that do not satisfy a humanities and social sciences elective:

Cluster 3: Society, Environment and Globalization (SEG)
Courses in this cluster address how the critical areas of society, environment and globalization are interlinked and how they affect the experience of modern life. SEG courses, from the complementary perspectives of the humanities and social sciences, provide students with a broad, multicultural perspective on how environmental issues and global exchange in this "flat world" are changing society here and across the globe.

SEG Humanities and Social Sciences Electives:
The following satisfy a humanities and social sciences elective:

HI 2003/W	The Age of Conquistadors
HI 2053/W	Intro to Urban Policy
HI 2103/W	Western and Non-Western Societies
HI 2113	The Making of the Modern World
HI 2163/W	History of Mass Media
HI 2303/W	Introduction to New York City History
HI 2313/W	History of New York's Urban Infrastructure
HI 2353	History of NYC Transit and the Development of NYC
HI 2713	Urban Environmental History
HI 3103	Modern Asia
HI 3253	History of Political Technology
HI 3313/W	History and Literature of New York City in the Twentieth Century
HI 4303/W	Seminar in Urban Infrastructure History
PL 2243/W	Thinking About the Environment
PL 3103/W	Philosophy East and West
PS 2323/W	Environmental Psychology
PS 2723	Human Factors in Engineering Design
PS 3723	Psychology of Sustainability
PS 3743	Psychology of Transportation
PS 3753	Psychology of Living in Extreme Environments
PS 3813	Social Psychology of Virtual Worlds
PS 3833	Special Topics in Psychology
PS 4443	Guided Readings in Psychology
SEG 2183/W	Beyond Oil: Fueling Tomorrow's Vehicles
SEG 2193/W	Writing About Nature and the Environment
SEG 291x	Special Topics in SEG
SEG 3213	Sustainable Systems and the Natural History of Whaling
SEG 391x	Special Topics in SEG
SEG 491x	Special Topics in SEG
URB 2023/W	The Design of Cities
URB 2033	Humans in the Urban Environment

URB 2053	Introduction to Urban Policy
URB 2223	Natural Environment of New York City
URB 2233	Natural Environmental Catastrophes and Cities
URB 3033	Evidence-based Design
URB 3113	Case Studies in Sustainability
URB 3313	History and Design of Urban Parks
URB 3353	Urban Impact Assessment
URB 3833	Special Topics in Sustainable Urban Environments
URB 4443	Guided Readings in Sustainable Urban Environments

SEG Courses That Do Not Satisfy a Humanities and Social Sciences Elective:
The following are core courses in the Sustainable Urban Environments major that do not satisfy a humanities and social sciences elective:

URB 3013	Directed Study in SUE
URB 4014	Internship/Study Abroad
URB 4023	Capstone Project

ELECTIVES

FIRST-YEAR WRITING COURSES

EN 1013H Honors Program College Writing Workshop

This course develops the advanced abilities of students in the Honors Program. While it introduces students to the expectations of college-level writing—including writing-process fundamentals and the inherently rhetorical dimension of all writing—it moves quickly to advanced writing applications. Through the strategies of invention, drafting, responding and revising, students better understand and hone their writing abilities as they critique and challenge one another. Instructors emphasize argumentative and analytical writing, critical reading and writing, use of academic sources, knowledge of academic forms and sentence-level control. *Credits: 3. Prerequisites: For some students, placement into the course may require the prerequisite of EN 1080W or EN 1090W. For most, there is no prerequisite.*

EN 1013W College Writing Workshop

This course introduces students to the expectations of college-level writing, including writing-process fundamentals and the inherently rhetorical dimension of all writing. Through the strategies of invention, drafting, responding and revising, students better understand and hone their writing abilities. The instructor emphasizes argumentative and analytical writing, critical reading and writing, use of academic sources, knowledge of academic forms and sentence-level control. *Credits: 3.*

EN 1033W College Writing Workshop for ESL Students

This course introduces non-native English speakers to the expectations of college-level writing, including writing-process fundamentals and the inherently rhetorical dimension of all writing. Through the strategies of invention, drafting, responding and revising, students better understand and hone their writing abilities. Instructors focus on argumentative and analytical writing, critical reading and writing, use of academic sources, knowledge of academic forms and sentence-level control. *Credits: 3. Prerequisites: For some students, placement into this course may require the prerequisite of EN 1080W or EN 1090W. For most, there is no prerequisite.*

EN 1080W Introduction to College Writing for ESL Students

This intensive course in reading comprehension and composition skills is for non-native speakers of English who are inadequately prepared for college composition. The course emphasizes competency in standard written English and fluency in writing, grammatical control, comprehension of college-level texts, practice in listening and speaking and expansion of English-language skills for academic and professional purposes. *Credits: 3. Prerequisite: EN Placement exam.*

EN 1090W Introduction to College Writing

This intensive course in reading comprehension and composition skills is for native English speakers who are inadequately prepared for college composition. The course emphasizes competency in standard written English and fluency in writing. *Credits: 3. Prerequisite: EN Placement exam.*

EN 1203H Honors Program First-Year Writing Seminar

An introduction to advanced techniques, this writing-intensive course will focus on variable topics defined by individual instructors. The small, seminar-format course introduces students to core questions relating science and technology to the humanities and social sciences. The course builds on writing skills learned in EN 1013H and offers continued, intensive practice in college-level writing, research and critical-thinking skills. The pace and expectations of this honors-program course exceed those of the non-honors sections. *Credits: 3. Prerequisite: EN 1013H.*

EN 1233W First-Year Writing Seminar for ESL Students

An introduction to advanced writing techniques for non-native English speakers, this writing-intensive course focuses on variable topics defined by individual instructors. The small seminar-format course introduces students to core questions relating science and technology to the humanities and social sciences. Building on writing skills learned in EN 1033W or EN 1013W, the course provides continued, intensive practice in college-level writing, research and critical thinking skills. *Credits: 3. Prerequisite: EN 1013W or EN 1033W.*

HuSS 1023W First-Year Writing Seminar

As an introduction to advanced techniques in writing, this writing-intensive course focuses on variable topics defined by individual instructors. The small seminar-format course introduces students to core questions relating science and technology to the humanities and social sciences. The seminar builds on writing skills learned in EN 1013W and provides continued, intensive practice in college-level writing, research and critical-thinking skills. *Credits: 3. Prerequisite: EN 1013W.*

CAM CLUSTER COURSES

(For DM-designated courses, see the catalog entry under Integrated Digital Media.)

AH 2113 History of Art as Techné

This introduction to Western Art in different historical periods focuses on pre-20th-century art. The course samples important periods and themes in art history, from ancient Egypt and archaic Greece to the present. This course also enhances cultural, social and aesthetic understanding through intensive engagement with a variety of visual forms in different historical periods. In addition, the course focuses on technological and social developments that drive creative innovation. Credits: 3. *Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

AH 3113 Contemporary Art, Electronic Art and Technology

This audiovisual lecture course focuses on contemporary international art. Each week will feature a selected media element (film, video or audio) to illustrate the focus of the session, a required reading assignment and a discussion period. *Credits: 3. Prerequisites: AH 2113. Note: Satisfies a humanities and social sciences elective.*

AH 4911/4912/4913
Special Topics in Art History

This advanced seminar explores a specific topic in historical or contemporary art history. Students are expected to participate actively through seminar presentations on specific subjects and through vigorous class discussion and debate. *Credits: Variable. Prerequisite: AH 3113. Note: Satisfies a humanities and social sciences elective.*

AN 2383 Jade, the Stone of Heaven

Four cultures-civilizations around the world have discovered jade and considered it a sacred substance, divine and useful. In Pre-Columbian Mesoamerica jade symbolized the state and the authority of the gods, and was a useful material more precious than gold. In the Middle Kingdom, or China, jade was the magical "Stone of Heaven," celebrated from prehistory into modern times. Jade is found in Neolithic graves, and small disks of fine white jade were set in the gold medals of the recent Chinese Olympics. This course summarizes how jade fit into several cultures and civilizations around the world, with emphasis on historical and modern China. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

AN 2883 The Upper Paleolithic and the Evolution of Modernity

During the last decade, archaeology and anthropology began to intensively study the evolution of the Upper Paleolithic period, which lasted from roughly 40 thousand years ago until about 10,000 years ago. This period coincides with the last part of the Pleistocene glacial epoch. The Upper Paleolithic was followed by the Mesolithic and the Neolithic revolution, which saw the invention of agriculture and animal husbandry and the unfolding of recent human cultures and civilizations. We shall investigate how new scholarship casts the Upper Paleolithic as a time of intensive cultural and social growth when the human species witnessed its ascent into "modernity." This scholarship casts modernity in a novel sense as the time in which humans forged new modes of cultural and ecological adaptation into present-day hunting and gathering societies. This new scholarship will help researchers to understand the Upper Paleolithic as the most salient shaper of human nature and action. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

CAM 200x Special Topics in Culture, Arts and Media

This course discusses selected topics and issues in culture, arts and media at the 2000 level. *Credits: Variable. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

CAM 300x Special Topics in Culture, Arts and Media

This course looks at selected topics and issues in culture, arts and media at the 3000 level. *Credits: Variable. Prerequisite: One Level 2 CAM cluster humanities and social sciences elective. Note: Satisfies a humanities and social sciences elective.*

EN 2123 Technologies of Literary Production

This course examines how the changing status and technologies of written language have shaped and continue to transform literary culture. Beginning with works first conceived and transmitted as part of rich oral traditions, the course will end with works of literature produced primarily for online readers. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

EN 2133/W The Invention of the Word

This course explores not the subject of "innovation" in literature, but the fact of it. Students read a range of literary texts that invented utterly new ways of writing: new forms and new approaches to consciousness and language itself. The course focuses on two clusters of literary and linguistic innovation: (1) writing in the ancient world, where narrative, drama and lyric—and indeed, the technology of writing itself—were first invented, and (2) works by pioneering literary modernists who radically reinvented the forms forged by their earliest predecessors. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

EN 2143/W Machines Made of Words I: Poetry as Design

Following (and challenging) William Carlos Williams' definition of a poem as "a machine made of words," this course examines how poems are made. The course explores questions of invention and innovation in poetic form and how "form" and "content" interact in a wide range of poetry—from the earliest English ballads to contemporary work. Students write five critical essays. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

EN 2153/W Inventing America: Nation, Culture, Self

This course explores the ways American writers have imagined—and participated in—the invention of nation, culture and self, from the Colonial period through the Civil Rights era. Special attention is paid to how American writers have engaged with questions surrounding the "newness" of American culture and how literature has reflected and affected "change" in American culture. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

EN 2163 Shakespeare and the Creative Imagination

In this course, students learn how Shakespeare's writings were influenced by his literary forebears and how he has inspired artists since his own time. Through this approach, the course explores the author's particular creative genius and his legacy. *Credits: 3. Prerequisites: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

EN 2173/W The World's Greatest Journeys

In this introduction to the literature of the journey, from several countries and historical periods, the focus is on the place of science, innovation and invention in these works. This writing-intensive course emphasizes revision. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

EN 2183/W The Novella: Between the Short Story and the Novel

This course introduces the origins, characteristics and innovative qualities of the novella from several countries and historical periods. The course compares this genre with the novel and short story. Students discuss and write about assigned works. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

EN 2193/W The Rise of the Graphic Novel

This course explores the recent emergence of the graphic narrative as a literary genre. How has the comic book, once exclusively identified with popular culture, developed into a mode for sophisticated literary and artistic creation? *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

EN 3133 Machines Made of Words II: Designing Poetry

In this seminar/workshop, students read a wide range of poetic forms or structures and practice making poems, focusing on the reading and composition of poems as forms of design. *Credits: 3. Prerequisite: EN 2143 or permission of instructor. Note: Satisfies a humanities and social sciences elective.*

EN 4911/4912/4913 Special Topics in Literature

This course discusses variable topics in literature. *Credits: Variable. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 3403 History of Political Technology

This course examines the history of American elections through the lens of the technologies employed to win them—from the use of the barbeque and distilled whiskey in the Colonial period through the 19th century to the advent of polling, marketing and the blogosphere in the 21st century. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

MD 2163/W Media Studies 1

This historical survey of media, from oral culture to the Internet, is a foundation for analyzing the historical and contemporary media practices and provides vital critical tools for creative professionals in a dynamic culture. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

MD 2213/W Cinema 1895–1950

This critical survey of cinema, from the Lumière brothers to the immediate post–World War II period, covers genres including short and feature formats in documentary, drama and animation. Works will be examined in detail, with attention to their place in the development of the form and their cultural and social context. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

MD 2263/W Digital Humanities

What happens to works of the humanities when they are distributed electronically and created on computers? What values from the analog humanities should be preserved in the digital world? This course examines traditional works of literature available in electronic formats as well as digital-only creations. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

MD 3163/W Media Studies II

Where MD 2163 was primarily a historical orientation to media communications, this course is its complement: a critical orientation. Drawing on their evolving research, discursive and creative skills, students in MD 3163 are expected to consider contemporary media-communications practices as integral parts of an ongoing global cultural process, with all of the potential that implies. *Credits: 3. Prerequisite: MD 2163W. Note: Satisfies a humanities and social sciences elective.*

MD 3213/W Cinema 1948–2000

This course is a critical survey of cinema from in immediate post-WWII period to 2000. Genres covered will include documentary, comedy, drama and experimental. Works will be discussed in detail in terms of their place in the development of the form, and in terms of their cultural and social context. Each week, students will view the assigned film before class for details formal analysis and critical context in class. The course will be organized thematically; each week, a selection of alternate films will be offered for additional viewing and essay topics. *Credits: 3. Prerequisites: HuSS 1023W or EN1233W of EN 1203H, and a 2000-level humanities and social sciences course. Note: Satisfies a humanities and social sciences elective.*

MD 4163/W Media Studies III

This seminar, a synthesis of the historical and critical approaches developed in the prerequisites, MD 2163 and MD 3163, asks students to participate actively and to consider key aspects of media in depth. *Credits: 3. Prerequisite: MD 3163W. Note: Satisfies a humanities and social sciences elective.*

MD 4911/4912/4913 Special Topics in Media Studies

This advanced seminar looks at contemporary developments in media communications from a global perspective. Students are expected to participate actively through presentations on specific subjects and through vigorous seminar discussion and debate. *Credits: Variable. Prerequisite: MD 3163W. Note: Satisfies a humanities and social sciences elective.*

MU 2113 Western Music Theory

This course, an introduction to the fundamentals of Western music theory, focuses on nomenclature, basic notation literacy and fundamentals of harmony, counterpoint and rhythm. Students complete weekly exercises to learn basic skills in composition and musicianship, including dictation, sight-singing, chord analysis and identification, transposition and voice-leading. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

MU 2213 Non-Western Music Appreciation

This analysis-and-discussion course examines the music of non-Western cultures, from the pre-Colonial period through the present day. The course focuses on performance practices, the relationship between music and the arts, the influence of Western music and technology, and hybridity in contemporary popular music. A topical focus on different cultures will look at the musical traditions of the Middle East, North and Sub-Saharan Africa, India and East and Southeast Asia. Students complete regular listening assignments and perform research on musical styles and traditions. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

MU 3113 Music Since 1900

This course examines the development of musical instruments from ancient to modern times, looking at the relationship between technology and society as it expresses itself in musical culture. Topics include the development of the "classis" orchestral instrument families (strings, percussion, woodwind, brass), non-Western instrumental evolution (gamelan, Arabic instruments), the impact of industrialization and the rise of electronic and digital technology. Students will perform research on the relationship between technology and performance practice. *Credits: 3. Prerequisite: MU 2113. Note: Satisfies a humanities and social sciences elective.*

MU 3133 Music Theory for Songwriters

In this introduction to music theory as it applies to songwriting, students compose music and lyrics, building on a practical application of scale, chord and harmony theory. An integral part of the course is an introduction to the craft of poetry as applied to song-lyric writing. Students need free access to a guitar or piano, and some experience on either instrument is preferred. However, neither formal training nor technical proficiency is required. *Credits: 3. Prerequisite: Instructor's permission or MU 2113. Note: Satisfies a humanities and social sciences elective.*

MU 3213 The Musical Instrument

This course, on the art music of the 20th century, focuses on social and historical trends and their impact on developments in compositional practice, instrumental forms and technology. Topics covered include the role of nationalism in music, the European serialist avant-garde, the New York School, the changing nature of the composer in society, the increasing role of technology and the musical dialogue between art and popular music. Students complete regular listening and writing assignments and are required to attend performances outside of class. *Credits: 3. Prerequisite: MU 2113. Note: Satisfies a humanities and social sciences elective.*

MU 3313 Phonography

This course looks critically at the development of recording technology as a catalyst for trends in popular and art music, from the early 20th century to the present. Topics include the rise (and possible fall) of the record industry in the United States, the development of musique concrète and electroacoustic music and the massive impact of recording technology on popular urban, electronic and dance music. Students are encouraged to explore how the artistic practices of sampling, dubbing and remixing have expressed themselves in different genres, scenes and musical styles. The course also looks at current legal, ethical and social issues behind musical copyright and distribution. *Credits: 3. Prerequisite: MU 2113. Note: Satisfies a humanities and social sciences elective.*

MU 4113 Musical Informatics Studio

This studio examines how music and sound actually "work," from the view of mathematics, physics and information theory. This is a music-theory course in reverse. The class looks at the underlying mathematical principles behind harmony, melody, rhythm (and their "scientific" equivalents of frequency, timbre and duration). Using acoustics, instrument design and basic analog and digital-signal theory, students investigate the properties of music from a scientific, engineering and analytic perspective. Students perform research on topics of interest and present their findings semiweekly. *Credits: 3. Prerequisite: MU 3XXX or DM 3113. Note: Satisfies a humanities and social sciences elective.*

MU 4313 Psychoacoustics

This course looks at how people hear and listen to sound and music from a physiological, psychological and sociological frame of reference. The class investigates the basics of human hearing and auditory perception and examines how sonic and musical practices and vocabularies evolve based on how people hear. Students perform basic research (including developing simple experiments) and present their findings semiweekly. *Credits: 3. Prerequisite: MU 3XX3. Note: Satisfies a humanities and social sciences elective.*

MU 4211/4212/4213
Special Topics in Music

This variable-credit intensive course, combining music theory and practice, may be repeated for credit under different topics. *Credits: Variable. Prerequisite: MU 3XXX. Note: Satisfies a humanities and social sciences elective.*

PL 2013/W Ancient Greek Philosophy

This introduction to ancient philosophy in the Western tradition covers the pre-Socratic philosophers Plato and Aristotle. The course unites them in a dialogue, highlighting their similarities and differences to show their importance in the history of philosophy and their relevance to society today. The course emphasizes the history and methods of early Greek science and examines Greek attitudes toward technology and their implications for science and society. *Credits: 3. Prerequisites: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PL 2023/W Early Modern Philosophy in Europe

This course examines the central figures and issues of the Modern era, especially the European scientific and ontological revolution of the 16th, 17th and 18th centuries. The course focuses on issues that were in those eras and that remain important today, including the state of nature and society, epistemology, metaphysics and the role of God in philosophical and scientific thinking. Topics include the Renaissance and the rise of modern science, Descartes and rationalism, Locke, Berkeley, Hume and empiricism and Kant and the Copernican revolution. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PL 2113/W Philosophy of Religion

This course investigates religious concepts, belief systems and practices. By analyzing central concepts of religion—such as God, faith, revelation, salvation and the relationships between religion and science and morality and art—both believers and non-believers can achieve a more sophisticated understanding and appreciation of religions. The course considers the epistemological status of religious language (e.g., propositions that refer to God). The class addresses such topics as the phenomenology of religious experience, faith and reason, arguments for God's existence, the problem of evil, religious language, life and the after-life and the conflicting claims of different religions. Special attention is given to the dialogue between science and religion today. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PL 3103W Philosophy East and West

Philosophy develops in different ways in different cultures. Because philosophy aims to be universal and to address fundamental issues without cultural bias, these differences in philosophical development raise important questions. This course introduces the classical problems of philosophy from traditionally Eastern and Western perspectives. Standard readings from Greek and Roman, European and American philosophy are compared with parallel texts from other traditions, including Arabic, Chinese and Indian. Science and technology development in each tradition is also covered. *Credits: 3. Prerequisite: One level 2 STS cluster course. Note: Satisfies a humanities and social sciences elective.*

PS 3693 Humor and Modern Media

Humor is considered one of the most pleasurable positive emotions. The questions asked will include: What makes something funny? Why do people find someone falling down funny in one culture and tragic in another? What are the cross-cultural implications of humor and how have they been affected by a global worldview? How has the Internet changed our view of humor, now that technologies like YouTube make it possible for anyone to be a director or cinematographer with a worldwide audience? Topics will include psychoanalysis; superiority; reversal theories of humor; the psychology and psychobiology of humor; and humor, laughter and mental health. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

STS CLUSTER COURSES
(For STS-designated courses, see the catalog entry under Science and Technology Studies.)

HI 2203/W Medieval Technology

This course considers medieval heritage, culture, society, technology and its impact and continuity in modern times. The course looks at the nuclear family as it originated in medieval times, and emphasizes concepts of

modern law, religion, war, science, race and class. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective*.

HI 2213 History of Aviation and Aviation Technology

In little more than 100 years, aviation has passed from a ground-hugging flight of less than a minute to high-altitude, supersonic flights that cross continents and oceans. This course surveys the history of aviation and the technological innovations that led to this crucial modern technology. This course also discusses the physics of flight, how increased understanding of aerodynamic principles led to successive aircraft improvements, and the development of new materials and control systems. Although military research drove many technological innovations, this course focuses on the economics and development of commercial aviation, which has changed the world. The course also looks at ultramodern trends in aircraft design and control, including unmanned cruise missiles and aircraft, and new commercial-aircraft designs and production techniques. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 2223/W Physics and Society

This course examines the historically contingent relationship between physical knowledge and society, from ancient Greece to the present. Investigations include how scientific knowledge is constructed locally and the impact of sociocultural factors on such knowledge. The course also examines the conceptual foundation of physics, its history, and how physics has influenced culture and society over two millennia. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 2233 Introduction to the History of Western Technology

This course surveys generally the history of technology (from the early modern period to the present) and investigates how technology shapes society, and how society molds technology. Topics include ancient technologies, the printing press, the Industrial Revolution, the replacing of laborers with machines, electricity, transportation, Ford and the invention of the automobile, Taylorism and the organization of labor, technology during World War II (including radar, V1and V2 rockers and the Enigma machine) and the rise of the NASA space program. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 2243/W The History of Light

What is the nature of light? How does it relate to magnets, electric circuits, TVs, radioactivity and the fundamental forces of nature? More importantly, what really happens to your burrito when you microwave it? This course answers these and similar questions by following the historical development of three apparently distinct and unrelated phenomena—electricity, magnetism and light. Topics range from descriptions of these phenomena by the Greeks to Maxwell's 19th-century unification of them into a single phenomenon to Einstein's theory of special relativity to their incorporation into the Standard Model of contemporary physics. The course considers theoretical descriptions of the phenomena and technologies derived from them. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 2253/W From Heat Engines to Black Holes

What is the nature of heat? How does it relate to atoms, black holes, information and a demon in a box full of gas molecules? This course answers these questions by developing the history of thermodynamics. That history begins with early 18th-century caloric theories of heat, 19th-century analyses of steam engines, the kinetic theory of gases, the statistical approach to mechanics, atomic theories of matter, the concept of entropy, early 20th-century concepts of information and, finally, current applications to black holes (as well as Maxwell and his famous demon). The course considers theoretical descriptions of the phenomena and the technologies derived from them. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 2263 The Ship

Ships, the largest human-made moving objects, have played a pivotal role in trade and warfare throughout history. This course covers the history, development and technology of ships from ancient times to the present. The course discusses aspects of the atmosphere and seas as they relate to ship design and use. Technological advances in hull design, materials, sails and power also will be discussed. The use of ships in trade, human transportation, warfare, fishing, piracy and global exploration are covered, along with the satellite industries of shipbuilding and port support. The course also looks at the manning of ships, the social and military organization, the life of mariners, the development of navigation and its technologies in an historical context, and submarine evolution and technologies. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 3303 Science and Technology as a Strategic Resource in World War II

This course examines the role of technology and science during World War II. Among the technologies that are considered are some that were inherited from World War I and much improved (e.g., tanks, airplanes, aircraft carriers and submarines). Others were completely new and required considerable scientific input to be developed (e.g., radar, code breaking by the use of computers, jet engines, ballistic missiles, antibiotics and the atomic bomb). *Credits: 3. Prerequisite: One level 2 STS cluster course. Note: Satisfies a humanities and social sciences elective*.

HI 3413 History of Intellectual Property in America

This course, a history of successive regimes of patent, trade secret, copyright and trademark law from the early modern period to the present, introduces undergraduates to basic intellectual property concepts, language, the political and distributive implications of intellectual property regimes, and the possibility or even inevitability of alternative regimes. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PL 2003 Symbolic Logic

This course introduces the methods and applications of propositional logic and relational predicate logic. The course looks at the concept of a formal language and covers semantic and proof-theoretic methods of testing arguments for validity. Semantic concepts of tautology, logical equivalence and consistency are compared with their proof-theoretic counterparts, and the notions of soundness and completeness of proof-theoretic methods are introduced. *Credits: 3. Note: Satisfies a humanities and social sciences elective.*

PL 2103/W Philosophy of Science, Technology and Society in China and India

This course addresses the fundamental questions of philosophy—What is real? What is good? How do we know?—by considering the answers by classical philosophers from India and China. Philosophy in Asia has not been viewed as an abstract academic subject with little or no relevance to daily life. Rather, it has been seen as one of life's most basic and important enterprises. Philosophy is seen as essential to overcoming suffering and improving the quality of human life. Since

Asian philosophy is concerned with practical issues to a greater extent than in the West, the course considers how technology is understood and valued. Attention is given to the history of science in China and India. Since no rigid distinctions exist between philosophy and religion in Asian thought, the place of science and technology in relation to human values is also different. The class examines the Asian philosophical tradition to understand both its historical importance and its relevance to society today. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PL 2143 Ethics and Technology

This course considers how technology shapes and patterns—and is shaped and patterned by—human activities, from a moral point of view. This course focuses on how the technologically textured world changes human life, individually, socially and culturally, for better or worse. The course considers several views of technology and several ethical theories for evaluating technology. The course explains the structures of change and transformation and develops critical forms of thought, so that students can understand, evaluate, appreciate and criticize technological development. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PL 2203 Philosophy of Technology

This survey of prominent approaches to the philosophy of technology asks: What are the philosophical problems presented by technology? How does technology influence ethics, politics and society? What is the relation of philosophy of technology to the traditional branches of philosophy (aesthetics, epistemology, metaphysics)? *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PL 2253/W Science and Pseudoscience

This survey of popular pseudoscientific claims emphasizes issues in the philosophy of science, including demarcation, evidential warrant, scientific progress, science and public policy, and fallacies of reasoning. Topics include UFO sightings and alien abductions, the Nemesis theory of dinosaur extinctions, astrology, creationism, psychic phenomena, theories of intelligence, alternative medicines, global warming and cold fusion. The course emphasizes student input to determine the topics covered. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PL 2273/W Space and Spacetime

What is the nature of space? Is it an independently existing substance, or does it merely consist of the relations between physical objects? Can motion be described simply in terms of the relational properties of objects, or must people always define motion with respect to an absolute motionless substratum? Does the existence of left-handed gloves entail the existence of absolute space? This course considers these and other questions about the nature of space and time as they appear in the writings of philosophers and scientists, including Plato, Aristotle, Descartes, Newton, Leibniz, Berkeley, Kant, Poincaré and Einstein. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PL 2283/W Philosophy of Relativity

The first part of this course develops the physics underlying special relativity and considers such conceptual questions as: Does Special Relativity prohibit faster-than-light travel? Does it allow a traveling astronaut to age less and return home in the distant future? What is the significance of Einstein's famous equation "E = mc2"? The second part of the course develops the physics underlying general relativity and considers conceptual issues surrounding such current applications as time machines, wormholes and "warp-drive" spacetimes. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PL 2293/W Philosophy of Quantum Mechanics

Quantum mechanics is today the best-confirmed theory of particle dynamics. The theory is not only the basis for all digital technologies, but also the theoretical foundation for the best-confirmed theories of matter (quantum field theories). However, since its inception, quantum mechanics has been beset with conceptual problems. No consensus exists on how to interpret it: What would the world be like if it were true? This course develops the mathematical formalism of the theory and explores several proposals about how to interpret it. Other topics include conceptual issues of quantum teleportation, quantum computing and quantum cryptography. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PL 3003 Metalogic

What is the relation between truth and proof? Are there true statements about natural numbers that cannot, in principle, be proven? Can an algorithm be written to decide which statements about numbers are provable and which are not? What is the mathematical basis of the concept of a mechanically implementable algorithm (i.e., a computer program)? What does all of this have to do with logic? This course addresses these and other questions by investigating the properties of propositional and 1st-order logic. Topics include the soundness and completeness of formal systems of propositional and 1st-order logic, the Löwenheim-Skolem and Compactness theorems for 1st-order logic, Gödel's incompleteness theorems for formal arithmetic, and Turing machines and the notions of computability and undecidability. *Credits: 3. Prerequisite: PL 2003 or permission of the instructor. Note: Satisfies a humanities and social sciences elective.*

PL 3203/W Philosophy of Technology: The Critique of Heidegger

This course examines, critically and reflectively, the impact, effects and outcomes of technologies upon human activities. The course studies the nature of the technologically textured ecosystem, or technosystem. The course focuses on how technologies change human life, individually, socially and culturally, and considers the effects of human-technology relations on science, culture, democracy and human values. Emphasis is on the position of Heidegger, his predecessors, followers and critics. The course will examines Heidegger's unusual interpretation of East Asian philosophy in relation to technology. Heidegger claimed to find merit in Eastern thought, and his critique of Western technology is seen in an Eastern philosophical context. *Credits: 3. Prerequisite: One level 2 STS cluster course. Note: Satisfies a humanities and social sciences elective.*

PL 3213 The Phenomenon of Life

This course offers an existential interpretation of biological facts. The problem of inwardness as examined in modern philosophy is addressed from the standpoint of scientific biology. The course approach is not be limited by the anthropocentric tradition of idealist and existentialist philosophy, nor the materialist standards of natural science. The course explores the great contradictions of human experience—freedom and necessity, autonomy and dependence, self and world, creativity and mortality—through the ascending order of organic powers and functions: metabolism, motility, desiring, sensing and perceiving and on to imagination, art and mind. *Credits: 3. Prerequisite: One level 2 STS cluster course. Note: Satisfies a humanities and social sciences elective.*

PL 3253/W Philosophy of Science

The philosophy of science is divided into two subfields: The first studies the nature and methodology of science. The second examines the conceptual and philosophical foundations of particular scientific fields. This course considers topics in the first subfield, including philosophical attempts to describe scientific explanations, laws of nature and the process by which evidence confirms theories in science. The course also considers the nature of scientific theories: what they are, how they change and how they can and should be interpreted. *Credits: 3. Prerequisite: One level 2 STS cluster course. Note: Satisfies a humanities and social sciences elective.*

PL 3263/W Physics Information and Computation

This course investigates the conceptual foundations of contemporary notions of information and computation from the point of view of physics. The course is divided into four parts: Part I considers the relation between entropy and global concepts of information; Part 2 considers the relation between spacetime structure and physical concepts of computation; Part 3 considers the relation between quantum and classical information; and Part 4 considers attempts to reconceive physics entirely in information-theoretic terms. *Credits: 3. Prerequisite: One level 2 STS cluster course. Note: Satisfies a humanities and social sciences elective.*

PS 2613 Psychology of the Internet

This class investigates aspects of human behavior in terms of the Internet. The Internet is a technological phenomenon that allows people separated by huge distances to interact with each other in relatively seamless fashion. Does the Internet allow people to connect in ways never possible before? Or are these new connections variations of previous human interactions, only on a computer screen. For all of its positive attributes, the Internet has a negative side: People become increasingly dependent on interacting only through the Internet. Is this dysfunctional? What characterizes addictive behavior? Can addictive behavior be attributed to a physical action as opposed to a biological substance? *Credits: 3. Prerequisites: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PS 2643 Creativity and Innovation

This course explores the nature of the creative act. What does it take to be creative? What are some of the cognitive and personality variables that aid and hinder creativity? What are the characteristics of great innovators? Is innovation purely individual? Or are innovators a product of their time? The course also surveys literature on teaching creativity and innovation. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PS 2663 Intelligence: Real and Artificial

This course explores the nature of intelligence, both human and computer, and covers historical debates centered on intelligence testing. Can computers be programmed to think? If they can, what would a "thinking" computer look like? The course covers issues such as the Turing test and human-computer interaction. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PS 3603 Psychology of Internet Security

This course looks at the relationship between psychology and online security. How do computer hackers access secure computers strictly by asking people for their password? What are the key features of current security messages and how can they be made more explicit so the average computer user can understand them? What social-psychology principles are required for a secure network? And what perceptual issues help secure a computer network? *Credits: 3. Prerequisite: One level 2 STS cluster course. Note: Satisfies a humanities and social sciences elective.*

SEG CLUSTER COURSES
(For URB-designated courses, see the catalog entry under Sustainable Urban Environments.)

HI 2003/W The Age of Conquistadors

This course will focus on European discovery of Americas since 1492. Emphasis will be given more to the conquest of Americas in Caribbean, Mexico, Peru, Central America, New Mexico and Brazil. In doing so, this course will address the role of the Catholic Church, the imposed imperial system and the sufferings of indigenous people. For many historians, 1492 is the landmark of European-dominated modernity. While the Chinese made a major breakthrough in navigation and while the Arab merchants traded globally, the Europeans were far behind in modernity. But by 1492 Europeans expanded its horizons to the Americas, Asia and Africa. Was it because of gold? Was it because of religious motivation? Or was it to save the "savages"? What consequences did the indigenous population face? What advancement did the Europeans make in such ventures? This course will address these questions. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 2053/W Intro to Urban Policy

The purpose of this course is to introduce students to the process and some of the major substantive issues in urban policy and politics in the United States, with some transnational contrasts. These include some of the basic issues of any political system: how cities function as part of a global urban network; the structure of decision-making, the allocation of resources and delivery of services. *Credits: 3. Note: Satisfies a humanities and social sciences elective.*

HI 2103/W Western and Non-Western Societies

The course introduces a comparative study of Western and non-Western societies, emphasizing the importance of Western and non-Western relations and the impact Europe made upon the rest of the world. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 2113 The Making of the Modern World

This course provides a systematic and broad survey of the political, social, technological and cultural history of the world from the early sixteenth century to the present. The course examines major events and themes that have shaped the development of the modern world over the past four centuries, including: Capitalism and Technology; Exploration, Mapping and Measurement; the Industrial Revolution; Technology and Colonial Imperialism; and Technology and War in the 20th Century. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 2163/W History of Mass Media

This mass-media history course examines broadsides, newspapers, cinema, radio, TV and the Internet, from the advent of cheap print in the early modern period to the turn of the 21st century. Themes include the history of mass-media technology, the mass dissemination of news and its effects on popular culture and gender relations, sensationalism, and the role of the media in developing advertising and consumer culture. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 2303/W Introduction to New York City History

This course looks at the history and development of the City of New York, from Verazzano's exploration to the present. Major themes include the evolution of the city's political economy, political and economic influences on land and space use, and ethnic and class conflict in the urban environment. *Credits: 3. Prerequisites: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 2313/W History of New York's Urban Infrastructure

This survey of New York City's infrastructure concentrates on water, sanitation and public health, electrical and communications systems, the development of housing and real estate, the security infrastructure and plans for the future. The course explores how the city's political economy has shaped its physical environment and how technological innovations have made the city modern and postmodern. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 2353 A History of NYC Transit and the Development of NYC

This course traces the technological history of public transportation in New York City and investigates its role in the development of the city, its economy and its social fabric. From the early days of horse-drawn public carriages to the modern subway system, the role of the public transit in the historical development patterns of New York City is treated. The course covers trolley systems, the age of the elevated railways and the subway system. Political, social and economic issues involved in the development of these critical infrastructures are discussed. Students develop independent project reports on aspects of the NYC public transit system, or on public-transit systems in other major world cities. *Credits: 3. Prerequisite: Junior Status or permission of instructor. Note: Satisfies a humanities and social sciences elective.*

HI 2713 Urban Environmental History

This course will examine the development of cities, primarily in North America, the evolution of the technologies used for that development, and their effect on the natural environment of cities and their regions, and the effects of the modernization and electrification of rural America on cities. Students will use a broad toolkit of historical methods and modes, including environmental history, social history, world history and history of technology. *Credits: 3. Prerequisites: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 3103 Modern Asia

This course explores the major Asian civilizations since the mid-17th century, concentrating on their social, political, economic, religious and cultural histories. The course emphasizes principal Asian civilizations of China, India and Japan and also looks at Vietnam, Afghanistan and Iran. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 3253 History of Political Technology

This course will examine the history of American elections through the lens of the technologies employed to win them—from the use of the barbeque and distilled whiskey used from Colonial period through the 19th century to the advent of polling, marketing and the blogosphere in the 21st century. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 3313/W History and Literature of New York City in the 20th Century

This course examines the history and literature of New York in the 20th century, focusing on the city's social and technological evolution since the late 19th century. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

HI 4303/W Seminar in Urban Infrastructure History

This seminar investigates the urban and environmental history of New York City's infrastructure, including water, sewage, transportation, housing and office construction. The course investigates these systems in the context of the environmental, political and economic concerns that shape the city's infrastructure. The course looks at the transnational circulation of ideas about designing and constructing urban systems. Questions include: How and why are infrastructure systems built? Why are they built the way they are? How do the technologies used affect the environment? Are the systems sustainable and interoperable? How do ideas about infrastructural needs, design and financing circulate transnationally? *Credits: 3. Prerequisite: HI 2313 or instructor's permission. Note: Satisfies a humanities and social sciences elective.*

PL 2243/W Thinking About the Environment

This survey of contemporary environmental issues emphasizes developing the reasoning skills needed for informed judgments. Topics include the history of environmentalism in the United States, the global character of the environmental crisis and special topics, including atmospheric ozone, global warming, acid rain, air pollution, global population growth, pesticides, nuclear power, alternative energy, biodiversity and species extinction and genetically modified crops. The limits of technology to resolve environmental problems is also addressed. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PL 3103/W Philosophy East and West

Philosophy develops in different ways in different cultures. Because philosophy aims to be universal and to address fundamental issues without cultural bias, these differences in philosophical development raise important questions. This course introduces the classical problems of philosophy from traditionally Eastern and Western perspectives. Standard readings from Greek and Roman, European and American philosophy are compared with parallel texts from other traditions, including Arabic, Chinese and Indian. Science and technology development in each tradition is also covered. *Credits: 3. Prerequisite: One level 2 SEG cluster course. Note: Satisfies a humanities and social sciences elective.*

PS 2323/W Environmental Psychology

This course looks at how people interact with their environments: how settings affect behavior; how people change environments to fit their needs; and how people can become an active part of the environmental-design process. The course discusses how people use space and the way environmental design meets (or fails to meet) human needs. These concerns are valid for very-small-scale design problems (as in human-factors engineering); mid-size spaces (architecture and interior design); large-scale spaces (communities, urban areas). *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PS 2723 Human Factors in Engineering Design

The purpose of this course is to familiarize students with basic concepts, research findings and theories related to the way in which human characteristics, capabilities and limita-

tions, including physiology and psychology, affect system design and performance. Students will develop a basic understanding of methods for studying and assessing human behavior and for analyzing human performance. It will introduce aspects of system, interface, organizational design and physical setting as they influence operators and performance. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PS 3723 Psychology of Sustainability

This course addresses the psychological bases of environmental problems, investigates theories of behavior change as they relate to environmental issues and introduces practical strategies to foster behavior change. Topics include the ways in which the fit (or lack of it) of design to human behavior can affect environmentally relevant behaviors, such as energy use and recycling. Course issues include designing green buildings and creating sustainable communities. *Credits: 3. Prerequisite: One level 2 PS course. Note: Satisfies a humanities and social sciences elective.*

PS 3743 Psychology of Transportation

The human element is the central focus of all transit systems. How users respond to a transportation system ultimately determines its success or failure. Psychological and behavioral issues range from the small scale (ergonomics of signal and platform design; design that causes slips, trips and falls), to the psychological and psychophysiological (such as commuter stress), through large-scale implementation (mode choice, social impacts of highways or transit lines). *Credits: 3. Prerequisite: One level 2 PS course. Note: Satisfies a humanities and social sciences elective.*

PS 3753 Psychology of Living in Extreme Environments

This course considers issues, research and theory in relation to creating human habitats in extreme space, undersea and polar regions. The course reviews firsthand experiences and formal studies of life in these settings, and extrapolates from work in other, less extreme human settings. Psychological issues include privacy, territoriality, isolation and crowding, light and views of nature, as well as personality and organizational issues. Students complete a research paper and engage in a team-design project. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

PS 3813 Social Psychology of Virtual Worlds

This course explores human relations in the virtual world. Do real-world interactions maintain themselves in an online community, or do the rules of social interaction change significantly in a virtual environment? When people perceive themselves as being anonymous, do they feel the same responsibility for their own behavior, or do they interact with others differently as they would in the real world? This course examines the psychology of online, virtual relationships with a view to compare and contrast them with real-world relationships. *Credits: 3. Prerequisite: One level 2 PS course. Note: Satisfies a humanities and social sciences elective.*

PS 3833 Special Topics in Psychology

This course discusses new or experimental topics in psychology offered by current or visiting faculty. *Credits: 3. Prerequisite: One level 2 PS course. Note: Satisfies a humanities and social sciences elective.*

PS 4443 Guided Readings in Psychology

The course focuses on selected problems in psychology. Faculty members supervise students in pre-arranged individual or group studies/projects involving guided reading or research. This course is for mature students who undertake specialized independent study under tutorial guidance. *Credits: 3. Prerequisite: Consent of instructor. Note: Satisfies a humanities and social sciences elective.*

SEG 2183/W Beyond Oil: Fueling Tomorrow's Vehicles

This course explores the alternatives to oil that vehicle manufacturers are pursuing in their desire to wean away from oil and its mercurial price swings. Students will be required to choose two of these alternative approaches and prepare white papers on each, covering the technology, advantages, limitations or drawbacks, cost saving, environmental impact and likelihood of success in the market place. The focus will be on biofuels, hybrids, the fuel cell, natural gas, hydrogen, the electric car. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

SEG 2193/W Writing About Nature and the Environment

In this course, students explore today's major environmental and ecological issues and write a number of pieces that discuss causes and possible solutions. Each article is based on a literature search and on interviews with professionals. Class critiques of articles are an integral part of the learning process. Topics include global warming, renewable energy, health and the environment, environmental law and biodiversity. Authors of the best pieces are encouraged to submit them for publication. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

SEG 291x Special Topics in Society, Environment and Globalization

This course looks at selected topics and issues concerning human society, the environment or globalization at the 2000 level. *Credits: Variable. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

SEG 3213 Sustainable Systems and the Natural History of Whaling

The Cetaceans (whales, dolphins and porpoises), including some of the largest animals ever known to have lived, have evolved many unusual structures, physiologies and social organizations. This course discusses Cetacean biology, including their ecological relationships and their social and migratory behaviors. The course covers the history of the whaling industry, ships, catching whales, processing them and shipping the products. The uses and markets for the products also are discussed. Topics include the global aspects of whale harvesting, the depletion of whale stocks, and attempts by governments and concerned groups to control and stop the hunting. Discussions include international frustrations over whaling-control bans—whales were part of the ocean "commons," accessible to all nations. The course also looks at the sealfur trade industry and fishing threats to the dolphin/porpoise population. *Credits: 3. Prerequisite: One level 2 PS course. Note: Satisfies a humanities and social sciences elective.*

SEG 391x Special Topics in Society, Environment and Globalization

This course covers selected topics and issues concerning human society, the environment or globalization at the 3000 level. *Credits: Variable. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

SEG 491x Special Topics in Society, Environment and Globalization

This course looks at selected topics and issues concerning human society, the environment or globalization at the 4000 level. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

DEPARTMENT OF TECHNOLOGY MANAGEMENT

Head: Bharat Rao

MISSION STATEMENT

The mission of the Department of Technology Management is to act as a major educational gateway and premier learning and research hub devoted explicitly to broadly defined innovation and technology management and entrepreneurship. The scholarly intellectual capital it produces and its tailored programs at the undergraduate, graduate and doctoral levels enable the department to provide unique and valuable opportunities for students, practicing managers and scholars. The department is committed unequivocally to upgrade and revise continually its learning programs and courses to meet fast-changing demands of a dynamic, innovation-driven and competitive environment and to be an academic leader in technology management

THE DEPARTMENT

Effective technology and innovation management and entrepreneurship increasingly determine success in business today. The Department of Technology Management is an acknowledged pioneer and leader in the New York City/tri-state region and beyond in offering courses and programs about these increasingly critical arenas. The department serves a diverse and broad range of professionals, and its faculty and students compose a vital and forward-thinking research and learning community. The department's research and educational offerings focus on a broad range of sectors, including financial and professional services; retailing and logistics; bio-medical, biotechnology and pharmaceuticals; renewable energy and clean technology; media and entertainment; IT, telecom, networks and modern electronic business; and non-for-profits and government—all constituting areas of greatest growth and opportunity in the modern economy, especially in New York City, the nation's foremost global city.

CONTACT INFORMATION

Brooklyn Campus
Polytechnic Institute of NYU
Five MetroTech Center
Brooklyn, NY 11201
Tel: (718) 260-3760
Fax: (718) 260-3874
E-mail: mgt-dept@poly.edu
Web: www.poly.edu/ academics/departments/technology/

Manhattan Location
MOT and IM Executive Master's Programs
Institute for Technology and Enterprise
55 Broad Street, Suite 13B
New York, NY 10004
Tel: (718) 260-4015
Fax: (212) 547-7029
E-mail: mot-im@poly.edu; ite@poly.edu
Web: www.poly.edu/academics/programs/management-technology-ms/; www.ite.poly.edu

DEGREES OFFERED

Bachelor of Science
- Business and Technology Management

Master of Science
- Information Management (IM)
- Management (MSM)
- Management of Technology (MOT)***
- Organizational Behavior (MSOB)

Doctor of Philosophy
- Technology Management

Graduate Certificates
- Construction Management**
- Electronic Business Management
- Entrepreneurship
- Human Resource Management
- Information Management
- Operations Management
- Organizational Behavior
- Project Management
- Technology Management
- Telecommunications Management

*Offered with the Department of Electrical and Computer Engineering and the Department of Computer and Information Science.
**Offered with the Department of Civil Engineering.
***Offered in the MOT and eMOT Programs.

RESEARCH PROFILE

The Department of Technology Management consists of an interdisciplinary group of scholars that studies various aspects of technology and innovation - strategic, behavioral, organizational and sociological. Some specific streams of research and sub-topics include:
- Global innovation and R&D strategy - Managing emerging technologies - Technology and development - Service design and innovation -Tech entrepreneurship and commercialization - Sustainable and clean-tech innovation
- Impacts of information technology upon individuals, organizations and society - Citizen science - Social computing - Open source - Business model innovation - Pervasive information services
- Sociological aspects of technology and work - Communicative practices - Distributed collaboration and virtual teams - Knowledge management - Leading Distributed and Virtual Organizations - Project Management

EDUCATIONAL PROGRAMS

UNDERGRADUATE PROGRAM

The Department of Technology Management offers a Bachelor of Science in Business and Technology Management (BTM). This program prepares students to be next-generation managers in fields dominated by technological innovation and especially the rapid advancement of information technology and other fields in the applied science and engineering disciplines. Students completing the BTM Program are prepared to succeed in positions such as technology project leaders, technology savvy entrepreneurs, technology and IT analysts, customer-relationship managers and in other cross-functional roles, and developers of business innovations in financial services and other professional services fields.

MINOR IN MANAGEMENT

Undergraduate students may obtain an undergraduate minor in management by completing 14 credits of undergraduate management courses. An overall GPA of at least 2.0 must be maintained. At least 8 of the 14 credits must be taken by students while enrolled at Polytechnic.

GRADUATE AND CERTIFICATE PROGRAMS

The department offers a portfolio of redesigned and modernized educational programs, all dealing with the broad spectrum of innovation, technology management and entrepreneurship in the modern economy, and the department's graduate programs attract a wide range of students and professionals. This is because all managers should understand how technology and innovation management and entrepreneurship are essential for delivering value to organizations and to the market.

The department offers several graduate and professional programs, two of which are earned in executive management format (meeting every other week on Thursday evening and all day Saturday) and four of which are offered on weekday evenings. One program is offered in both formats.

The department's graduate and professional programs include:

- Management of Technology Master's Program (MOT)
- Information Management Executive Master's Program (eIM)
- Master of Science in Management Program (MSM)
- Management of Technology Executive Master's Program (eMOT)
- Master of Science in Organizational Behavior (MS-OB)
- PhD-Technology Management

Students may pursue the MOT, MSM and MS-OB programs either part time or full time with an evening schedule. Each has concentrations that allow students to specialize in selected areas.

The department also offers advanced graduate certificates from the MSM and MS-OB Programs, which consist of sequences of courses leading to advanced knowledge in a desired area of specialization.

GRADUATE PROGRAMS

We encourage and welcome prospective students to apply to our other thriving and innovative graduate programs: the Management of Technology (MOT) and Information Management (IM) Executive Master's programs, the Master's of Science—Management (MSM) and the Master's of Science—Organization Behavior (MS-OB). Further information on these programs can be found on the department's website.

DOCTOR OF PHILOSOPHY IN TECHNOLOGY MANAGEMENT

Modern technologies increasingly and profoundly affect the management of products, services, processes, organizational forms, business models, the shape of industry structures and modern business environments, the available kinds of technology-enabled innovation and the capability of integrating technology and management—all aimed at creating value for customers and organizations. The ability to conduct research on and to educate about the managerial implications of such topics—all composing technology management—is a highly sought-after and important arena for business scholarship and education. The PhD in Technology Management provides this increasingly significant set of scholarly and educational opportunities.

This degree program is for research-oriented students. Both full-time and part-time students are accepted. Admission criteria include academic record, professional experience, research potential, GMAT or GRE scores, references and a writing sample.

Please visit the program's website for more information.

All management undergraduate and graduate degree programs, as well as certificate programs, are further described in this catalog.

STUDENT PROFESSIONAL SOCIETIES, ASSOCIATIONS AND ORGANIZATIONS

The Management of Technology and the Information Management Executive Programs Alumni Association actively seek to continue and expand shared professional experience gained during and after the programs. Members meet face to face or electronically to share insights obtained in their work experiences and to debate issues broadly relevant to technology management.

The Organizational Behavior Program sponsors an award-winning student chapter of the Society for Human Resources Management (SHRM). The PolySHRM chapter was selected as one of the top 10 in the country by national SHRM. PolySHRM sponsors forums with experts and provides opportunities for professional networking and mentoring to enhance a student's education and career.

The student club associated with the Bachelor of Science in Business and Technology Management degree program is a strong and valued component of the social fabric of undergraduate life at Polytechnic. This organization works to create professional knowledge and opportunities for members.

Departmental representatives are available for student advising at all NYU-Poly campuses — Brooklyn, Long Island and Westchester— and at the Manhattan location.

EXTENSION IN ISRAEL

The Department of Technology Management offers the Master of Science in Management (MSM) as well as in Organizational Behavior (OB) at its extension in Israel. The Polytechnic Israel extension program was initiated in 1997 by Polytechnic Management Professor Harold Kaufman to fill a local demand for managerial expertise.

The programs are identical to the evening curricula in New York and offer selected concentrations specifically for professionals and managers working in Israeli business and industry. The program brings cutting-edge technology management approaches taught by Polytechnic professors together with Israeli faculty to address the advanced state of technology in Israel.

For further information about the extension in Israel, contact Academic Director Harold Kaufman at (718) 260-3485 in New York or by e-mail at hkaufman@poly.edu.

FACULTY

PROFESSORS

Mel Horwitch, Professor of Technology Management; on leave
MBA, DBA, Harvard University
AB, Princeton
Innovation management, global innovation, technology strategy, technology policy

Harold G. Kaufman, Professor of Technology Management; Academic Director, Organizational Behavior Program; Academic Director, Department of Management Extension in Israel
MIE, PhD, New York University
BME, Cooper Union for the Advancement of Science and Art
Managing professional and technical workers, career management, obsolescence of knowledge and skills, research methods

ASSOCIATE PROFESSOR

Bharat P. Rao, Associate Professor of Technology Management and Department Chair
PhD, University of Georgia
Managing emerging technologies, broadband, wireless and digital business, global innovation, strategic marketing, IT in the supply chain, alliances, networks and collaborative enterprises

ASSISTANT PROFESSORS

Anne-Laure Fayard, Assistant Professor of Technology Management and Academic Director, PhD Program in Technology Management
PhD, Ecole Des Hautes Etudes en Sciences Sociales (France)
Discourse analysis, communication, online communities, social-material practices, space and culture

Oded Nov, Assistant Professor of Technology Management
PhD, University of Cambridge, UK,
MSC, London School of Economics, UK
Technology management, behavioral aspects of information systems, knowledge management, motivations of open source and user-generated content contributors

INDUSTRY FACULTY

Jerry MacArthur Hultin, Industry Professor of Law, Management and Public Policy; President of Polytechnic Institute of NYU
JD, Yale University
Innovation management, global development, modern university education, technology policy

Joseph S. Nadan, Industry Professor of Technology Management; Director of eMOT and eIM Master's Programs
PhD, New York University
Content innovation, social networks, global entrepreneurship, media management, wireless innovation, e-business

TECHNOLOGY, CULTURE AND SOCIETY

Richard. C. Wener, Professor of Psychology
PhD, University of Illinois at Chicago
Environmental psychology, crowding, assessment of the built environment

RESEARCH FACULTY AND FACULTY EMERITI

Seymour Kaplan, Associate Professor Emeritus of Operations Management and Management Science
PhD, New York University
Operations research and management

ADJUNCT FACULTY

Frank Apicella
MBA, New York University
Finance

John Artise
MA, New York University
Global human resource management

Harun Asad
MBA, George Mason University
General management, marketing, innovation

Yair Berson
PhD, State University of New York Binghamton
Organizational behavior, leadership of high technology firms, strategic leadership

Tushar Bhattacharjee
PhD, Post-Doctoral Research, MIT and Osaka University
Data communications, electrical engineering

Parbati Bhattacharya
MS, Pace University
Finance

Rabindre Bhattacharya
MS, Mercy College
Economics, finance

Robert Biolsi
PhD, Graduate Center, College University of New York
Finance, inflation, equity prices and commodity diversification, electricity deregulation

Jabril Bensedrine
PhD, ESSEC Graduate School of Business (France)
Entrepreneurship, corporate entrepreneurship, technology strategy

Ravi Bhatia
MS, Polytechnic Institute of New York
Project management

Denise Bracamonte
BA, St. John University; PMP and PMI
Certified Project management
Project management

Aurora Brito
MBA, Suffolk University
Coaching in organizations, organizational behavior

Howard Bruck
MBA, Fordham University
Project management

Srimat T. Chakradhar
PhD, Rutgers University
Design/test distributed, networked computing systems, embedded systems

Arnold Cohen
MBA, City College of New York
Marketing

Lance Cohen
PhD, Columbia University
Management information systems

Robert Cohen
MBA, New York Institute of Technology
Management information systems, quality control and systems

Vaughan Coleman
MSOB, Polytechnic University
MA, New York University
Knowledge Management in HR

Vincent Conte
PhD, Hofstra University
Globalization and technology in HR

Alejandro Crawford
MBA, Tuck School, Dartmouth
Entrepreneurial marketing and sales, managing growing enterprises, marketing

Michael Cortegiano
BS, Fairfield University
Accounting and finance

Jan Damsgaard
PhD, Copenhagen Business School (Denmark)
e-Business, management information systems

Anthony Deak
MS, Polytechnic Institute of New York
Foundations of management, global perspectives in management

Matthew J. DeLuca
MPA, University of Pittsburgh
Labor relations, performance management, reward systems, organizational consulting, outsourcing, global HR management

Michael D'Emic
PhD, National University of Ireland, Cork
MBA, Trinity College (Dublin)
Accounting, finance

Philip Dorin
Management Department Adviser for Long Island Campus
PhD, University of Connecticut
Organizational behavior, human resource management, training and development

Roger D. Eisenhardt
MA, Long Island University, CW Post
MSOB, Polytechnic Institute of NYU
Human resource management

Noha S. El-Ghobashy
MS, Columbia University
Project management

James Fazio
MA and MBA, St. John's University
Operations management

Philip Ferrara
PhD, Hofstra University
Organizational staffing, job design, employee engagement

William Feuss
PhD, Stevens Institute of Technology
Marketing

Steve Goldberg
MBA, New York University
Digital marketing, accounting, finance, human resources

Sara Grant
PhD, New York University
Organizational theory and design, human resource management, conflict management, organizational behavior, research methods

Edward Greenbaum
MS, Cornell University
Industrial and labor relations

Bohdan Hoshovsky
PhD, Pacifica Graduate Institute
Organizational behavior, project management, general management, transhumanism

Jonatan Jelen
MBA, Ecole Superieure de Commerce de Paris
PhD candidate, Baruch
Economics, supply chain management

Seymour Kaplan
PhD, New York University
Economics, management science

David Kalow
JD, University of Chicago
Intellectual property

Armand Keim
MBA, City College of NY, Baruch
CAPSTONE projects

Zuño Kristal
EdD, Columbia University
Leadership, organizational learning, executive coaching

Howard Kupferman,
MS, Polytechnic Institute of New York
MBA, Finance, Fordham University
Organizational behavior, business ethics, human resource management, marketing

Tate Lacy
MBA, UC Berkeley
Marketing, biochemistry

David Lefferts
MBA, Columbia University
Emerging financial technologies, financial products, e-Business

Gary Levanti
MBA, Binghamton University
New product development

Gary Levanti
MBA, Binghamton University
Entrepreneurship

Rob Marano
MS, University of Pennsylvania
Entrepreneurship, engineering

Thomas Mazzone
MBA, Theseus Institute (France)
Operations management, supply chain management, project management

Louis Minakakis
MSM, Polytechnic University
Marketing

Mark Mishken
PhD, University of Tennessee
Organizational staffing, organizational behavior

Pavlos Mourdoukoutas
PhD, University of Connecticut
Economics

Bala Mulloth
PhD, Polytechnic Institute of NYU
Entrepreneurship, e-Business, technology management

Carl Nelson
MIE, New York University
Operations management

Bruce Niswander
JD, MBA, Ohio State University
Entrepreneurship, entrepreneurial finance, managing intellectual property and intellectual capital

James Paguagua
MBA, Pace University
New product development, marketing

Mark Popolano
BS, Brooklyn College
Information technology, systems, management in organizations

Ravi Rajagopal
MS, Queens College
Cloud computing

John Reilly
MA, Columbia University
Human resource information systems, web-based human resource management, managing new technology in HR

Teresa Piliouras
PhD, Polytechnic University
Operations management, risk management, management of information technology

Timothy W. Reinig
JD, State University of New York at Buffalo
e-Business, e-Commerce marketing, Internet law and intellectual property

Gary Rinkerman
JD, Georgetown University Law Center
Intellectual property

Suman Sabastin
MSOB, Polytechnic University
Statistics

Fred Schlissel
MBA, Columbia University
Entrepreneurship

Ron Spinelli
MS, Brooklyn Polytechnic University
Supply chain management, strategic business

Wendy Stahl
MBA, Harvard University
Marketing new product development

Thomas Stiles
MBA, New York University
Telecommunications management

John Thomas
MBA, University of Rochester
Operations, quality and project management

Vivek Veeraiah
MS, MBA, Polytechnic Institute of NYU
Operations management, enterprise data systems

Carla Visser, Adjunct Associate Professor of Management
M.Ed, Rutgers University
Coaching in organizations

Jack Yurkiewicz
PhD, Yale University
Management science

Anthony Zinsser
PhD, Stevens Institute of Technology
Organizational behavior, organization development, talent management, leadership and team development

ADVISORY BOARDS

Corporate and Academic

The Department of Technology Management maintains deep ties with a wide range of firms in a host of knowledge- and innovation-intensive sectors. The department is honored to have a distinguished and active Corporate Advisory Board. The department also works closely with high-quality academic institutions and colleagues worldwide and is honored to have an active and highly respected Academic Advisory Board. Both boards meet regularly to review the department's programs, research and plans. In this manner, the department stays informed, meets the pragmatic and scholarly needs and critical challenges confronting technology and innovation executives and entrepreneurs, and assures that its courses and programs are state of the art and relevant.

Corporate Advisory Board Members

Mark Chardack
Chief Financial Officer
LextraNet.com

Patrick S. Finn
Director, Northeast Market Development
CISCO Systems

Edward Fitzpatrick
First Deputy Controller
City of New York

John Gilbert
Executive Vice President, COO
Rudin Management Inc.
Chief Technology Officer
New York Information Technology Center

Dr. Alan Kantrow, PhD
Chief Content Officer, Monitor Group
Dean of Faculty, Monitor University,
Monitor Group
Visiting Professor, Skolkovo Business School, Moscow

Stephen Lake
Investment Director
QinetiQ Ventures (UK)

Sean Phelan
Founder, Multimap (UK)
Private Investor

J. R. (Jay) Topper Jr.
CIO
Rosetta Stone

Academic Advisory Board

Professor Michael Cusumano
Sloan School of Management, MIT
Cambridge, Massachusetts

Professor Yves Doz
INSEAD
Fontainebleau, France

Dr. Alan Kantrow, PhD
Chief Content Officer, Monitor GroupDean of Faculty, Monitor University, Monitor Group
Visiting Professor, Skolkovo Business School, Moscow

Professor Shlomo Maital
Technion Institute of Management
Tel Aviv, Israel

Professor Pedro Nueno
IESE
Barcelona, Spain

Professor Ananth Ramen
Harvard Business School

Professor Denis Fred Simon
Penn State University

Professor Edward A. Stohr
Stevens Institute of Technology

Professor Raymond-Alain Thietart
Director, PhD Program
ESSEC Business School, France

Professor N. Venkatraman McGrath
Boston University School of Management

PART 3
ACADEMIC PROGRAMS

A BRIEF GUIDE TO COURSE DESCRIPTIONS

Each program described in this catalog contains detailed descriptions of the courses offered within the program. A sample course description follows:

> **MA 1234 EXPERIMENTAL DESIGN** *2.5:1.5:0:4*
>
> Principles of modern statistical experimentation, including practice using basic designs for scientific and industrial experiments and testing. Single factor experiments, randomized block design, Latin squares, Graeco-Latin squares; factorial and fractional factorial experiments; surface-fitting designs. *Prerequisite: MA 2244; Co-requisite: MA 1534. Also listed under IE 1234.*

The first line gives the official course number for which students must register and the official course title. The letters indicate the discipline of the course and the first number of the official course numbers indicates the level of the course. The levels are as follows:

- 1XXX - Freshman Level
- 2XXX - Sophomore Level
- 3XXX - Junior Level
- 4XXX - Senior Level
- 5XXX to 9XXX - Graduate level

Typically the last number of the course number indicates the number of credits. The breakdown of periods of the course is also listed. In the sample description, the course meets for 2.5 lecture periods, 1.5 laboratory periods and no recitation periods per week.

The paragraph description briefly indicates the contents and coverage of the course. A detailed course syllabus may be available by request from the office of the offering department.

"Prerequisites" are courses (or their equivalent) that must be completed before registering for the described course. "Co-requisites" are courses taken concurrently with the described course.

The notation "Also listed…" indicates that the course is also given under the number shown. This means that two or more departments or programs sponsor the described course and that students may register under either number, usually the one representing the student's major program. Classes are jointly delivered.

BIOINFORMATICS PROGRAM

Academic Director: Kalle M. Levon
Program Manager: Mgavi E.Brathwaite

Bioinformatics is a relatively new branch of science that organizes and interprets the overwhelming amount of data recently available on living organisms generated by the human genome project and follow-up projects. The need for this branch of science is real. While it is becoming increasingly simple to obtain experimental information on DNA, RNA and protein sequences and expression levels, the interpretation of this information is far from straightforward. Due to its interdisciplinary nature, there is a critical scarcity—in academia and especially in industry—of individuals with the training in molecular biology, computer science, probability and statistics and bioinformatics algorithms to interpret this data. The need for specialists with focused bioinformatics expertise is growing rapidly. New technologies such as next generation sequencing have produced a data tsunami which will continue to grow particularly with the application of this technology to clinical diagnostics. Hence the demand for bioinformatics professional will continue to grow for the foreseeable future.

NYU-Poly's MS in Bioinformatics provides a solid, carefully tailored program of study. It responds to the needs of (1) persons with BS degrees seeking entry into the field and (2) persons with advanced degrees who may be employed in the pharmaceutical, healthcare, or IT sectors that now value and require such expertise. The program meets industry's demand for professionals with solid foundations in genomics, proteomics, Perl & BioPerl, R & BioConductor, MySQL, sequence and pathway analysis, as well as a host of genome informatics tools and algorithms such as BLAST.

GOALS AND OBJECTIVES

The Master of Science program in bioinformatics offers a mechanism to train individuals seeking entry into this fast-growing field. The MS program goal is to fulfill the present educational needs with flexible on-site requirements and extensive use of Web-based or other remote-access training concepts such as multimedia instruction. In addition to traditional computer-science components, the program offers training in databases and exposure to theory and to hands-on experience with widely used bioinformatics algorithms. These include BLAST, ClustalW, hidden Markov chains and neural nets to predict protein secondary structure. The core goal is for students to understand sequence analysis (Sanger and NextGeneration), structural genomics and the protein structure/function relationship.

REQUIREMENTS FOR THE MASTER OF SCIENCE

The Master of Science degree is generally intended for students from life science, computer science, computer engineering, math and statistics backgrounds seeking in-depth knowledge in informatics applications for genomics and proteomics. Admission to the master's program requires a bachelor's degree from an accredited institution, with superior undergraduate academic record and completion of all prerequisite courses. Students who do not meet all requirements will be considered individually for admission and may be admitted subject to the completion of appropriate undergraduate courses to remove preparation deficiencies. Applicants who are otherwise sufficiently prepared for admission without undergraduate deficiencies may be required to take specified undergraduate and introductory-level graduate courses. Such courses count towards the master's degree.

To satisfy the requirements for the Master of Science degree, the student must complete 30 credits. The Institute requires an overall grade-point average of B in all graduate courses. Students are required to take the four core courses. The students who do not have a BS degree in Chemical or Biological Sciences are required to take Chemical and Biological Foundations for Bioinformatics courses [BI 7513 and BI 7523]. Computational proficiency is expected.

Students may elect research and a thesis (9 credits). An oral thesis defense is held after the typed, written thesis is submitted in accordance with university formats for projects, theses and publications. A grade of A or B is required. Students who elect not to write a thesis may choose to take 3 to 6 credits of guided studies and submit a written report. Students can satisfy remaining credit requirements by taking elective courses with their adviser's approval. No more than 9 credits of electives can be selected from outside the program.

Basic Core Courses

Required courses for students with computer science or similar background:

BI 7513	Chemical Foundation for Bioinformatics	3
BI 7523	Biological Foundation for Bioinformatics	3

Required courses for students with chemical or biological science background:

CS 5303	Introduction to Programming and Problem Solving	3
CS 5403	Data Structures and algorithms	3

Required Core Courses

BI 7533	Bioinformatics I: Sequence Analysis	3
BI 7543	Bioinformatics II: Protein Structure	3
BI 7553	Bioinformatics III: Functional Prediction	3
BI 7643	Methods in Genome Computing	3

Electives

BI 7613	Systems Biology: Modeling of Biological Networks	3
BI 7623	Systems Biology: -Omes and -Omics	3
BI 7633	Microarray Data Analysis	3
BI 7843	Molecular Modeling and Simulations	3
BI 7573	Special Topics in Bioinformatics	3
BI 7583/93	Guided Studies in Bioinformatics	3-6
CS 6003	Foundation of Computer Science	3
CS 6083	Principles of Database Systems	3
CS 6923	Machine Learning	3

GRADUATE COURSES

BI 7513 Chemical Foundation for Bioinformatics *3:0:0:3*

This course intensively reviews those aspects of organic chemistry and biochemistry necessary to begin research in bioinformatics and to enter graduate courses in biology. Topics include covalent bonding, quantum mechanical basis of bond formation, three-dimensional structure of molecules, reaction mechanisms, catalysis, polymers, enzymes, thermodynamic and kinetic foundations, metabolic pathways, sequence and structure of macromolecules. This course extensively uses computer approaches to convey the essential computational and visual nature of material to be covered. *Prerequisites: General Chemistry, General Physics, Organic Chemistry and Calculus.*

BI 7523 Biological Foundation for Bioinformatics *3:0:0:3*

This course intensively reviews the aspects of biochemistry, molecular biology and cell biology necessary to begin research in bioinformatics and to enter graduate courses in biology. The areas covered include cell structure, intracellular sorting, cellular signaling (i.e., receptors), Cytoskelton, cell cycle, DNA replication, transcription and translation. This course extensively uses computer approaches to convey the essential computational and visual nature of the material to be covered. *Prerequisites: General Chemistry, General Physics, Organic Chemistry, Calculus or permission of instructor.*

BI 7533 Bioinformatics I: Sequence Analysis *3:0:0:3*

This course covers computer representations of nucleic acid and protein sequences; pairwise and multiple alignment methods; available databases of nucleic acid and protein sequences; database search methods; scoring functions for assessment of alignments; nucleic acid to protein sequence translation and codon usage; genomic organization and gene structure in prokaryotes and eukaryotes; introns and exons; prediction of open reading frames; alternative splicing; existing databases of mRNA, DNA protein and genomic information; and an overview of available programs and of Web resources.

BI 7543 Bioinformatics II: Protein Structure *3:0:0:3*

The course explores protein-folding representations; databases of protein-folding classes; secondary structure prediction; tertiary structure prediction via computer-folding experiments threading; homology model building; prediction of post translation modification sites; active and binding sites in proteins; representations of contiguous and non-contiguous epitopes on protein surfaces at the sequence level; representations of functional motifs at the three dimensional and at the sequence level. *Prerequisite: BI 7533.*

BI 7553 Bioinformatics III: Functional Prediction *3:0:0:3*

The course covers functional classifications of proteins; prediction of function from sequence and structure; Orthologs and Paralogs; representations of biological pathways; available systems for the analysis of whole genomes and for human-assisted and automatic functional prediction. *Prerequisites: BI 7543.*

BI 7573 Special Topics in Informatics in Chemical and Biological Sciences

This course covers special topics on various advanced or specialized topics in chemo- or bioinformatics that are presented at intervals.

BI 7603 Research in Informatics in Chemical and Biological Sciences *(As arranged)*

The course emphasizes original research, which serves as the basis for a master's degree. The minimum research registration requirement for the master's thesis is 9 credits. Registration for research is required each semester consecutively until students have completed adequate research projects and an acceptable thesis, and have passed required oral examinations. Research credits registered for each semester realistically reflect time devoted to research. *Prerequisites: For MS candidates; Degree status, consent of graduate adviser and thesis director.*

BI 7613 Introduction to Systems Biology *3:0:0:3*

This course explains the functioning of basic circuit elements in transcription regulation, signal transduction and developmental networks of living cells, using simplified mathematical models. The course focuses on design principles and information processing in biological circuits. It discusses network motifs, modularity, robustness, evolutional optimization and error minimization by kinetic proofreading in specific applications to bacterial chemotaxis, developmental patterning, neuronal circuits and immune recognition in several well-studied biological systems. *Prerequisite: BI 7543.*

BI 7623 Systems Biology: -Omes and -Omics *3:0:0:3*

This course summarizes knowledge in genomics, proteomics, transcriptomics, metabolomics and relative molecular technologies. Topics include an overview of technologies in functional genomics (DNA chip arrays); whole genome expression analysis (EST, MPSS, SAGE, arrays); proteome analysis technology (2D-electrophoresis, protein in situ digestion for mass spectrometric analysis, yeast 2-hybrid analysis. 2-D PAGE, MALDI-TOF spectroscopy); the principles of Nuclear Magnetic Resonance Spectroscopy and Mass Spectrometry technologies for metabolomics, including general principles, the strengths and weaknesses of each technique, the requirements for sample preparation and the options for the management of output data. This course explains how to exploit different -ome database resources for investigations via special practical tasks to lectures. Special attention is focused on nutrigenomics, a multidisciplinary science that uses genomics, transcriptomics and proteomics to study metabolic health. This relatively new area of metabolomics has the potential to contribute significantly to advances in nutrition and health. *Prerequisites: BI 7543 and BI 7553.*

BI 7633 Microarray Analysis *3:0:0:3*

This course will train students how to analyze DNA microarrays experiments. In first part of the course, students will gain practical experience using R (Bio Conductor packages) in pre processing microarray data, normalization and summarizing expression data, putting data together for filtering, differential expression, clustering annotations to identify differentially expressed genes and relevant pathways. The second part of the course focuses on labs from Bio Conductor workshops, review of computational approaches for studying gene expression data. Data mining techniques such as linear modeling for time course data analysis, learning algorithms like support vector machines for classification problems and meta-analysis across experiments are introduced.

BI 7643 Methods in Genome Computing *3:0:0:3*

This course is designed to introduce students to the Perl programming language, its bioinformatics toolbox BioPerl and Unix commands for processing high throughput genomic and/or proteomic data. The first part of the course deals with the fundamentals of Perl. The second part deals with subroutines, object oriented Perl, and using BioPerl modules to perform sequence analysis and graphics rendering. Students also learn how to use BioPerl modules to set up an analysis pipeline.

BI 7843 Molecular Modeling and Simulation *3:0:0:3*

This course introduces principles and applications of modern molecular modeling and simulations methods, using commercial software packages on powerful computer workstations. Algorithms for visualizing and predicting structural and physical properties of molecules and molecular aggregates are taught, based on principles of quantum, classical and statistical mechanics, which are in a mathematically simplified form. Commercial software packages are applied to illustrative problems in physical chemistry, chemical engineering, biology and medicine. *Prerequisites: Completion of core undergraduate courses in mathematics and science (grade C or better) in CE, CM, CS, EE, ME or PH, or equivalent.*

BI 7583, 7593 Guided Studies in Informatics in Chemical and Biological Sciences *3:0:0:3*

This research/case course can be handled in different ways at the faculty adviser's discretion. The course may involve a series of cases that are dissected and analyzed, or it may involve teaming students with industry personnel for proprietary or non-proprietary research projects. Generally, the student works under faculty supervision, but the course is intended to be largely self-directed within the guidelines established by the supervising faculty member. Master's degree candidates must submit an unbound copy of their report to adviser/s one week before the last day of classes. *Credits: 6 total, each 3 credits. Prerequisite: Degree status.*

THE MASTER OF SCIENCE IN BIOMEDICAL ENGINEERING

Academic Director: Gene R. DiResta

GOALS AND OBJECTIVES

The goal of the MS in Biomedical Engineering program is to give students an in-depth, advanced education that provides them with the analytical tools to perform fundamental and applied research in biomedical engineering. Alternatively, students gain the requisite technical knowledge to apply to management, marketing, sales and other entrepreneurial activities related to biomedical engineering. Specific objectives include the following:

- Enrolling students who come from many disciplines and bring different skill sets to solve a broad range of biomedical-engineering problems. The program accommodates students with a BS or a more advanced degree in chemical engineering, mechanical engineering, electrical engineering, computer science, computer engineering, physics, chemistry, biology, premedical, bioengineering and biotechnology.
- Providing students with a cutting-edge program that integrates quantitative-engineering skills with biological and medical sciences. Students acquire the skills to engage in technological innovations that give people longer, healthier and more productive lives.
- Merging the leadership and talents found at the Institute in chemistry, biology, engineering, computer science, mathematics, management and humanities with the expertise in medical sciences at the NYU School of Medicine, NYU School of Dentistry, NYU Courant Institute and SUNY Downstate Medical Center.
- Giving students an opportunity to focus on a wide range of contemporary topics critical to biomedical engineering. Students choose courses in topics that include biomedical instrumentation, biomaterials, drug delivery, orthopedic biomechanics and devices, protein engineering, anatomy and physiology, biochemistry, immunology, bioinformatics, systems analysis and mathematics, medical imaging and material science.
- Giving students the option of doing research in laboratories at NYU-Poly, NYU Medical and Dental Schools, NYU-affiliated hospitals or SUNY Downstate Medical Center. Students may also substitute research credits with course electives.

In the years ahead, health and human productivity can be improved vastly through major advances in medicine. The successful, seamless integration of biology and modern engineering will drive those advances. Scientists anticipate future breakthroughs ranging from the design of drugs customized to an individual's genome to the perfection of artificial implantable organs. Aggressive and intelligent integration of engineering with the biological and medical sciences will hasten the realization of these and other innovations, leading to longer, healthier and more productive lives. Scientists now can visualize internal structures with a level of clarity thought impossible only a decade ago. With the improved diagnosis that comes from these advances and those that follow, science will discover further treatments.

Today, miniature devices can be manipulated through endoscopes, making it possible to perform minimally invasive surgery that reduces patient trauma. In the future, the micro-fabrication of biomedical devices at Polytechnic and elsewhere will enhance surgical technology and increase the functionality and quality of life of the physically-impaired in applications ranging from congenital defects to improving major organ function (heart, kidneys and liver). Other areas show similar promise. Breakthroughs in human tissue research point to the possibilities of replacing damaged or diseased bone, cartilage and other tissues with newly engineered materials. Bioresorbable materials will substitute for permanent implants to allow tissue recovery followed by clearance of the degraded implant material. New imaging modalities are emerging that provide advanced information and monitoring capabilities. Wireless technology will integrate medical devices and homecare systems with primary healthcare providers, and facilitate the storage and retrieval of patient data. Over the coming decades, these and other extraordinary developments will dramatically affect lives.

By merging Polytechnic's leadership and talents in its programs in engineering, chemistry, biology, computer science, management and humanities programs with NYU's and SUNY Downstate's expertise in medical sciences, the Polytechnic Biomedical Engineering Program provides students with a broad range of research opportunities. The partnership between Polytechnic, NYU and SUNY Downstate is dedicated to this new model of biomedical education and to developing students with practical and fundamental knowledge. Students move freely among the institutions, taking advantage of faculty and associated research programs. Polytechnic's goal is to provide the best in-classroom and laboratory education to develop the skills to succeed in a wide range of opportunities after graduation.

A PERFECT FORMULA FOR A SUCCESSFUL BIOMEDICAL ENGINEERING PROGRAM

Polytechnic's Master of Science in Biomedical Engineering program originated in a strategic alliance between the Institute and SUNY Downstate Medical Center. The two institutions developed extensive research interests with complementary technological expertise. Common areas of scientific investigation include Biosensors, Telemetry, Neurorobotics, Optical Imaging, Bioresorbable Biomedical Materials, Drug Delivery, Protein and Glycolipid Therapeutics, Tissue Engineering and Microchip Sensors. These collaborations remain a vital program component. With the merging of NYU and the Institute, research opportunities are expanded dramatically.

FULL- AND PART-TIME STUDENTS

Students entering this master's program may wish to complete their degree rapidly by taking a full course load, or proceed at a slower pace if they are working professionals who have other full- or part-time commitments. The curriculum structure and class schedule accommodates part-time and full-time students. Thus, most 3-credit courses are given as two-and-a-half hour lectures one evening a week during a 15-week semester. Evening research opportunities are available.

ADMISSION AND DEGREE REQUIREMENTS

The Master of Science degree is for students from various backgrounds seeking the in-depth knowledge and quantitative skills required for biomedical engineering. Students may apply to the master's program if they have one or more of the following: (1) BS or a more advanced degree in any engineering discipline, (2) BS or more advanced degree in mathematics or (3) BS or more advanced degree in any of the natural sciences. Entering students should have a minimum of two semesters of college-level calculus (see Polytechnic course descriptions for mathematics courses MA 1024 and MA 1124), two semesters of college-level physics (see Polytechnic course descriptions for physics, PH 1004 and 2004), two semesters of college-level chemistry (see Polytechnic course descriptions for Chemistry, CM 1014 and CM 1024). For students focusing on the **Biomaterials**

track, additional background in organic chemistry and biochemistry is desirable. For those choosing the **Medical Imaging** or **Bioinstrumentation** track, additional advanced mathematics courses (e.g., Polytechnic courses MA 2132, ordinary differential equations; and MA 2112/2122 multi-variable calculus) are recommended. Students lacking undergraduate courses described above may be admitted contingent upon the student's satisfying courses necessary for success in the program. To help students raise their level of knowledge in chemical and biochemical concepts specific to advanced courses in the **Medical Imaging** or **Bioinstrumentation** tracks, the program developed BE 6653 Principles of Chemical and Biochemical Systems for Engineers. A program adviser reviews with successful applicants what undergraduate courses, if any, they must take. Such courses do not count toward the master's degree.

THE CURRICULUM

Requirements for the Master of Science
Each track within the BME MS program includes two options. The first specifies course requirements that include a thesis option and a second that specifies courses only. Students who choose the master's thesis option must register for at least 3 credits of BE 997x and then write and defend a master's thesis according to Institute guidelines. Those students electing the thesis option will also be required to take CM5040: Chemical Lab Safety.

BIOMEDICAL ENGINEERING—BIOMATERIALS TRACK

To meet graduation requirements, students must have an overall B average in all courses (including MS thesis, research or guided studies) and must not have more than two grades of C in required (core) subjects.

Required courses for all students in the **Biomaterials** Track that fulfill their requirements for an MS in Biomedical Engineering are shown below:

Required Courses

Course	Title	Credits
BE 6013	Molecular Immunology	3
BE 6103	Anatomy, Physiology and Biophysics I	3
BE 6113	Anatomy, Physiology and Biophysics II	3
G23.2303	Intro to Biostatistics	
or		4
G23.2030	Statistics in BiologyI	
BE 6703	Materials in Medicine	3
BE 6753	Biomechanics & Biomaterials in Orthopedics	3
BE 9433	Protein Engineering	3
BE 9443	Tissue Engineering	3
BE 9740	Seminar in Biomedical Engineering	0
BE 9730	Colloquium in Biomedical Engineering	0

Electives

* See List	6

Research

BE 997X	MS Thesis in Biomedical Engineering	6

Total Credits **31**

In addition, once per year, biomedical engineering MS students must register for Colloquium in Biomedical Engineering (BE 9730, 0 credits) and Seminar in Biomedical Engineering (BE 9740, 0 credits).

For all students in the **Biomaterials and Polymer Therapeutics** track, remaining credits (6) must be selected from the list of electives unless permission is granted by the biomedical engineering graduate adviser to substitute a course not listed below. Alternatively, students also may elect to take research in biomedical engineering courses (873x, 3 to 6 credits) without writing a thesis.

BIOMEDICAL ENGINEERING—MEDICAL IMAGING TRACK

Requirements for the Master of Science
To meet graduation requirements, students must achieve an overall B average in all courses (including MS thesis, research or guided studies) and must not have more than two grades of C in required (core) subjects.

Listed below are required (core) courses for students in the **Medical Imaging** track that fulfill the requirements for an MS in Biomedical Engineering.

Required Courses:

Course	Title	Credits
BE 6103	Anatomy, Physiology, & Biophysics I	3
BE 6113	Anatomy, Physiology, & Biophysics II	3
BE 6203	Medical Imaging I	3
BE 6223	Image Processing	3
BE 6453	Probability Theory	3
CBE 6153	Applied Mathematics in Engineering	3
BE 6403	Signals, Systems, Transforms	3
BE 9740	Seminar in Biomedical Engineering	0
BE 9730	Colloquium in Biomedical Engineering	0

Electives

* See List	3-9

Research

BE 997X	MS Thesis in Biomedical Engineering	6

Total Credits **30**

In addition, once per year, biomedical engineering MS students must register for Colloquium in Biomedical Engineering (BE 9730, 0 credits) and Seminar in Biomedical Engineering (BE 9740, 0 credits).

For all students in the **Medical Imaging** track, the remaining 6 credits must be selected from the list of course electives, unless permission is granted by the biomedical engineering graduate adviser to substitute a course not listed below. Alternatively, students also may elect to take one or two biomedical engineering research courses (BE 873x) without writing a thesis.

BIOMEDICAL ENGINEERING—BIOINSTRUMENTATION TRACK

Requirements for the Master of Science
To meet graduation requirements, students must achieve an overall B average in all courses (including MS thesis, research or guided studies) and must not have more than two grades of C in required (core) subjects.

Listed below are required (core) courses for students in the **Bioinstrumentation** track that fulfill the requirements for an MS in Biomedical Engineering. Two options are presented, one for students electing the thesis option.

Required Courses:

Course	Title	Credits
BE 6103	Anatomy, Physiology, & Biophysics I	3
BE 6113	Anatomy, Physiology, & Biophysics II	3
BE 6303	Bio-optics	3
BE 6453	Probability Theory	3
BE 6503	Biomedical Instrumentation	3
CBE 6153	Applied Mathematics in Engineering	3
BE 6403	Signals, Systems, Transforms	3
BE 9740	Seminar in Biomedical Engineering	0
BE 9730	Colloquium in Biomedical Engineering	0

Electives

* See List	3-9

Research

BE 997X	MS Thesis in Biomedical Engineering	6

Total Credits **30**

In addition, once per year, biomedical engineering MS students must register for Colloquium in Biomedical Engineering (BE 9730, 0 credits) and Seminar in Biomedical Engineering (BE 9740, 0 credits).

For all students in the **Bioinstrumentation** track, the remaining 6 credits must be selected from the list of course electives, unless permission is granted by the biomedical engineering graduate adviser to substitute a course not listed below. Alternatively, students also may elect to take one or two biomedical engineering research courses (BE 873x) without writing a thesis.

Electives Courses
The table below lists the elective courses that are available to students pursuing an MS degree in either the Biomaterials, Medical Imaging or Bioinstrumentation tracks.

Course	Title	Credits
BE 6013	Molecular Immunology	3
BE 6023	Cellular & Molecular Neuroscience	3
BE 6203	Medical Imaging I	3
BE 6213	Medical Imaging II	3
BE 6223	Image Processing	3
BE 6303	Bio-optics	3
BE 6403	Signals, Systems, Transforms	3
BE 6453	Probability Theory	3
BE 6483	Digital Signal Processing Lab	3
BE 6503	Biomedical Instrumentation	3
BE 6603	Drug Delivery	3

BE 6653	Prin. of Chemical & Biological Systems for Engineering	3
BE 6703	Materials in Medicine	3
BE 6753	Biomechanics & Biomaterials in Orthopedics	3
BE 8713	Guided Studies in Biomedical Engineering I	3
BE 8733	Guided Studies in Biomedical Engineering II	3
BE 9433	Protein Engineering	3
BE 9443	Tissue Engineering	3
BE 9753	Bioethics Seminar	3
CBE 6153	Applied Mathematics in Engineering	3
CS 6643	Computer Visions & Scene Analysis	3
EL 5013	Wireless Personal Communication Systems	3
MA 6283	Mathematical Modeling in Biology	3
ME 7863	Special Topics	3
PH 6403	Physical Concepts of Polymer Nanocomposites	3
G23.2303	Intro to Biostatistics	4
G23.2030	Statistics in Biology	4

ADVANCED CERTIFICATE PROGRAMS

The Biomedical Engineering Program administers two certificate programs: Biomedical Materials and Bioinstrumentation. The Advanced Certificates in Biomedical Materials and Bioinstrumentation are for students from various backgrounds seeking in-depth knowledge in a specialty within biomedical engineering. Students may apply to the certificate program if they have one or more of the following:

(1) BS or a more advanced degree in any engineering discipline, (2) BS or more advanced degree in mathematics and/or (3) BS or more advanced degree in any natural science. The program adviser reviews with successful applicants prerequisites that may be required for successful completion of certificate courses. A certificate program requires four courses (12 credits) that are for working professionals seeking advanced training in a specific area within the Biomedical Engineering Program. Students must achieve an average of B or better in all graduate courses. Upon completion of a sequence with an average grade of B or better, students are issued Advanced Certificates. Those who choose to work toward the master's degree in biomedical engineering are able, upon admission, to apply all courses taken toward a certificate to fulfill the degree program. Additional information may be obtained from the department. To satisfy the requirement for the Advanced Certificate in Biomedical Materials, students must complete a minimum of 12 credits.

Certificate Requirements for an Advanced Certificate in Biomedical Materials

Required:

1. BE 6703 Materials in Medicine
2. BE 6723 Natural Polymers and Materials

3. One of the following courses:

CM 7723	Synthesis of Macromolecules
CM 7813	Characterization of Macromolecules
CBE 7263	Engineering Properties of Polymers

4. One of the following courses:

BE 6603	Intro to Drug Delivery
BE 6253	Biosensors
BT 6033	Biosensors and Biochips
BE 9433	Protein engineering
BE 9443	Tissue Engineering
BE 6753	Biomechanics and Biomaterials in Orthopedics

Certificate Requirements for an Advanced Certificate in Bioinstrumentation

Required:

1. BE 6703 Materials in Medicine
2. BE 6203 Biomedical Imaging I
3. BE 6253 Biosensors
4. BE 6503 Biomedical Instrumentation

GRADUATE COURSES

Course descriptions of biomedical engineering courses, as well as CM and CBE courses associated with the MS in Biomedical Engineering Program, are given below. Other courses that are not described below are listed in the Biomedical Engineering Program and can be found in the course descriptions by their departments elsewhere in this catalog.

BE 6013 Molecular Immunology *3:0:0:3*

This course familiarizes students with the body of research that underpins the present understanding of the molecular basis and the cellular interactions that regulate the immune responses. The principal learning tool is the reading and discussion of research papers in immunology by a small group of students supervised by a faculty member, who is active in the specific research area. Topics covered include antibody structure, B-cell development, T-cell structure and development, T-cell-MHC interaction, MHC structure and antigen processing, complement chemistry, complement and Fc receptor structure and function, transplantation immunogenetics, mucosal immunology and allergic reactions. *Prerequisite: Undergraduate biochemistry.*

BE 6023 Cellular and Molecular Neuroscience *3:0:0:3*

This course provides a comprehensive overview of cellular neuroscience and consists of 14 lectures and two exams. The course is divided into three parts: (1) the physiology and biophysics of neurons; (2) neuronal signal transduction, gene expression and transport of RNA and protein; and (3) synaptic transmission and plasticity. The textbook is *Fundamental Neuroscience* by Zigmond, Bloom, Landis, Roberts and Squire. Supplementary readings are from other textbooks and journal articles. *Prerequisite: BE 6103.*

BE 6103 Anatomy, Physiology and Biophysics I *3:0:0:3*

Anatomy and Physiology are the sciences that identify body structures and how they function and interact, respectively. Therefore, academic training for biomedical engineering must include a sound, comprehensive knowledge of human anatomy and physiology. While the course emphasizes normal functions, it also considers the consequences of disease and injury and deals with the body's potential for recovery and compensation. The Biophysics' component examine the underlying physical principles of organ function. Part I of this two-part sequence focuses on Cell Physiology and Homeostasis, Cardiac, Nervous, and Respiratory systems. The course will be taught using a "systems engineering" approach and introduce the design considerations for artificial organs. The material includes hands-on demonstration of technology to measure EEGs, EKG and respiratory function. *Prerequisites: Calculus, biochemistry, introductory gross and cellular anatomy.*

BE 6113 Anatomy, Physiology and Biophysics II *3:0:0:3*

Part II of this sequence focuses on the muscular, skeletal, renal and endocrine systems and includes discussions on skin and basic oncology. This part is taught using a same systems engineering and biophysics approach and link concepts from BE 6103. The material includes hands-on demonstration of technology to measure EMG and plasma glucose. *Prerequisite: BE 6103.*

BE 6203 Biomedical Imaging I *3:0:0:3*

This course introduces the physics, instrumentation and signal-processing methods used in X-ray imaging (projection radiography), X-ray computed tomography, nuclear medicine (SPECT/PET), ultrasound imaging and magnetic resonance imaging. *Prerequisites: Undergraduate-level courses in multivariable calculus, physics, and probability. Co-requisites: undergraduate or graduate level signals and systems. Open to graduate students and upper-level UG students.Co-requisite: Signals and systems (EE 3054, preferred but not required). Also listed under EL 5823.*

BE 6213 Biomedical Imaging II *3:0:0:3*

This course introduces the mechanisms and concepts related to image acquisition and subsequent image processing and image formation

in biomedical imaging modalities. Building on material covered in Biomedical Imaging I, these courses focus on advanced topics such as functional magnetic resonance imaging (MRI), ultrasound imaging, biomagnetic imaging and optical tomographic imaging (OTI). *Prerequisite: BE 6203 (Biomedical Imaging 1, B). Also listed under EL 6823.*

BE 6223 Image Processing *3:0:0:3*

The course covers image formation and perception; image acquisition, representation and display; image sampling and resizing; contrast enhancement; two-dimensional Fourier transform and other unitary transforms; frequency domain and spatial domain linear filtering; median and morphological filtering; image smoothing, sharpening and edge detection through linear and nonlinear filtering; color image representation and processing; lossless and lossy-image coding techniques and standards, image deblurring; imaging geometry, image registration and geometric transformation. C- or MATLAB implementation of selected imaging-processing algorithms. *Prerequisites: Graduate student status or EE 3054 and MA 3012. Also listed under EL 5123.*

BE 6303 Bio-optics *3:0:0:3*

Recent growth in using optics technology for biomedical research and health care has been explosive. New applications are made possible by emerging technologies in lasers, optoelectronic devices, fiber optics, physical and chemical sensors and imaging—all of which are now applied to medical research, diagnostics and therapy. This sequence course on optics for biomedical students combines fundamental knowledge of the generation and interaction of electromagnetic waves with applications to the biomedical field. The goal is for this approach is to provide tools for researchers in bio-physics and to familiarize researchers, technologists and premed students with cutting-edge approaches. *Prerequisites: An undergraduate course in physics that includes electricity, magnetism and waves such as PH 2023 and multivariable calculus (MA 2122 and MA 2122).*

BE 6403 Signals, Systems and Transforms *3:0:0:3*

The course covers continuous and discrete linear systems and system function. Topics: Fourier transforms, periodic functions, Z transforms, discrete Fourier series, fast Fourier transforms. Magnitude Characteristics of LTI systems, All-pass Systems and Properties. Analog and digital filters, finite order system functions. Digital processing of analog signals. Sampling theorems. *Prerequisites: Graduate status. Also listed under EL 6113.*

BE 6453 Probability Theory *3:0:0:3*

This course explores the axiomatic definition of experiment and probability. Topics: Conditional probability. Bayes' Theorem, Notion of independence. Repeated trials. Bernoulli trials and their limiting forms. The concept of a random variable. Probability distribution and density functions. Probability mass functions. Examples of random variables: Normal (Gaussian), Poisson, Gamma, Exponential, Laplace, Cauchy, Rayleigh, etc. Bayes' Theorem revisited. Functions of one random variable and their density functions. Expected value of a random variable: mean, variance, moments and characteristic functions. Two random variables: Joint distribution and joint density functions of two random variables, independence. One function of two random variables. Two functions of two random variables. Order statistics. Joint moments, Uncorrelatedness, orthogonality, joint characteristic function. Jointly Gaussian random variables. Conditional distribution and conditional expected values. The central limit theorem. The principle of maximum likelihood. Elements of parameter estimation. Maximum likelihood estimation for unknown parameters. Unbiased estimators and their variances. *Prerequisites: Graduate status and MA 3012. Also listed under EL 6303.*

BE 6483 Digital Signal Processing Laboratory *1.5:1.5:0:3*

This course includes hands-on laboratory experiments, lectures and projects relating to real-time, digital signal processing (DSP) systems using a DSP microprocessor. Students gain experience in implementing common algorithms used in a variety of applications and learn tools and functions important for designing DSP-based systems. Students are required to complete a project and give an oral presentation. This course is suitable for students interested in DSP and Embedded Systems. *Prerequisites: EL 6113 or Equivalent, C/C++. Also listed under EL 6183.*

BE 6503 Biomedical Instrumentation *3:0:0:3*

This course, is for graduate students in the Bioengineering Program, introduces the principles of commonly used instruments in neuroscience research, particularly in electrophysiology and imaging. The course discusses theoretical considerations in choosing techniques as well as practical issues in selecting materials and designing experiments. *Prerequisite: Adviser's approval.*

BE 6603 Intro to Drug Delivery *3:0:0:3*

The course provides an integrated approach to the basic and clinical science of drug delivery. Topics: the history drug delivery; kinds of drugs to be delivered, including genes and proteins; various targeting mechanisms; transport phenomena and thermodynamic concepts; pharmacokinetics of drug delivery, polymeric drug-delivery systems; various devices developed for controlled delivery. *Prerequisite: calculus with ordinary diff. eq.; undergraduate courses in biology, chemistry and physiology (minimum grade B).*

BE 6653 Principles of Chemical and Biochemical Systems *3:0:0:3*

This introductory course for graduate engineering students focuses on fundamental knowledge of chemical and biochemical reactions. Students learn structure and function of biological molecules such as proteins, carbohydrates and DNA. They master basic concepts of structure-property relationships of macromolecules. Chemistries critical to biosensor technologies such as linking biological molecules to various supports, is described. Students appreciate and understand the wide range of chemical and biological molecules critical to living systems. *Prerequisite: Instructor's permission.*

BE 6703 Materials in Medicine *3:0:0:3*

The course focuses on the basic principles behind human-tissue response to artificial surfaces and materials; the general types of polymeric and metallic materials used in soft- and hard-tissue replacements; tissue engineering and drug-delivery devices; current approaches to the engineering of cell-based replacement for various tissues; techniques to control the physiologic response to artificial surfaces; critical review of current biomaterials literature; current research in the field; and evaluation of the design criteria that a material must meet for a given biological application and what is required for "biocompatibility." *Prerequisites: Introductory undergraduate courses in biology, chemistry and physiology. Courses in polymers, biochemistry, molecular/cellular biology and immunology are helpful but are not essential.*

BE 6753 Orthopaedic Biomechanics and Biomaterials *3:0:0:3*

The course provides fundamental knowledge of the relevant background science, theory, practice and materials required to provide modern orthopedic and trauma care. Students learn about biomaterials used in orthopedics and how materials engineering has made them increasingly sophisticated. The course covers important clinical applications as well as fundamental concepts in biomechanics of bone and other tissues; materials used; wear and corrosion during use; dental implants; joint-replacement devices; stress-strain analysis, beam theory; introduction to finite element analysis design for prosthesis; and more. *Prerequisite: Calculus with ordinary diff. eq. and BE 6703.*

BE 871x Guided Studies in Biomedical Engineering

Under faculty supervision, students study selections, analyses, solutions and presentations of biomedical engineering reports for problems in products, processes or equipment design, or other fields of biomedical-engineering practices. Conferences are scheduled. Master's degree candidates are required to submit three unbound copies of their reports to advisers one week before the last day of classes. Credits: 6 total, each 3 credits. *Prerequisite: Degree status.*

BE 9433 Protein Engineering *3:0:0:3*

This course introduces the modern protein-engineering techniques that allow researchers to understand protein structure and function and to create new proteins for many purposes. This new field is at the interface of chemistry, biology and engineering. The first part of the course discusses the protein composition and structure, various genetic, biochemical and chemical techniques required to engineer proteins, which is followed by specific topics. Topics include designing proteins that are highly structured; that are active at high temperatures and in non-aqueous solvents; that interact selectively with other proteins, small molecules and nucleic acids for therapeutic purposes; and that catalyze new reactions. *Prerequisite: CM 9413 or adviser's approval.*

BE 9443 Tissue Engineering *3:0:0:3*

This course teaches basic biological processes that occur during blood contact with artificial surfaces; how to critically read and review literature on tissue engineering; how to anticipate biocompatibility issues with a variety of implant devices students may later encounter; current approaches directed toward the engineering of cell-based replacements for various tissue types. *Prerequisite: Adviser's approval.*

BE 9753 Bioethics Seminar *3:0:0:3*

This graduate-level seminar course discusses the ethical issues relevant to today's bioengineers and molecular and cell biologists. Topics include: Darwin's theory of evolution; science and religion in twentieth-century America; Intelligent Design Theory; social Darwinism and the concomitant rise of eugenics in Europe and the U.S., the ways in which molecular genetics has challenged historical categories of race; the ethical, social, and legal implications of the Human Genome Project (specifically genetic privacy and testing, human genes and intellectual property); argobiotechnology and the science, ethics, and politics of genetically modified organisms (GMOs); and the science, politics, and ethics of human-embryonic-stem-cell research. The student is encouraged to think about the way in which debates concerning "nature versus nurture" have been framed historically, in order to understand current controversies over that distinction.

CBE 6153 Applied Mathematics in Engineering *3:0:0:3*

This course covers mathematical formulation of chemical engineering problems in terms of ordinary, partial differential and differential equations. Topics include solutions of boundary and initial value problems using Green's functions and other techniques; characterization of second-order partial differential equations and properties of their solutions; asymptotic methods and numerical techniques. *Prerequisites: MA 2122 and MA 2132 or adviser's approval.*

CS 6643 Computer Vision and Scene Analysis *3:0:0:3*

An important goal of artificial intelligence is to equip computers with the capability to interpret visual inputs. Computer vision and scene analysis is an AI area that deals with constructing explicit, meaningful descriptions of physical objects from images. It includes many techniques from image processing, pattern recognition, geometric modeling and cognitive processing. This course introduces the many techniques and applications of computer vision and scene analysis. *Prerequisites: CS 5403 and MA 2012, or equivalents, or instructor's permission.*

EL 5013 Wireless Personal Communication Systems *3:0:0:3*

The course introduces underlying principles of wireless communications and practical systems. Topics: Science and technology including radio signal propagation, interference-limited communications, multiple access, radio resources management and mobility management. Building blocks of wireless networks. Essential functions of cellular telephone systems and wireless local area networks. Details of the most important technologies including GSM, CDMA, wideband CDMA and WiFi (IEEE802.11). *Prerequisite: EE 3404 or equivalent.*

MA 6283 Mathematical Modeling in Biology *3:0:0:3*

This course covers: Linear and nonlinear difference equations for population growth and propagation. Stability. Competitive systems. Growth of microorganisms. Steady states in chemostats. Predator-prey models. Populations of infectious diseases. Michaelis-Menten kinetics. Cooperative reactions. Hodgkin-Huxlley equations. Fitzhugh-Nagumo model of nerve impulses. Conservation equations. Convection and diffusion of species. Transport in axon. Slime molds. Aggregation. Morphogenesis. *Prerequisites: MA 2122, MA 2132.*

ME 7863 Special Topics *3:0:0:3*

These course numbers are reserved for special topics offered periodically by the Mechanical Engineering Program and are open to first-year graduate students. When offered, the subject matter is indicated as part of the title after the words "Special Topics," and the complete title appears on the student's transcript. *Prerequisite: tailored to the offering, and adviser approval.*

PH 6403 Physical Concepts of Polymer Nanocomposites *3:0:0:3*

This course presents fundamental aspects of polymer nanocomposites and updates on recent advancements and modern applications. Topics include nanostructured materials; assembly at interfaces; interactions on surfaces; properties of polymer nanocomposites; reliability; nanodevices.

BIOL-GA 2030 Statistics in Biology *4:0:0:4*

Advanced course on techniques of statistical analysis and experimental design that are useful in research and in the interpretation of biology literature. Principles of statistical

inference, the design of experiments, and analysis of data are taught using examples drawn from the literature. Covers the use of common parametric and nonparametric distributions for the description of data and the testing of hypotheses.

BIOL-GA 2303 Introduction to Biostatistics

4:0:0:4

Introduction to probability and statistical methods utilized in the analysis and interpretation of experimental and epidemiological data. Statistical techniques associated with the normal, binomial, Poisson, t, F, and chi-squared distributions plus an introduction to nonparametric methods. Applications in biology, medicine, and the health sciences.

PROJECTS, THESES AND SEMINARS

BE 873x Research in Biomedical Engineering

Supervised by faculty, this course examines engineering fundamental or applied research in biomedical engineering. Conferences are scheduled. Master's degree candidates are required to submit three unbound copies of their reports to advisers one week before the last day of classes. Credits: 6 total, each 3 credits. *Prerequisite: Degree status.*

BE 9730 Colloquium in Biomedical Engineering

Engineers and scientists from industry and academia present recent developments in biomedical engineering. Two and four semesters are required for master's and PhD students, respectively. Credits: 0. *Prerequisite: None.*

BE 9740 Seminar in Biomedical Engineering

Students present research findings if engaged in MS or PhD thesis research, or make presentations from their critical analysis of recent biomedical-engineering publications. The seminar gives students the opportunity to prepare a scientific presentation on a biomedical-engineering topic of interest and to speak before their peers, who will question them.

BE997x Thesis for Degree of Master of Science in Biomedical Engineering

The thesis for the master's degree in biomedical engineering should report the results of an original investigation of problems in biomedical engineering or application of physical, chemical or other scientific principles to biomedical engineering. The thesis may involve experimental research, theoretical analyses or process designs, or combinations of them. Master's degree candidates are required to submit four unbound copies to advisers before the seventh Wednesday before commencement. Registration of at least 9 credits required. Credits: 9 total, each 3 credits. *Prerequisite: Degree status.*

CM 5040 Chemical Laboratory Safety

This course discusses problems of health and safety in chemical laboratories, including how to work safely with dangerous chemicals. This course must be completed by graduate and undergraduate chemistry students before they begin laboratory research.

BIOMOLECULAR SCIENCE PROGRAM

Academic advisers:
Gene DiResta, Tommy S. Lee and Bruce Garetz

Advances in biology, particularly at the cellular and molecular level, are changing the world. The basic knowledge of how nature functions to create and sustain life on earth is increasingly applied to advancing health care, to feeding an expanding world population, to producing cheap energy from renewable sources, and to cleaning the environment. Biology is the enabling science of the 21st century and is creating numerous future job-market opportunities. The BS in Biomolecular Science lies at the interface between biology and chemistry and builds upon the understanding of molecular-level biology. The curriculum also provides a strong foundation in mathematics and physics. This broadly based science education is a prerequisite for successful careers in industry and governmental laboratories and for professional or graduate studies in the biological sciences, medicine and other health-related fields.

The BS in Biomolecular Science has three options to meet diverse student needs. The biomedical science option provides students with the fundamental knowledge and skills needed to work in the rapidly changing, bio-related industries or to pursue advanced professional or graduate degrees. The highly innovative curriculum spans the boundaries between biology and chemistry and involves considerable exposure to research.

The biotechnology option is oriented toward students who plan to work in the fast-growing biotechnology industry. The nature of the industry has changed dramatically in the past decade as technologies based on human-gene therapy and engineering take their place alongside the production of antibiotics, vaccines and hormones.

This option provides a large choice of electives that meet the specific needs and interests of students. The chemistry option combines an excellent chemistry education with a fundamental knowledge of biology, thereby preparing students to work in pharmaceutical and related companies. Graduates are prepared for positions at educational, research institutions and governmental laboratories. The research opportunities provided by this option prepare students to pursue graduate degrees in chemistry as well as degrees bordering on biology.

GOALS AND OBJECTIVES

The goal of the BS in Biomolecular Science is to provide the fundamental knowledge and skills to work and advance in the rapidly changing, bio-related industries or to pursue advanced professional or graduate degrees. This goal is reached with an innovative curriculum that spans the boundaries between biology and chemistry and through exposure to research. In this way, the program attracts and trains adaptable and active learners.

The BS in Biomolecular Science Option in Chemistry, with an approved selection of electives, is certified by the American Chemistry Society (ACS) to be a rigorous academic program, which is valued by potential employers and graduate schools. ACS-certified graduates are immediately eligible for society membership.

BS/MS PROGRAM

The BS/MS Option leads to the simultaneous awarding of bachelor's and master's degrees. Possible BS/MS combinations include a BS in biomolecular science with a MS in chemistry, bioinformatics, biotechnology, biotechnology and entrepreneurship, or biomedical engineering. The required courses for the two degrees include all courses required for individual BS and MS degrees, except for Senior Research Project II (either BMS 4924 or CM 4924); all curriculum footnotes apply. Required credits are the sum of the credits for the two degrees minus the 4 credits for Senior Research Project II. Students in this program must complete a Master's Thesis. No Bachelor's Thesis is required.

See the BS/MS Program description in the Undergraduate Academic Policies and Degree Requirements section of this catalog.

MEDICAL SCHOOL EARLY ASSURANCE GUARANTEED ADMISSIONS PROGRAM

NYU-Poly and SUNY Downstate Medical Center have created the Medical School Early Assurance Guaranteed Admissions Program. Through the program, four slots are reserved in the first-year medical school class for graduating NYU-Poly students. Students majoring in biomolecular science who satisfy certain requirements are eligible for this program. Contact the Department of Chemical and Biological Sciences for more information.

REQUIREMENTS FOR THE BACHELOR OF SCIENCE

	OPTION		
Subject	Biomedical Science	Bio-technology	Chemistry
Chemistry	35cr	35cr	38cr
Biology	26	18	8
Research*	8	8	8
Chemical and Biomolecular Engineering	0	0	4
Computational	3	3	3
Engineering and Technology Forum	1	1	1
Humanities/ Social Sciences	24	24	27
Mathematics	8	8	12
Physics	10	10	10
Technical electives	13	21	17
Total	**128**	**128**	**128**

A minimum of 128 credits is required for the BS in Biomolecular Science.

*Students registering for research must submit a written report before graduation. Students may elect to write an undergraduate thesis.

UNDERGRADUATE COURSES

BMS 1004 Introduction to Cell and Molecular Biology *3:3:0:4*

The course covers the fundamentals of biology. Topics: Physical, chemical and biochemical bases of life on various organizational levels, cellular morphology, complementarily of form and function, including reproduction, development and genetics.

BMS 2004 Introduction to Physiology *3:3:0:4*

This course continues biology fundamentals. Topics: Emphasis on evolutionary theory, phylogeny and comparative physiology including homeostasis, regulation, integration and coordination of organisms at the systems level. *Prerequisite: BMS 1004 or instructor's permission.*

LS 2314 Organismal Physiology *3:3:0:4*

Mechanism involved in functional processes of cells and multicellular organisms, including integration and control aspects. Membrane function, transport, excitation, conduction, contraction, luminescence. Lab fee required. *Prerequisites: BMS 2004 and CM 1004 or CM 1024. Co-requisite: PH 2023.*

BMS 2512 Biostatistics *2:0:0:2*

The course introduces statistical methods used in biology, including probability, statistical distributions, regression, correlation and tests.

BMS 3114 Genetics *3:3:0:4*

The course covers the genetics of bacteria, viruses and high organisms. Emphasis is on both the genetic and biochemical analyses of gene replication, heredity, mutation, recombination and gene expression. Included are comparisons of prokaryotic and eukaryotic genetics and regulation. Laboratory techniques are used to study genetic phenomena in prokaryotes, eukaryotes and viruses. The course emphasizes modern approaches to genetic research. A lab fee is required. *Prerequisite: BMS 1004. Co-requisite: CM 2213.*

BMS 3214 Microbiology *3:3:0:4*

The course studies microbial organisms, especially bacteria and viruses. Topics: Microbial relationship to disease, infections and immunological processes. Mutation, transformation, transduction, induction and bioenergetic processes. Laboratory work includes experimental analysis of microbial structure and physiology by biochemical and cytochemical means. Also studied: Influence of environment on nutrition, enzymes and metabolism of representative microbial species. Lab fee required. *Prerequisites: BMS 2004 and CM 1014 or instructor's permission.*

BMS 3314 Advanced Cell and Molecular Biology I *3:3:0:4*

This first semester of a year-long course explores the molecular basis of cell function and current trends in molecular biology. The lab component is a year-long project to locate, characterize, clone and express a gene. A lab fee is required. *Prerequisites: CM 3314 and CM 2223 (see BMS 4324 for second semester).*

BMS 4011 Senior Seminar *1:0:0:1*

In this course, students present seminars based on current literature.

BMS 4314 Advanced Cell Physiology *3:3:0:4*

The course analyzes chemical and physical mechanisms of cellular function. Topics: Molecular constituents of biological systems, enzymes and reaction rates, energetic and regulation of metabolic processes, membrane transport, contractility and irritability. Laboratory studies examine cellular components in terms of their functional activities (enzymes, oxidative-phosphorylation, photosynthesis), kinetics of soluble and membrane-bound enzymes and membrane transport. A lab fee is required. *Prerequisites: BMS 2004 and CM 2614.*

BMS 4414 Biophysics *4:0:0:4*

This course explores the molecular basis of complex biochemical functions, membrane transport, intercellular and extracellular signaling, metabolism and energy transduction, DNA, RNA and protein synthesis and control, macromolecular assemblies and special topics in biochemistry.

BMS 4324 Advanced Cell and Molecular Biology II *3:3:0:4*

This is the second semester of a year-long course that examines the molecular basis of cell function and current trends in molecular biology. The lab component is a year-long project to locate, characterize, clone and express a gene. Lab fee required. *Prerequisite: BMS 3314.*

BMS 4814/4824/4834/4844 Topics in Biology *4 credits each as arranged*

BMS 4914/4924 Undergraduate Research in Biomolecular Science *4 credits each*

The course investigates problems in biology under faculty supervision. Library research, experimental studies and written reports are required. A lab fee is required. *Prerequisites: Senior status or adviser's approval, CM 5011 and CM 5040.*

BMS 4934 Life Science Internship *4 credits*

The internship comprises supervised projects in hospital, community or industrial settings. Students are evaluated on the basis of written and oral reports presented to faculty and outside project co-sponsors. Faculty conferences and visits are required. Internships are open to senior students with approval of the departmental adviser. Planned experiences significantly expose students to relationships between theoretical information and practical applications. *Prerequisite: Senior status or adviser's approval.*

GRADUATE COURSES

BMS 8011 Advanced Molecular Biology Laboratory *0:3:0:1.5*

The course covers the fundamentals of biology. Topics: Physical, chemical and biochemical bases of life on various organizational levels, cellular morphology, complementarily of form and function, including reproduction, development and genetics. *Co-requisite: BMS 8013. This course is not open to students who have taken BMS 4324.*

BMS 8013 Advanced Molecular Biology *3:0:0:3*

Understanding the complex and dynamic interactions of cellular function. Topics include classical molecular biology (DNA, RNA and protein biosynthesis), recombinant DNA and genetic engineering, interactions of macromolecules and regulation of biologic systems. *Prerequisite: Instructor's permission. This course is not open to students who have taken BMS 4324.*

BMS 8021 Advanced Cell Biology Laboratory *0:3:0:1.5*

Provides students with practical experience in some key cell and molecular biology techniques, including analysis of different cell types, cell differentiation, PCR, transformations and selection of cell lines with particular features. The course covers proper data handling and reporting techniques. *Co-requisite: BMS 8023. This course is not open to students who have taken BMS 3314.*

BMS 8023 Advanced Cell Biology *3:0:0:3*

Understanding cell biology through the biochemistry of the cell, with emphasis on the structure and function of the cell and its organelles. Advanced theories of cytoskeletal proteins, cell junctions and matrix, protein signaling and cell death will be covered. *Prerequisite: Instructor's permission. This course is not open to students who have taken BMS 3314.*

Typical Course of Study for the Bachelor of Science in Biomolecular Science Option in Biomedical Science

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Hours/Week Class	Lab.	Rec.	Cr.
MA 1054	Calculus I with Precalculus[1]	4	0	0	4
CM 1014	General Chemistry I	3	2	1	4
CM 1101	Numerical Methods for Chemistry	1	0	0	1
BMS 1004	Biology I (Intro Cell and Molecular Bio)	3	3	0	4
EN 1013W	College Writing Workshop[2]	3	0	0	3
EG 1001	Engineering and Technology Forum	1	0	0	1
					17

Spring Semester

Course No.	Course Title	Hours/Week Class	Lab.	Rec.	Cr.
MA 1154	Calculus II with Precalculus	4	0	0	4
CM 1024	General Chemistry II	3	2	1	4
BMS 2004	Biology II (Intro Physiology)	3	3	0	4
HuSS 1023W	First-Year Writing Seminar	3	0	0	3
CM 1032	Chemistry, The Central Science	2	0	0	2
					17

SOPHOMORE YEAR

Fall Semester

CM 2213	Organic Chemistry I	3	0	0	3
CM 2211	Organic Chemistry Lab I	0	3	0	1
PH 1013	Mechanics	3	0	1	3
PL 2143	Ethics and Technology	3	0	0	3
BMS 2512	Biostatistics	2	0	0	2
CM 5040	Laboratory Safety	1	0	0	0
Humanities and Social Sciences Elective[3]		3	0	0	3
					15

Spring Semester

CM 2223	Organic Chemistry II	3	0	0	3
CM 2221	Organic Chemistry Lab II	0	3	0	1
PH 2023	Electricity, Magnetism and Fluids	3	0	1	3
PH 2021	Introductory Physics Lab I	0	1.5	0	.5
CM 2614	Physical Chemistry I	4	0	0	4
CM 2102	Molecular Modeling in Chemistry	2	0	0	2
Humanities and Social Sciences Elective[3]		3	0	0	3
					16.5

JUNIOR YEAR

Fall Semester

BMS 3114	Genetics	3	3	0	4
PH 2033	Waves, Optics and Thermodynamics	3	0	1	3
PH 2031	Introductory Physics Lab II	0	1.5	0	.5
CM 3314	Biochemistry I	4	0	0	4
	Elective[4]	3	0	0	3
Humanities and Social Sciences Elective[3]		3	0	0	3
					17.5

Spring Semester

BMS 3314	Adv. Cell and Molecular Bio I	3	3	0	4
CM 3324	Biochemistry II	4	0	0	4
CM 3514	Analytical Chemistry	3	3	0	4
CM 5011	Information Sources	1	0	0	1
	Elective[4]	3	0	0	3
					16

SENIOR YEAR

Fall Semester

BMS 4914	Senior Project Research	0	12	0	4
BMS 4324	Adv. Cell and Molecular Bio II	3	3	0	4
	Elective[4]	4	0	0	4
Humanities and Social Sciences Elective[3]		3	0	0	3
					15

Spring Semester

BMS 4924	Senior Project Research	0	12	0	4
BMS 48XX	Topics in Biology	4	0	0	4
	Elective[4]	4	0	0	3
Humanities and Social Sciences Elective[3]		3	0	0	3
					14

Total credits required for graduation: 128

See page 120 for footnotes.

Typical Course of Study for the Bachelor of Science in Biomolecular Science Option in Biotechnology

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Hours/Week Class	Lab.	Rec.	Cr.
MA 1054	Calculus I[1] with Precalculus	4	0	0	4
CM 1014	General Chemistry I	3	2	1	4
CM 1101	Numerical Methods for Chemistry	1	0	0	1
BMS 1004	Biology I (Intro Cell and Molecular Bio)	3	3	0	4
EN 1013W	College Writing Workshop[2]	3	0	0	3
EG 1001	Engineering and Technology Forum	1	0	0	1
					17

Spring Semester

Course No.	Course Title	Hours/Week Class	Lab.	Rec.	Cr.
MA 1154	Calculus II with Precalculus	4	0	0	4
CM 1024	General Chemistry II	3	2	1	4
BMS 2004	Biology II (Intro Physiology)	3	3	0	4
HuSS 1023W	First-Year Writing Seminar	3	0	0	3
CM 1032	Chemistry, The Central Science	2	0	0	2
					17

SOPHOMORE YEAR

Fall Semester

CM 2213	Organic Chemistry I	3	0	0	3
CM 2211	Organic Chemistry Lab I	0	3	0	1
PH 1013	Mechanics	3	0	1	3
PL 2143	Ethics and Technology	3	0	0	3
BMS 2512	Biostatistics	2	0	0	2
CM 5040	Laboratory Safety	1	0	0	0
Humanities and Social Sciences Elective[3]		3	0	0	3
					15

Spring Semester

CM 2223	Organic Chemistry II	3	0	0	3
CM 2221	Organic Chemistry Lab II	0	3	0	1
PH 2023	Electricity, Magnetism and Fluids	3	0	1	3
PH 2021	Introductory Physics Lab I	0	1.5	0	.5
CM 2614	Physical Chemistry I	4	0	0	4
CM 2102	Molecular Modeling in Chemistry	2	0	0	2
Humanities and Social Sciences Elective[3]		3	0	0	3
					16.5

JUNIOR YEAR

Fall Semester

BMS 3114	Genetics	3	3	0	4
PH 2033	Waves, Optics and Thermodynamics	3	0	1	3
PH 2031	Introductory Physics Lab II	0	1.5	0	.5
CM 3314	Biochemistry I	4	0	0	4
	Elective[5]	3	0	0	3
Humanities and Social Sciences Elective[3]		3	0	0	3
					17.5

Spring Semester

BMS 3314	Advanced Cell & Molecular Bio I	3	3	0	4
CM 3324	Biochemistry II	4	0	0	4
CM 3514	Analytical Chemistry	3	3	0	4
CM 5011	Information Sources	1	0	0	1
	Elective[5]	3	0	0	3
					16

SENIOR YEAR

Fall Semester

BMS 4914	Senior Project Research	0	12	0	4
	Elective[5]	4	0	0	4
	Elective[5]	4	0	0	4
Humanities and Social Sciences Elective[3]		3	0	0	3
					15

Spring Semester

BMS 4924	Senior Project Research	0	12	0	4
	Elective[5]	4	0	0	4
	Elective[5]	3	0	0	3
Humanities and Social Sciences Elective[3]		3	0	0	3
					14

Total credits required for graduation: 128

See page 120 for footnotes.

Typical Course of Study for the Bachelor of Science in Biomolecular Science Option in Chemistry

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Hours/Week Class	Lab.	Rec.	Cr.
MA 1024	Calculus I[1]	4	0	0	4
CM 1014	General Chemistry I	3	2	1	4
CM 1101	Numerical Methods for Chemistry	1	0	0	1
BMS 1004	Biology I (Intro Cell and Molecular Bio)	3	3	0	4
EN 1013	College Writing Workshop[2]	3	0	0	3
EG 1001	Engineering and technology Forum	1	0	0	1
					17

Spring Semester

Course No.	Course Title	Hours/Week Class	Lab.	Rec.	Cr.
MA 1124	Calculus II	4	0	0	4
CM 1024	General Chemistry II	3	2	1	4
BMS 2004	Biology II (Intro Physiology)	3	3	0	4
HuSS 1023W	First-year Writing Seminar	3	0	0	3
CM 1032	Chemistry, The Central Science	2	0	0	2
					17

SOPHOMORE YEAR

Fall Semester

CM 2213	Organic Chemistry I	3	0	0	3
CM 2211	Organic Chemistry Lab I	0	3	0	1
PH 1013	Mechanics	3	0	1	3
MA 2012	Linear Algebra I	2	0	0	2
CM 5040	Laboratory Safety	1	0	0	0
Humanities and Social Sciences Elective[3]		3	0	0	3
Humanities and Social Sciences Elective[3]		3	0	0	3
					15

Spring Semester

CM 2223	Organic Chemistry II	3	0	0	3
CM 2221	Organic Chemistry Lab II	0	3	0	1
PH 2023	Electricity, Magnetism and Fluids	3	0	1	3
PH 2021	Introductory Physics Lab I	0	1.5	0	.5
CM 2614	Physical Chemistry Lab I	4	0	0	4
CM 2102	Molecular Modeling in Chemistry	2	0	0	2
MA 2132	Ordinary Differential Eqn.	4	0	0	2
					15.5

JUNIOR YEAR

Fall Semester

CM 4413	Polymer Science	3	0	0	3
PH 2033	Waves, Optics and Thermodynamics	3	0	1	3
PH 2031	Introductory Physics Lab II	0	1.5	0	.5
CM 3314	Biochemistry I	4	0	0	4
CBE 2124	Chemical and Biological Processes	4	0	0	4
Humanities and Social Sciences Elective[3]		3	0	0	3
					17.5

Spring Semester

CM 3324	Biochemistry II	4	0	0	4
CM 3514	Analytical Chemistry	3	3	0	4
CM 5011	Information Sources	1	0	0	1
	Elective[6]	3	0	0	3
Humanities and Social Sciences Elective[3]		3	0	0	3
					15

SENIOR YEAR

Fall Semester

CM 4914	Senior Project Research	0	12	0	4
	Elective[6]	3	0	0	3
	Elective[6]	3	0	0	3
Humanities and Social Sciences Elective[3]		3	0	0	3
Humanities and Social Sciences Elective[3]		3	0	0	3
					16

Spring Semester

CM 4914	Senior Project Research	0	12	0	4
	Elective[6]	4	0	0	4
	Elective[6]	4	0	0	4
Humanities and Social Sciences Elective[3]		3	0	0	3
					15

Total credits required for graduation: 128

See page 120 for footnotes.

Footnotes for Typical Course of Studies for the Bachelor of Science in Biomolecular Science Options in Biomedical Science, Biotechnology and Chemistry

1. Students placed by examination or an adviser into MA 914 must defer registration for MA 1054 or MA 1024.

2. Students placed by examination or an adviser into EN 1090W must subsequently register for EN 1013W.

3. Approved Humanities and Social Sciences electives are courses with the following prefixes: AH, AN, CAM, EN, MD, MU, PL, PS, HI, STS, SEG or URB. One course must be at the 3xxx/4xxx level. At least one elective must be a writing-intensive course labeled by "W."

4. Electives for the Option in Biomedical Sciences: Two courses must be chosen from the following list or must be approved by an adviser, subject to the courses being offered in a given semester. Graduate courses may be taken only by students with junior standing and a C+ average or better, unless otherwise approved by the adviser. The remaining courses are free electives.

CBE 2124	Chemical and Biological Processes	4 credits
LS 2314	Organismal Physiology	4 credits
BMS 3214	Microbiology	4 credits
BMS 4414	Biophysics	4 credits
BMS 48XX	Topics in Biology	4 credits
CM 9443	Tissue Engineering	4 credits
BE 6603	Drug Delivery	4 credits
BE 6703	Materials in Medicine	4 credits

5. Electives for the Option in Biotechnology: Three courses must be chosen from the following list or must be approved by an adviser, subject to the courses being offered in a given semester. Graduate courses may be taken only by students with junior standing and a C+ average or better, unless otherwise approved by the adviser. The remaining courses are free electives.

CBE 2124	Chemical and Biological Processes	4 credits
BMS 4324	Advanced Cell and Molecular Biology	4 credits
BMS 48XX	Topics in Biology	4 credits
CM 4314	Biomaterials	4 credits
CM 4413	Polymer Science	3 credits
CM 9463	Recombinant DNA Technology	3 credits
CM 6253	Biosensors	3 credits
CM 9053	Enzyme Catalysis in Organic Synthesis	3 credits
BI 7513	Chemical Foundations of Bioinformatics	3 credits
BI 7533	Bioinformatics I: Sequence Analysis	3 credits
BI 7543	Bioinformatics II: Protein Structure	3 credits
BT 6013	Biotechnology and the Pharmaceutical Industry	3 credits
BT 6023	Biotechnology and Health Care	3 credits

6. Electives for the Option in Chemistry: Two courses must be advanced undergraduate CM, BMS or CBE courses, or graduate CM courses, or must be approved by an adviser, subject to the courses being offered in a given semester. Graduate courses may be taken only by students with junior standing and a C+ average or better, unless otherwise approved by the adviser. The remaining courses are free electives.

NOTES:

All laboratory courses in chemistry require a breakage deposit. The department usually does not grant transfer credits to students who, while registered at NYU-Poly, take biology or chemistry courses at other schools.

BIOTECHNOLOGY PROGRAM

Academic Adviser: Evgeny Vulfson

GOALS AND OBJECTIVES

The main goal of the Master of Science in Biotechnology program is to advance students' knowledge and experience beyond the BS level and equip them for the rapidly evolving, life-sciences-based industries. The program provides students with a broad and comprehensive coverage of established and emerging bio-technologies. Course topics range from industrial application of enzymes and bio-polymer synthesis to the modern drug design and the role of biotechnology in health care. The availability of many elective courses enables students to specialize further in selected biotechnology areas. The program includes a guided study to develop analytical skills. The students are trained to perform at the entry-/mid-managerial level in life-sciences-based industries and other organizations involved in biotechnology-related work.

REQUIREMENTS FOR THE MASTERS OF SCIENCE

Students are expected to have an undergraduate degree in a science or engineering discipline and must have taken undergraduate courses in (1) biochemistry and (2) cell and molecular biology, or they may take these classes at NYU-Poly. The 30-credit curriculum consists of three parts:

1. Five required courses in biotechnology, protein and tissue engineering, enzyme catalysis and biosensors (15 credits);
2. Three elective courses in biotechnology and related fields (9 credits); and
3. Two more elective courses or Guided Studies in Biotechnology, involving laboratory or literature work (6 credits).

   To meet graduation requirements, students must have an overall average of a B in all courses.

REQUIRED COURSES (15 credits)

The five required courses are listed below:

Course	Title	Credits
BT 6013	Biotechnology and the Pharmaceutical Industry	3
BT 6023	Biotechnology and Health Care	3
BT 6033	Biosensors and Biochips	3
BT 9053	Enzyme Catalysis in organic Synthesis	3

Choose one of the following:

BT 9433	Protein Engineering	3
BT 9443	Tissue Engineering	3

ELECTIVE COURSES (9-15 credits)

Students must select courses from the following list:

Course	Title	Credits
BE 6703	Materials in Medicine	3
CM 7923	Natural Polymers and Materials	3
CM 8213	Bioanalytical Chemistry	3
BE 6013	Molecular Immunology	3
BT 6043	Biocatalysis in Industry	3
CM 9423	Biochemistry II	3
BMS 8013	Advanced Molecular Biology	3
BMS 8023	Advanced Cell Biology	3
BE 6023	Cellular and Molecular Neuroscience	3
BT 7013	Special Topics in Biotechnology	3
JW6003	Introduction to Technical Communication	3
BMS 8011	Advanced Molecular Biology Lab	1.5
BMS 8021	Advanced Cell Biology Lab	1.5
BE 6601	Introduction to Drug Delivery	1.5
MG 7871	Introduction to Managing Intellectual Property	1.5
BT 7011	Special Topics in Biotechnology	1.5

GUIDED STUDIES (up to 6 credits)

Students may optionally enroll in up to two Guided Studies courses (one per semester), which involve laboratory or literature work, as arranged with their advisers:

BT 8713	Guided Studies in Biotechnology I	3
BT 8723	Guided Studies in Biotechnology II	3

Total: 30 credits

GRADUATE COURSES

REQUIRED COURSES

BT 6013 Biotechnology and the Pharmaceutical Industry *3:0:0:3*

The course offers an in-depth look at the modern process of drug development, from the early stage of target identification and generation of lead compounds to regulatory approval, and the role of biotechnology in this complex process. All the key aspects, including preclinical development, clinical trials and regulatory requirements, are covered with considerable contributions from pharmaceutical professionals. Real-life case studies are presented to illustrate critical points in the development process. Major classes of biotech drugs are briefly discussed. Many course lectures are delivered by scientists from the major U.S. pharmaceutical companies. *Prerequisite: Adviser's approval.*

BT 6023 Biotechnology and Health Care *3:0:0:3*

Biotechnology's contribution to modern health care stretches far beyond developing new therapeutic entities. This course provides an overview of key cutting-edge technologies such as stem-cell research and therapeutic cloning and demonstrates how their applications change "the conventional" in terms of availability of new treatments, monitoring services and diagnostics. The course also examines the implications of Human Genome Project for health care and the role of genetics and epigenetic modifications of genes in health and disease. The role of biotechnology in managing a number of sociologically high-impact diseases in developed and developing countries is highlighted. *Prerequisite: Adviser's approval.*

BT 6033 Biosensors and Biochips *3:0:0:3*

Biosensors and biochips is one of the most exciting, complex and fast-growing areas of biotechnology today—the interface between biotechnology, nanotechnology and micro-electronics industries. The course covers both conventional biosensors based on whole cells, nucleic acids, antibodies and enzymes (e.g., enzymatic glucose monitoring) as well as new and emerging technologies related to designing, fabricating and applying multi-array biochips and micro-fluidic systems (lab-on-the-chip). The goal is to familiarize students with basic principles of biosensors design and applications. The course also covers practical applications of this technology in health care, medical diagnostics, defense and other areas. *Prerequisite: Adviser's approval.*

BT 9053 Enzyme Catalysis in Organic Synthesis *3:0:0:3*

The course provides a working knowledge of how to use biotransformations as a tool in organic chemistry. Students learn about general enzymatic reaction types that carry out the cleavage and formation of C-O bonds, P-O bonds, C-N bonds, C-C bonds, reduction reactions, oxidation reactions and isomerizations. Students also are taught advanced principles that apply to catalytic-protein engineering. *Prerequisite: Adviser's approval.*

BT 9433 Protein Engineering *3:0:0:3*

This course introduces modern protein-engineering techniques available to researchers to understand protein structure and function and to create entirely new proteins for many purposes. This new field lies at the interface of chemistry, biology and engineering. The first section discusses protein composition and structure, and various genetic, biochemical and chemical techniques required to engineer proteins, followed by specific topics. Topics include designing highly structured proteins that are active at high temperatures and in non-aqueous solvents; that interact selectively with other proteins, small molecules and nucleic acids for therapeutic purposes; and that catalyze new reactions. *Prerequisite: Adviser's approval.*

BT 9443 Tissue Engineering *3:0:0:3*

This courses covers basic biological processes that occur during blood contact with artificial surfaces; how to critically read and review literature about tissue engineering; how to anticipate bio-compatibility issues relevant to a variety of implant devices students may later encounter; and current approaches directed toward the engineering of cell-based replacements for various tissue types. *Prerequisite: Adviser's approval.*

ELECTIVE COURSES

BE 6703 Materials in Medicine *3:0:0:3*

The course focuses on the basic principles behind human-tissue response to artificial surfaces and materials; the general types of polymeric and metallic materials used in soft- and hard-tissue replacements; tissue engineering and drug-delivery devices; current approaches directed toward the engineering of cell-based replacement for various tissues; techniques to control the physiologic response to artificial surfaces; critical review of current biomaterials literature; current research in the field; evaluation of the design criteria that a material must meet for a biological application; and what is required for "biocompatibility." *Prerequisite: Adviser's approval.*

BE 6723 Natural Polymers and Materials *3:0:0:3*

This course introduces natural and biomimetic polymers with an interdisciplinary view of biology, chemistry and macromolecular science. Topics: Natural building blocks and methods by which nature carries out polymer synthesis and modification reactions; DNA; structural proteins; plant proteins; polysaccharides; polyesters; biosurfactants; polymers built from natural monomers and a wide variety of renewable resources; uses of polymers as fibers, films, rheological modifiers, flocculants, foams, adhesives and membranes; special applications of natural polymers in medicine and as biodegradable plastics. *Prerequisite: Adviser's approval.*

CM 8213 Bioanalytical Chemistry *3:0:0:3*

The course covers exciting new analytical methods in biochemistry and biotechnology today, such as atomic-force microscopy, capillary electrophoresis, surface-plasmon resonance, microarrays, etc. The course is based on current scientific literature. *Prerequisite: Adviser's approval.*

BE 6013 Molecular Immunology *3:0:0:3*

The course familiarizes students with the body of research that underpins the understanding of the molecular basis and the cellular interactions that regulate immune responses. Topics: Antibody structure, B-cell development, T-cell structure and development, T-cell-MHC interaction, MHC structure and antigen processing, complement chemistry, complement and Fc receptor structure and function, transplantation immunogenetics, mucosal immunology and allergic reactions. *Prerequisite: Adviser's approval.*

BT 6043 Biocatalysis in Industry *3:0:0:3*

The course focuses on the commercial use of biological catalysts across various industry segments, including pharmaceuticals, health care, fine chemicals and food. The course combines a broad overview of technologies with industrial insights into the economics of bio-processing. The course also covers emerging biomaterials trends. Case studies are presented to facilitate analysis, formulate trends and underline major challenges. *Prerequisite: Adviser's approval.*

CM 9423 Biochemistry II *3:0:0:3*

The course covers membrane structure and function. Topics: Energy production, transformation and utilization. Regulation of biochemical systems. Replication, transcription and translation of DNA. Mutagenesis and carcinogenesis. Immune system. *Prerequisite: Adviser's approval.*

BMS 8013 Advanced Molecular Biology *3:0:0:3*

Understanding the complex and dynamic interactions of cellular function. Topics include classical molecular biology (DNA, RNA and protein biosynthesis), recombinant DNA and genetic engineering, interactions of macromolecules and regulation biologic systems. *Prerequisite: Adviser's approval.*

BMS 8023 Advanced Cell Biology *3:0:0:3*

Understanding cell biology through the biochemistry of the cell, with emphasis on the structure and function of the cell and its organelles. Advanced theories of cytoskeletal proteins, cell junctions and matrix, protein signaling and cell death will be covered. *Prerequisite: Adviser's approval.*

BE 6023 Cellular and Molecular Neuroscience *3:0:0:3*

A three-part, comprehensive overview of cellular neuroscience, this course covers the physiology and biophysics of neurons; neuronal signal transduction, gene expression and transport of RNA and protein; and synaptic transmission and plasticity. The textbook is Fundamental Neuroscience by Zigmond, Bloom, Landis, Roberts and Squire. Supplementary readings are from other textbooks and journal articles. *Prerequisite: Adviser's approval.*

JW 6003 Introduction to Technical Communication *3:0:0:3*

In this overview of the research, writing, editing and design principles of technical communication, particular attention is be paid to writing for new media. Students learn to gather, organize and present information effectively, according to audience and purpose. Interviewing skills, technical presentation skills and writing for the Web are covered. *Prerequisite: Adviser's approval.*

BT 7013 Special Topics in Biotechnology *3:0:0:3*

Special topics include courses, designed to aid students in gaining extra knowledge/ specialization in a subject area of their choice.

BMS 8011 Advanced Molecular Biology Lab *1.5:0:0:1.5*

Provides students with practical experience in key molecular biology and genetic engineering techniques. The course covers proper data handling and reporting techniques. *Prerequisites: BMS 8013 and adviser's approval.*

BMS 8021 Advanced Cell Biology Lab *1.5:0:0:1.5*

Provides students with practical experience in cell biology techniques, including analysis of different cell types, cell differentiation, PCR, transformations and selection of cell lines with particular features. This course covers proper data handling and reporting techniques. *Prerequisites: BMS 8023 and adviser's approval.*

BE 6601 Introduction to Drug Delivery *1.5:0:0:1.5*

This course introduces drug-delivery science focusing on the historical development of delivery methods, pharmacokinetics and pharmacodynamics of drug-delivery systems, routes of administration, devices for drug delivery and, briefly, on various targeting methods and delivery of gene- and protein-based therapeutics. *Prerequisites: BTE 6013 or adviser's approval.*

MG 7871 Introduction to Managing Intellectual Property *1.5:0:0:1.5*

This introductory course explores managing intellectual property, which is a major strategic and financial asset of a modern business. IP can be used to protect existing products, services and business methods and to accelerate development of new products, services and business methods. IP also can be leveraged to enhance a firm's competitiveness, value and profitability. This is true in the physical world and in the online world of the Internet and eBusiness (where traditional principles of intellectual-property rights are often stretched and may need reinterpretation and even modification). Intellectual property is becoming increasingly complex as emerging digital technologies advances. *Prerequisite: Adviser's approval.*

BT 7011 Special Topics in Biotechnology *1.5:0:0:1.5*

Special Topics include courses covering particular subject/technology to help students to gain more knowledge in an area they may want to specialize in after graduation. *Prerequisite: Adviser's approval.*

PROJECTS, THESES AND SEMINARS

BT 8713 / BT 8723: Guided Studies in Biotechnology I / II *3:0:0:3*

Special project (experimental, theoretical, computational, or literature search). Only one guided study course allowed per semester. *Prerequisite: Adviser's approval.*

BIOTECHNOLOGY AND ENTREPRENEURSHIP PROGRAM

Program Director: Evgeny Vulfson

GOALS AND OBJECTIVES

The goal of the Master of Science in Biotechnology and Entrepreneurship Program is to supplement students' knowledge of biotechnology beyond the BS level and provide a basic understanding of the business side of the biotech industry and the requirements for starting their own biotechnology businesses. The program provides broad coverage of key areas of modern biotechnology combined with a wide choice of business- and finance-related courses.

This program is most suitable for mature students with work experience and recent graduates who aspire to be entrepreneurs and establish their own biotech enterprise.

REQUIREMENTS FOR THE MASTERS OF SCIENCE

Students entering this program should have an undergraduate degree in a science or engineering discipline and must have taken undergraduate courses in biochemistry and cell and molecular biology. The 30-credit curriculum of this program comprises three parts:

1. Four required courses offering a broad overview of cutting-edge areas of biotechnology: biocatalysis and biomaterials, biotechnology and health care, biosensors and biochips, biotechnology and the pharmaceuticals industry (12 credits).
2. One required and a wide choice of elective 1.5- and 3-credit courses on technology innovation, intellectual-property management, finances, marketing, business-plan preparation and fund-raising (12 credits).
3. Two more electives up to 6 credits or an optional project involving either technology-competition analysis and business-plan preparation or a placement in an early-stage start-up company (6 credits).

REQUIRED COURSES (15 CREDITS)

The five required courses are listed below:

Course	Title	Credits
BTE 6013	Biotechnology and Pharmaceutical Industry	3
BTE 6023	Biotechnology and Health Care	3
BTE 6033	Biosensors and Biochips	3
BTE 6043	Biocatalysis in Industry	3
MG 7703	Entrepreneurship and Venture Creation	3

Elective Courses (6-15 credits)

Students must take courses from the list below, which will amount to at least 6 credits in total; e.g., two 3-credit or four 1.5-credit courses:

Course	Title	Credits
MG 6093	Managerial Accounting and Finance	3
MG 7871	Introduction to Managing Intellectual Property	1.5
	or	
MG 7873	Managing Intellectual Property	3
MG 8203	Project Management	3
MG 8653	Managing Technological Change and Innovation	3
MG 8711	Introduction to Entrepreneurial Finance	1.5
	or	
MG 8713	Entrepreneurial Finance	3
MG 8721	Introduction to Managing Growing Businesses	1.5
MG 8731	Introduction to Corporate Entrepreneurship	1.5
MG 8741	Introduction to Entrepreneurial Marketing and Sales	1.5
	or	
MG 8743	Entrepreneurial Marketing and Sales	3
JW 6003	Introduction to Technical Writing	3
BT 9433	Protein Engineering	3
BT 9442	Tissue Engineering	3
BE 6703	Materials in Medicine	3
CM 7923	Natural Polymers and Materials	3
CM 8213	Bioanalytical Chemistry	3
BE 6013	Molecular immunology	3
CM 9423	Biochemistry II	3
BE 6023	Cellular and Molecular Neuroscience	3
BT 7013	Special Topics in Biotechnology	3

PROJECTS

Students may take up to three Projects in Biotechnology and Entrepreneurship:

BTE 9503	Project in Biotechnology and Entrepreneurship I	3
BTE 9513	Project in Biotechnology and Entrepreneurship II	3
BTE 9523	Project in Biotechnology and Entrepreneurship III	3

Total: 30 credits

GRADUATE COURSES

REQUIRED COURSES

BTE 6013 Biotechnology and the Pharmaceutical Industry *3:0:0:3*

The course looks at the modern process of drug development in depth—from the early stage of target identification and generation of lead compounds to regulatory approval, and the role of biotechnology in this complex process. The course, featuring significant participation by industry professionals, covers all key aspects, including preclinical development, clinical trials and regulatory requirements. Real-life case studies illustrate critical points in the development process. Major classes of biotech drugs are briefly discussed. Many lectures are delivered by scientists from major U.S. pharmaceutical companies. *Prerequisite: Adviser's approval.*

BTE 6023 Biotechnology and Health Care *3:0:0:3*

The contribution of biotechnology to modern health care stretches far beyond developing therapeutic entities. This course provides an overview of key cutting-edge technologies such as stem-cell research and therapeutic cloning and demonstrates how their applications change "the conventional" for the availability of new treatments, monitoring services and diagnostics. The course also examines the implications of Human Genome Projects for health care and the role of genetics and epigenetic modifications of genes in health and disease. The role of biotechnology in managing several sociologically high-impact diseases in developed and developing countries is highlighted. *Prerequisite: Adviser's approval.*

BTE 6033 Biosensors and Biochips *3:0:0:3*

Biosensors and biochips are two of the most exciting, complex and fast-growing areas of biotechnology today—the interface between biotechnology, nanotechnology and microelectronics industries. The course covers conventional biosensors based on whole cells, nucleic acids, antibodies and enzymes (e.g. enzymatic glucose monitoring) as well as new and emerging technologies related to designing, fabricating and applying multi-array biochips and micro-fluidic systems (lab-on-the-chip). The goal is to familiarize students with basic principles of biosensors design and applications. The course also covers practical applications of this technology in health care, medical diagnostics, defense and other areas. *Prerequisite: Adviser's approval.*

BTE 6043 Biocatalysis in Industry *3:0:0:3*

Biosensors and biochips is one of the most exciting, complex and fast-growing areas of biotechnology today—the interface between biotechnology, nanotechnology and microelectronics industries. The course covers conventional biosensors based on whole cells, nucleic acids, antibodies and enzymes (e.g. enzymatic glucose monitoring) as well as new and emerging technologies related to designing, fabricating and applying multi-array biochips and micro-fluidic systems (lab-on-the-chip). The goal is to familiarize students with basic principles of biosensors design and applications. The course also covers practical applications of this technology in health care, medical diagnostics, defense and other areas. *Prerequisite: Adviser's approval.*

MG 7703 Entrepreneurship and New Venture Creation *3:0:0:3*

The course focuses on entrepreneurship and venture creation as key engines for wealth creation and successful business strategy in the modern innovation-intensive, high-tech economy. It deals with such key issues as: (1) assessing attractiveness of opportunities; (2) launching a new venture; (3) nurturing and growing an entrepreneurial venture; (4) obtaining the necessary financial, human and technology resources; (5) managing the transition from a small entrepreneurial firm to a large, sustainable, professionally managed, but still entrepreneurial corporation; and (6) being an entrepreneur and promoting entrepreneurship in a large corporation. *Prerequisite: Adviser's approval.*

ELECTIVE COURSES

MG 6093 Managerial Accounting and Finance *3:0:0:3*

The course focuses on elements of accounting and finance of importance for managers. Students cover analysis of principles and practices of the finance function; financing methods for internal and external ventures and innovations; capital budgeting; and R&D portfolio analysis. The course also contrasts strategic perspectives emphasizing innovation and development with those emphasizing short-term return and investment. *Prerequisite: Adviser's approval.*

MG 7871 Introduction to Managing Intellectual Property *1.5:0:0:1.5*

This introductory course explores the topic of managing intellectual property, a major strategic and financial asset of a modern business. IP can be employed to protect existing products, services and business methods and to accelerate development of products, services and business methods. IP also can be leveraged to enhance a firm's competitiveness, value and profitability. This leverage is true in the physical world and in the online world of the Internet and eBusiness (where traditional principles of intellectual property rights are often stretched and may need reinterpretation and even modification). Intellectual property is becoming increasingly complex as emerging digital technologies advance. *Prerequisite: Adviser's approval.*

MG 7873 Managing Intellectual Property and Intellectual Capital *3:0:0:3*

This course focuses in detail on managing intellectual property, a major strategic and financial asset of a modern business. IP can be employed to protect existing products, services and business methods and to accelerate development of new products, services and business methods. IP also can be leveraged to enhance a firm's competitiveness, value and profitability. This leverage is true in the physical world and in the online world of the Internet and e-Business (where traditional principles of Intellectual property rights are often stretched and may need reinterpretation and even modification). Intellectual property is becoming increasingly complex as emerging digital technologies advance. *Prerequisite: Adviser's approval.*

MG 8203 Project Management *3:0:0:3*

This course focuses on managing technology-based projects, ranging from individual research and development to large-scale and complex technological systems. It covers topics such as feasibility and risk analyses, project selection and portfolio optimization, functional and administrative structures, coordination and scheduling of activities, personnel planning, negotiations and contracts, cost estimation, capital budgeting, cost controls and effective matrix management. *Prerequisite: Adviser's approval.*

MG 8653 Managing Technological Change and Innovation *3:0:0:3*

The course focuses on effectively managing technological change and innovation, which is accomplished with a dual perspective. One perspective is based on individual, group and organizational theory, research and practice. This body of literature, viewpoints and experience provide essential guides to manage successfully the introduction of new technologies. Realizing the full potential of new technologies requires effectively managing change to assure the commitment of all stakeholders. The second perspective is based on innovation theory, research and practice. This body of literature, viewpoints and experience provide key insights to for effectively managing the process of innovation and the impact of innovation on all parts of an enterprise. Specifically, the course explores a firm's explicit need to manage and inspire people so they can communicate and innovate effectively. *Prerequisite: Adviser's approval.*

MG 8711 Introduction to Entrepreneurial Finance *1.5:0:0:1.5*

This course introduces the financial requirements of entrepreneurial ventures and the different sources of finance available to entrepreneurs. The course shows students how to understand and assess entrepreneurial-financial strategies. It also examine the unique roles played in the entrepreneurial finance arena by such actors as retail banks, investment banks, VCs, angels, internal sources of capital and incubators. *Prerequisite: Adviser's approval.*

MG 8713 Entrepreneurial Finance *3:0:0:3*

This course focuses in detail on the financial requirements of entrepreneurial ventures and on different sources of finance available to entrepreneurs. Students develop an understanding of how to assess entrepreneurial financial strategies. It also examines the unique roles played in the entrepreneurial finance arena by such actors as retail banks, investment banks, VCs, angels, internal sources of capital and incubators. *Prerequisite: Adviser's approval.*

MG 8721 Introduction to Managing Growing Enterprises *1.5:0:0:1.5*

This introductory course examines a critical challenge facing all successful entrepreneurial small- or medium-size firms: how to sustain and accelerate major growth. At some point in the life of all growing enterprises, a firm usually must change. This course introduces ways a growing firm can transform itself from a small to a larger enterprise. It explores how such companies can maintain the benefits of an entrepreneurial commitment and spirit while still obtaining needed skills associated with professionally-managed larger firms. *Prerequisite: Adviser's approval.*

MG 8723 Managing Growing Enterprises *3:0:0:3*

This course focuses in detail at a critical challenge facing all successful entrepreneurial small- or medium-size firms: how to sustain and accelerate major growth. At some point in the life of all growing enterprises, a firm usually must change. This course introduces ways a growing firm can transform itself from a small to a larger enterprise. It explores how such companies can maintain the benefits of an entrepreneurial commitment and spirit while still obtaining needed skills associated with professionally managed larger firms. *Prerequisite: Adviser's approval.*

MG 8731 Introduction to Corporate Entrepreneurship *1.5:0:0:1.5*

Although large firms require professional management, to innovate, large corporations often must practice entrepreneurship. This course examines how large corporations nurture and sustain entrepreneurship. *Prerequisite: Adviser's approval.*

MG 8741 Introduction to Entrepreneurial Marketing and Sales *1.5:0:0:1.5*

This course introduces critical marketing and sales challenges facing entrepreneurial firms. An underlying theme is that successful innovative enterprises must be deeply familiar with relevant markets and must effectively cultivate and reach those markets. Topics include market identification, segmentation, sales, overall market planning, niche and viral marketing and customers as sources of innovative ideas. *Prerequisite: Adviser's approval.*

MG 8743 Entrepreneurial Marketing and Sales *3:0:0:3*

This course focuses in depth on critical marketing and sales challenges facing entrepreneurial firms. An underlying theme is that successful innovative enterprises must be deeply familiar with relevant markets and must effectively cultivate and reach those markets. Topics include market identification, segmentation, sales, overall market planning, niche and viral marketing and customers as sources of innovative ideas. *Prerequisite: Adviser's approval.*

JW 6003 Introduction to Technical Communication *3:0:0:3*

This course is an overview of the research, writing, editing and design principles of technical communication. Particular attention is paid to writing for new media. Students learn to gather, organize and present information effectively, according to audience and purpose. Interviewing skills, technical presentation skills and writing for the Web are covered. *Prerequisite: Adviser's approval.*

BT 9433 Protein Engineering *3:0:0:3*

This course introduces modern protein engineering techniques available to researchers to understand protein structure and function and to create new proteins for a variety of purposes. This new field lies on the interface of chemistry, biology and engineering. Initially, the course discusses protein composition and structure, various genetic, biochemical and chemical techniques required to engineer proteins. Later, the following topics include designing proteins that are highly structured that are active at high temperatures and in non-aqueous solvents; and that interact selectively with other proteins, small molecules and nucleic acids for therapeutic purposes; and that catalyze new reactions. *Prerequisite: Adviser's approval.*

BT 9443 Tissue Engineering *3:0:0:3*

This course instructs students in basic biological processes that occur during blood contact with artificial surfaces; how to critically read and review literature on tissue engineering; how to anticipate bio-compatibility issues relevant to a variety of implant devices students may later encounter; and current approaches to the engineering of cell-based replacements for various tissue types. *Prerequisite: Adviser's approval.*

BE 6703 Materials in Medicine *3:0:0:3*

This course focuses on: the basic principles behind human tissue response to artificial surfaces and materials; the general types of polymeric and metallic materials used in soft- and hard-tissue replacements; tissue engineering and drug-delivery devices; current approaches to engineering cell-based replacements for various tissues; techniques to control the physiologic response to artificial surfaces; critical review of current biomaterials literature; current research in the field; and evaluation of design criteria that a material must meet for a biological application and what is required for "biocompatibility." *Prerequisite: Adviser's approval.*

BE 6723 Natural Polymers and Materials *3:0:0:3*

This course introduces natural and biomimetic polymers with an interdisciplinary view of biology, chemistry and macromolecular science. Topics: natural building blocks and methods by which nature carries out polymer synthesis and modification reactions; DNA; structural proteins; plant proteins; polysaccharides; polyesters; biosurfactants; polymers built from natural monomers and a wide variety of renewable resources; uses of these polymers as fibers, films, rheological modifiers, flocculants, foams, adhesives and membranes; and special applications of natural polymers in medicine and as biodegradable plastics. *Prerequisite: Adviser's approval.*

CM 8213 Bioanalytical Chemistry *3:0:0:3*

The course covers exciting new analytical methods used today in biochemistry and biotechnology, such as atomic force microscopy, capillary electrophoresis, surface plasmon resonance, microarrays, etc. The course is based on current scientific literature. *Prerequisite: Adviser's approval.*

BE 6013 Molecular Immunology *3:0:0:3*

This course familiarizes students with the body of research that underpins current understanding of the molecular basis and the cellular interactions that regulate the immune responses. Topics: Antibody structure, B-cell development, T-cell structure and development, T-cell-MHC interaction, MHC structure and antigen processing, complement chemistry, complement and Fc receptor structure and function, transplantation immunogenetics, mucosal immunology and allergic reactions. *Prerequisite: Adviser's approval.*

CM 9423 Biochemistry II *3:0:0:3*

This course covers membrane structure and function. Topics: Energy production, transformation and utilization. Regulation of biochemical systems. Replication, transcription and translation of DNA. Mutagenesis and carcinogenesis. Immune system. *Prerequisite: Adviser's approval.*

BE 6023 Cellular and Molecular Neuroscience *3:0:0:3*

A three-part comprehensive overview of cellular neuroscience, this course looks at the physiology and biophysics of neurons; neuronal signal transduction, gene expression and transport of RNA and protein; and synaptic transmission and plasticity. The textbook is Fundamental Neuroscience by Zigmond, Bloom, Landis, Roberts and Squire. Supplementary readings are from other textbooks and journal articles. *Prerequisite: Adviser's approval.*

BT 7013 Special Topics in Biotechnology *3:0:0:3*

Special Topics include courses covering particular subject/technology to help students to gain more knowledge in an area they may want to specialize in after graduation. *Prerequisite: Adviser's approval.*

PROJECTS

BTE 9503/9513/9523 Project in Biotechnology and Entrepreneurship *3:0:0:3*

This practical course offers students the opportunity to apply practically their knowledge and skills to analyzing technology, preparing their own business plans or working at an early-stage biotech company. The student can sign up for up to three projects (one per semester). *Prerequisite: Adviser's approval.*

BUSINESS AND TECHNOLOGY MANAGEMENT PROGRAM

Academic and Administrative Program Director: Bohdan Hoshovsky

GOALS AND OBJECTIVES

The Bachelor of Science in Business and Technology Management (BTM) Program is anchored on certain overarching themes, including:

- Achieving prowess through innovation, technology management and entrepreneurship.
- Leading based on a broad understanding of technology's role in the modern enterprise.
- Developing a global perspective of modern value creation.
- Committing oneself to service to the community.
- Adhering to the highest ethical standards.
- Obtaining practical exposure—through internships, speakers, on-site visits in New York City, etc.—to the latest best practices in management, especially as related to technology and innovation management and entrepreneurship.

BTM is oriented toward current and future arenas where high growth occurs. The program assumes that modern business leaders must be deeply familiar with technology and innovation. Those who have such knowledge are likely to have a distinct advantage and prosperous and satisfying careers. When appropriate, these leaders also can leverage entrepreneurship in diverse venues. The BTM Program prepares students to become such leaders.

BTM also provides students with relevant professional management education and effective approaches related to technology, innovation and information management and entrepreneurship. In other words, BTM creatively fuses modern business administration with state-of-the-art technology management.

The BTM Program also offers rigorous training in the qualitative, quantitative and innovative aspects of technology and innovation management. All courses nurture a broad managerial background along with specific application of ideas and practices relevant to the world of technologically innovative goods and services.

The art and science of management also demand that practitioners communicate ideas effectively. Therefore, as central components of the BTM learning experience the program emphasizes spoken and written presentations in individual, team, classroom and field internship settings.

Students completing BTM are prepared to succeed in a variety of positions—such as technology project leaders, technology entrepreneurs, venture capitalists, technology and IT analysts for various organizations, consultants in professional-services firms, marketing and business-unit managers for new products and services, and a variety of other exciting roles. BTM graduates work in large and small companies and they excel at jobs that require a cross-functional understanding of both technology and the motivational, financial, innovative and international challenges that need to be met for innovation to succeed. BTM students are also well prepared for advanced professional studies in management, such as in a MS in Management, MBA, or MS in MOT, program, as well as more scholarly and research-oriented programs, such as PhD studies.

PEDAGOGY

Management courses are taught using a variety of pedagogical methods.
These include:

- Theory-led teaching
- Case-method education
- Project-based and team-based teaching
- Action learning in the field

EXPERIENTIAL-BASED LEARNING

Teaching based on exposition of theory is often relevant to technology management classes. Case-method teaching emphasizes real-world business experiences and challenges students to draw general principles from many examples. Project-based and team-based education is experiential; students learn by doing, much as they would in a natural sciences laboratory class. Learning by doing in the field is also encouraged. It is very common in management courses for all pedagogical approaches to be employed.

COURSE DISTRIBUTION

The BTM Program requires 128 credits for graduation. Key characteristics* of this curriculum include:

- 60 credits in management
- 34 credits in courses in humanities and social sciences
- 10 credits in courses in mathematics
- 10 credits in "restricted" electives chosen from math, science, social sciences and humanities
- 6 credits in science
- 4 credits in computer science
- 3 credits in a "technical" elective
- 1 credit in the Engineering and Technology Forum

*Please see the Typical Course of Study for the BS-BTM at the end of this section.

Currently, management courses for the BS in BTM are each 4 credits. This new curriculum accommodates 3-credit courses in humanities and social sciences, as well as 3-credit courses in the sciences.

COURSE NUMBERING

BTM courses are numbered with the following schema:

- The first digit of a course number corresponds to the year in which a BTM student would take the course (1 = freshman, etc.)
- The second digit reflects the primary nature of the course material. Courses numbered with a second digit of
  "0" are focused primarily on processes in management
  "1" are oriented toward organizational behavior
  "2" are quantitative in nature
  "3" describe a firm's relationships with external forces
  "4" study innovation
  "5" are capstone courses
  "6" are Internship and Service courses

Thus, MG 3304 Introduction to Supply Chain Management is a 4-credit junior-year course focusing on external relationships.

CONCENTRATIONS

Students in this degree program may focus their study in one of two areas of concentration, which focus on particular issues and strategies that apply to business and technology management:

1. **Technology Innovation Strategy** enables students to develop effective skills for conducting strategic analysis addressing marketing, logistics, channel and operations managements issues, as well as relevant best business practiced in the technological arena.
2. **Technology and Innovation in Finance** prepares students to understand financial theory and how firms use modern finance for strategic and tactical decision-making.

Candidates who choose the first concentration complete MG 3304 (Introduction to Supply Chain Management) in their 6th semester and MG 4004 (Management Strategy in Technology Sectors) in their 7th semester. Students electing the Technology and Innovation in Finance concentration of study take MG 3214 (Advanced Corporate Finance) and MG 4204 (Management Science) at these points in their careers as students.

Degree Requirements
To remain in good standing, candidates for the degree BS-BTM must satisfy the following requirements, in addition to NYU-Poly requirements for a minimum term and cumulative 2.0 GPA in all courses:

- An average of C (2.0) or better in all MG courses must be maintained.
- A course in which the grade of I is received may not be used to satisfy any prerequisites until the incomplete is resolved.

Honors Capstone (Including Thesis and Honor's Thesis)
Students who earn a 3.6 GPA or better in MG courses through their junior year of study qualify for honors senior project capstone courses. These students are also free to not elect this project sequence.

As part of the Honor's Capstone course, students who earn a 3.6 GPA or better in MG courses through their junior year qualify for an optional MG 4904 BS Thesis in Business and Technology Management and follow the guidelines as outlined in the Academic Policies and Degree Requirements section of this catalog. They are advised to meet with the BTM Program Director before completing their junior year.

TRANSFER STUDENTS

Courses at other schools may or may not be granted transfer credit and require an evaluation of the content and level of material covered. Periodic reevaluation of courses at other institutions may lead to a variation in the number of credits granted from year-to-year. Thus, students completing the same program, but in different years, may receive different amounts of transfer credit.

Transfer students must present their records for evaluation at least two weeks before the regular registration period for their first semester.

MINOR IN MANAGEMENT

Students may obtain an undergraduate minor in management by completing 14 credits of management courses, which must include MG 1002 Foundations of Management. An overall GPA of at least 2.0 must be maintained in these classes. At least 8 of the 14 credits must be taken by students while enrolled at NYU-Poly.

INFORMATION

Curricula and prerequisite changes, new courses, special sections and other special announcements are posted in the Department of Technology Management office suite and on the program's website at www.poly.edu. Students are responsible for keeping informed, tracking their progress and are encouraged to visit the BTM Program Director.

The current 128 credit BS in BTM curriculum, which comprises 4-credit and 2-credit BTM courses, continues to be under review. The BS in BTM is intended to evolve into a 128-credit curriculum comprising 60 credits of 3-credit BTM courses in order to provide a more flexible and diverse academic experience. No loss of credit for currently enrolled BTM students would occur.

UNDERGRADUATE COURSES

MG 1002 Foundations of Management *4:0:0:2*

This course introduces the principles and practices of management. Management is viewed as a system of tasks and activities, including environmental scanning, planning, organizing, leading and controlling. Within each major task, is a series of processes, which show how to do what has to be done. Management is a science and an art; both aspects of management are covered in this course. Major emphasis is on management history, philosophy and the theory and practice of management planning, decision making, organizing, motivating and leading.

MG 2004 Management of Information Technology and Systems *4:0:0:4*

This course provides a foundation to understand the role and potential contributions of information technologies and systems in business organizations–what they are, how they affect the organization and its employees, and how they can make businesses more competitive and efficient. The course focuses on the current state of IT in organizations; challenges and strategic use of IT; IT infrastructure and architecture; building, implementing and managing IT applications; and emerging issues such as intelligent systems, business-process reengineering, knowledge management and group-support systems.

MG 2014 Operations Management *4:0:0:4*

A firm has the opportunity to create competitive advantage through proficient operations management. To do so, the firm first must recognize and establish the strategic role of its operations within the organization. Then, at the more detailed operational level, the firm must execute effectively and efficiently. This course examines the strategic role that the operations function can play and offers specific tools and techniques that a firm can use during implementation. *Prerequisite: 4 credits of calculus.*

MG 2104 Organizational Behavior *4:0:0:4*

This course focuses on the study of human behavior in innovative organizations. Emphasis is on teams, leadership, communication theory and organizational culture and structure. The course includes analyses of organizational behavior problems through case studies and participation in experiential learning.

MG 2204 Financial Accounting *4:0:0:4*

This course provides a solid foundation in constructing and interpreting financial statements. Topics include: accounting terminology, financial-statement preparation and analysis, liquidity and credit-risk ratios, depreciation calculations, revenue recognition, accrued liabilities and asset valuation. Also covered are the effects of equity transactions, cash flows and various accounting methods on financial statements.

MG 2304 Marketing *4:0:0:4*

This course is an undergraduate introduction to marketing. It discusses the fundamentals of marketing; e.g., the marketing mix, the role of the customer, marketing research and survey techniques. In addition, emerging marketing paradigms, like relationship marketing and online marketing, are introduced.

MG 3002 Project Management *4:0:0:2*

This course provides students with practical and best-practice project management theory, concepts and (hands-on) practical experience so that they may contribute effectively to and lead multicultural team projects framed for the new global economy. The practical component includes a team-based project that spans the duration of the course.

MG 3024 Management of Data Communications and Networking *4:0:0:4*

This course introduces the fundamentals of modern telecommunications and networking such as components of data communication, data transmission, open-system interconnection (OSI), TCP/IP and other models, data link and network layers and local area networks (LANs). The course focuses on managerial issues related to the management of data communications and networking technologies. *Prerequisite: MA 1024 and MA 1124 or equivalents and MG 2004.*

MG 3204 Introduction to Finance *4:0:0:4*

This course introduces business finance for BTM majors. It emphasizes the financing and investment decisions of the financial manager, with special emphasis on examples from technological environments. Included are topics such as time value of money, asset valuation, risk analysis, financial statement analysis and capital budgeting. *Prerequisites: MA 1024 and MA 1124 or equivalents and and MG 2204.*

MG 3214 Advanced Corporate Finance *4:0:0:4*

This course builds on the principles of basic corporate finance covered in MG 3204. It prepares students to understand financial theory and how firms use modern finance for strategic and tactical decision-making. The critical issue of how these decisions affect the value of a firm and the returns of assets is addressed. Major topics include bond valuation, the CAPM model, portfolio design and modeling and option pricing using the Black-Scholes model. A strong emphasis is placed on using spreadsheets as a financial-modeling tool. *Prerequisites: MA 1252 and MG 3204.*

MG 3304 Introduction to Supply Chain Management *4:0:0:4*

This course provides an undergraduate-level introduction to supply-chain management. The underlying objective is to introduce key supply-chain management concepts and examine relevant business practice. This course enables students to develop useful skills, in an increasingly global context, to analyze marketing, logistics, operations and channel-management issues. *Prerequisites: MG 2004, MG 2304 and MA 2054 or MA 2212 with MA 2222.*

MG 3404 Innovation Management *4:0:0:4*

This course examines the key managerial features of technology-enabled innovation and new product development. It focuses on accessing innovative capabilities through R&D, acquisition, alliances, joint ventures and innovation-friendly cultures and organizations. The key perspective underlying this course is managerial. Although the innovation activities studied are overwhelmingly technology-enabled ones, success is largely determined by managerial factors. The interplay between the technology and management leading to innovation is a major concern of the discussion and work in this course.

MG 4004 Management Strategy in Technology Sectors *4:0:0:4*

This course provides an overview of the process of implementing a successful management strategy in an information-, technology- and knowledge-intensive environment. Fundamental topics include the development of strategic vision, objectives and plans; implementation of strategy and the evaluation of performance; industry and competitive analysis; SWOT analysis and competitive advantage and sustained advantage. Advanced concepts include strategic positioning in global markets, Internet strategy, strategy in diversified firms and interactions between organizational structure and strategy and between ethics and strategy. *Prerequisites: MG 3204 and MG 3404.*

MG 4014 Introduction to E-Business *4:0:0:4*

Since its introduction, the Internet has changed how businesses work. In addition to creating new opportunities, the Internet has revolutionized existing businesses and entire industries. This course provides an undergraduate-level introduction to e-business. The main objectives of this course are to (1) provide a hands-on introduction to the emerging area of e-Business, (2) discuss the major business concepts and issues in this domain and (3) develop high-quality content based on team discussion and individual/group research. *Prerequisites: MG 3204, MG 3002, MG 3304 and MG 3404.*

MG 4204 Management Science *4:0:0:4*

This course teaches students to create mathematical models of managerial problems. Types of models discussed include linear programming, integer-linear programming, non-linear programming, queuing models, decision-tree models, game-theoretic models, simulation models, inventory models and more. Each model is discussed in the context of the assumptions necessary for modeling and the robustness of the model's managerial recommendations. *Prerequisites: 6 credits of calculus and (MA 2054 or MA 2212 and MA 2222).*

MG 4214 Financial Strategy *4:0:0:4*

This course deals with the financial strategy of modern firms. Topics include planning and implementation of financial strategies for start-up businesses and the utilization of venture capital; diverse issues related to designing financial strategies of rapidly growing companies after experiencing an IPO; challenges in constructing a financial strategy while undergoing a major corporate restructuring; key components of financial strategies for companies facing rapidly changing technological and competitive environments; and development of financial strategies for mature companies and declining business. *Prerequisites: MG 2204 and MG 3204.*

MG 4404 Entrepreneurship *4:0:0:4*

This course focuses on key aspects of entrepreneurship as a critical engine for innovation. It also treats entrepreneurship as a state of mind that is not limited to small firms. Students discuss current theories and practices related to starting and managing entrepreneurial enterprises, emphasizing firms in technology-, information- and knowledge-intensive environments. Particular attention is paid to the critical issues of (1) identifying opportunities that provide competitive advantage; (2) the development of a solid business plan; (3) the marketing of new ventures; (4) entrepreneurial business operations, including human-resource and process management; (5) ethical and social issues in entrepreneurial firms; and (6) financial management and fund raising for entrepreneurial firms. *Prerequisites: Junior or senior student status.*

MG 4114 Special Topics in Management (4 cr) *4:0:0:4*

MG 4113 Special Topics in Management (3 cr) *4:0:0:3*

MG 4112 Special Topics in Management (2 cr) *4:0:0:2*

MG 4111 Special Topics in Management (1 cr) *4:0:0:1*

Focus on a special topic in Management under the guidance of TM faculty member. Pre-approval required by BS BTM Program Director or TM. Department Chair.

MG 4504 Global Perspectives on Technology Management: A Capstone Project Course *4:0:0:4*

This course provides students with knowledge of current theories and practices related to managing international and multinational firms. Students study the ways in which international management differs from the management of a firm residing solely within domestic boundaries. Topics covered include planning, organizing, HR management, communication and negotiation and coordination and control of international endeavors. Case studies are used extensively to focus the class on technological examples of problems in

international management. Students undertake a term project that either (1) develops a business plan for a technological international venture, (2) creates a case study of a technological firm's challenges in international management, or (3) analyzes a technological industry's position vis-à-vis international management. *Prerequisites: MG 3002, MG 3024, MG 3204, MG 3304 and MG 3404.*

MG 4514 Honors Capstone Project in Technology, Innovation and/or Information Management and Entrepreneurship I *4:0:0:4*

In this course, qualified honors students work with a faculty member (and perhaps graduate students) on an advanced topic in technology, innovation and/or information management or entrepreneurship. This effort may be directed toward developing theory, developing case material, or developing a business plan and business strategy for a new venture, or another project of this caliber. A Thesis or Honor's Thesis may compose part of this Honor's Capstone course. *Prerequisites: senior status, 3.6 GPA or better through the junior year in major; all courses specified by the project adviser.*

MG 4524 Honors Capstone Project in Technology, Innovation and/or Information Management or Entrepreneurship II *4:0:0:4*

In this course, qualified honors students work with a faculty member (and perhaps graduate students) on an advanced topic in technology, innovation and/or information management or entrepreneurship. This effort may be directed toward developing theory, developing case material or developing a business plan and business strategy for a new venture, or another project of this caliber. A Thesis or Honor's Thesis may compose part of this Honor's Capstone course. *Prerequisites: senior status, 3.6 GPA or better through the junior year in major; all courses specified by the project adviser including MG 4514.*

MG 4603 Technology Management—Internship and Service *3:0:0:3*

This course provides undergraduate students with the opportunity to learn by working in the field under faculty supervision. This course exposes undergraduates to relevant, state-of-the-art and best practices in modern technology management from the perspective of reflective involvement and interaction in the field. In addition, a service often may be a significant part of this course. The course occurs largely in the field. This course may be taken only once. A member of the TM faculty oversees this course; but other faculty members may be involved in directing specific field assignments. This course is open to all undergraduates. Admission for BTM majors requires the permission of the Director of the BTM Program. Non-BTM majors must also obtain permission of their adviser as well that of the BTM director. *This course currently may be applied only in addition to the 128 credits required for graduation from the BS in BTM Program.*

MG 4904 BS Thesis in Business and Technology Management *4:0:0:4*

BTM students who earn an overall 3.0 GPA and a 3.4 GPA or better in technology management courses through their junior year of study qualify for an optional thesis. They are advised to meet with the Department Head or BTM Program Director in advance of completing their junior year. Before registering for the BTM Thesis, the student must find a Technology Management Department faculty member agreeing to serve as thesis adviser and then receive the Department Head's approval in writing before proceeding. BTM Thesis students are permitted to replace either the Honor's Capstone Project I MG 4514 or Honor's Capstone Project II MG 4524 with MG 4904. This course cannot be repeated. *Prerequisites: Overall 3.0 GPA and a 3.4 GPA or better in MG courses through their junior year. TM Department Chair approval.*

Typical[14] Course of Study for the Bachelor of Science in Business and Technology Management[15]

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Class	Hours/Week Lab.	Rec.	Cr.
MA 1054	Calculus I with Pre-calculus[1]	4	0	0	4
EN 1013W	College Writing Workshop (Humanities and Social Sciences1)[2]	3	0	0	3
CS 1114	Intro. Prog and Problem Solving	3	3	0	4
	Science/Engineering Elective (1)[2]				3
EG 1001	Engineering and Technology Forum	1	1	0	1
					15

SOPHOMORE YEAR[11]

Fall Semester

MG 2204	Financial Accounting	4	0	0	4
MG 2004	Mngt. of Info. Tech. and Systems	4	0	0	4
MG 2104	Organizational Behavior[9]	4	0	0	4
	CAM/STS/SEG Elect (Humanities and Social Sciences3)[2, 12]	3	0	0	3
	Restricted Elective 1[5]				3
					18

JUNIOR YEAR[11]

Fall Semester

MG 3204	Introduction to Finance	4	0	0	4
MG 3024	Mngt. of Data Comm. and Netwk.	4	0	0	4
MG 3002	Project Management	2	0	0	2
PL 2143	Ethics and Technology (Humanities and Social Sciences4)[4]	3	0	0	3
	Humanities and Social Sciences5 (BTM Mandatory Technology Subset)[8]				3
					16

SENIOR YEAR[11]

Fall Semester

MG 4004	Mgmt Strat Tech Sect (Strat.Con.)[10] or	4	0	0	4
MG 4214	Financial Strategy (Fin. Con.)[10]				
MG 4404	Entrepreneurship[6]	4	0	0	4
	Restricted Elective(3)[5]	2	0	0	2
	CAM/STS/SEG Elect[2] (Humanities and Social Sciences8)[2]	3	0	0	3
	CAM/STS/SEG Elect[2] (Humanities and Social Sciences9)[2]	3	0	0	3
					16

Spring Semester

Course No.	Course Title	Class	Hours/Week Lab.	Rec.	Cr.
MA 1252	Calculus Bus and Life Sci IIA (½ semester)	4	0	0	2
MG 1002	Foundations of Management	2	0	0	2
HuSS 1023W	First-Year Writing Seminar (Humanities and Social Sciences2)[2]	3	3	0	3
	Technical Elective[7]				3
	Science Elective(2)[3]				3
					13

Spring Semester

EC 2524	Managerial Microeconomics	4	0	0	4
MG 2304	Marketing	4	0	0	4
MG 2014	Operations Management	4	0	0	4
MA 2054	Applied Data Analysis[13]	4	0	0	4
					16

Spring Semester

MG 3404	Innovation Management	4	0	0	4
MG 3304	Intro. Supply Chain Mngt. (Strat. Con.)[10] or	4	0	0	4
MG 3214	Adv. Corp. Finance (Fin. Con.)[10]				
	Restricted Elective(2)	3	0	0	3
	CAM/STS/SEG Elect[2] (Humanities and Social Sciences6)[2]	3	0	0	3
	CAM/STS/SEG Elect[2] (Humanities and Social Sciences7)[2]	3	0	0	3
					17

Spring Semester

MG 4504	Global Perspect. on Tech Mngt.	4	0	0	4
MG 4014	Intro. to E-Business	4	0	0	4
MG 4204	Management Science[6]	4	0	0	4
	Restricted Elective (4)[5]	2	0	0	2
	CAM/STS/SEG Elect[2] (Humanities and Social Sciences10)[2]	3	0	0	3
					17

See following page for footnotes.

Total credits required for graduation: 128

1. Students who are placed by placement examination or by an adviser into MA 954 Precalculus or MA 914 Precalculus B must defer registration for calculus. Upon successful completion of these courses students may then register for MA 1054. Precalculus courses are developmental math courses and no credit is given towards graduation. Consult Department of Mathematics for latest information.

2. Follow latest NYU-Poly Humanities and Social Sciences requirements. See subset below, subject to correction or change to adhere to latest NYU-Poly TCS Department regulations:

   a. Mandatory Humanities and Social Sciences Freshman Course Fall Semester: EN 1013W-College Writing Workshop or EN 1033W-College Writing Workshop for ESL Students.

   b. Mandatory Humanities and Social Sciences Freshman Course Spring Semester: HuSS 1023W-First-Year Writing Seminar or EN 1233W-First-Year Writing Seminar for ESL Students.

   c. Humanities and Social Sciences Elective Requirement (six courses, 18 credits): Six 3cr courses chosen from any of the three Humanities and Social Sciences clusters (CAM/STS/SEG).

   d. Writing-Intensive Humanities and Social Sciences Elective Requirement: At least one of the six Humanities and Social Sciences electives must be a writing-intensive course labeled by "W." This Writing-Intensive Requirement will be phased in over a 5 year period. If this course is not available please contact TCS and receive permission to take another Humanities and Social Sciences course.

3. Approved science electives are CM 1004, CM 1014, CM1024, BMS 1004, Calculus-based physics: PH 1013, PH 2021 and PH 2023, PH 2031 and PH 2033 and noncalculus-based 3-credit Physics courses; PH 1213 and PH 1223. Note: EG 1003 is NOT an approved as science elective for BTM.

4. PL 2143 Ethics and Technology replaces previous PL 4052 and is mandatory for all BTM majors.

5. Restricted Electives are courses in math, science, Humanities and Social Sciencess ONLY. Restricted elective Humanities and Social Sciences courses follow the 3cr Humanities and Social Sciences electives.

6. Students with a 3.6 GPA or better in major at the end of junior year may substitute MG 4514 Honors Capstone Project I (4 credits) or the MG 4904 BS Thesis in Business and Technology Management for MG 4404. They may also substitute MG 4524 Honors Capstone Project II (4 credits) or the MG 4904 BS Thesis in Business and Technology Management for MG 4204. The MG 4904 BS Thesis in Business and Technology Management may take longer than 1 semester to complete and students must follow all NYU-Poly thesis guidelines.

7. Technical Electives can be chosen from computer science, engineering, mathematics, chemistry, physics, bio-molecular sciences, digital media and undergraduate finance courses from the Department of Finance and Risk Engineering. Technical Electives do not count towards the General Education requirements.

8. The Humanities and Social Sciences5 BTM Mandatory Technology Subset (previously called the Liberal Arts Elective) can ONLY be fulfilled by any ONE of the following 3-credit Humanities and Social Sciences Cluster 2 Science, Technology and Society (STS) courses listed below (with or without a "W" - Writing Intensive - designation):

HI 3413	History of Intellectual Property In America
PL 2003	Symbolic Logic
PL 2103W	Philosophy of Science, Technology, and Society in China and India
PL 2203	Philosophy of Technology
PL 3203W	Philosophy of Technology: The Critique of Heidegger
PL 3253	Philosophy of Science
PS 2613	Psychology of the Internet
PS 2643	Creativity and Innovation
PS 2663	Intelligence: Real and Artificial
PS 3603	Psychology of Internet Security
STS 2003	Science, Technology, and Society
STS 2113W	History and Philosophy of Internet Technology
STS 2133W	Perspectives on Science and Technology Reporting
STS 2153	Addressing Public Policy Issues in the Sciences, Engineering and Medicine
STS 2253	Biology and Society
STS 3003	Seminar in Science and Technology Studies
STS 3163	Science and Technology in the Literary Sphere

Please note that the above Humanities and Social Sciences electives may also be used as normal Humanities and Social Sciences electives in BTM.

9. MG 2104 Organizational Behavior is a BTM requirement and does not count as a Humanities and Social Sciences course.

10. Students must select a BS-BTM Concentration by the end of the fall semester of the junior year. Current BS-BTM Concentrations: Technology Innovation and Strategy Concentration (Strat. Concent.) and Technology and Innovation in Finance Concentration (Fin. Concent.).

11. BTM students have several internship options. They may register for MG 4603 Technology Management—Internship and Service for 3 credits for one semester only and as per the stipulations described in the BTM course description section. Also, students may register for CP 101 and CP 201, both provided by the Career Management Center. Internships generally run for 2 to 3 months the first year of study. No credit is offered towards the BS BTM degree for MG 4603 or for the above CP courses, but they all shall appear on the NYU-Poly transcript.

12. HI 2104 Contemporary History found previously here as a Humanities and Social Sciences mandatory course is no longer a requirement and is replaced by a Humanities and Social Sciences elective (Humanities and Social Sciences3 CAM/STS/SEG Elec).

13. MA 2054 may be substituted with MA 2212 (Data Analysis I) together with MA 2222 (Data Analysis II), for 4 total credits, only with the pre-approvals from the BTM Program Director and the Mathematics Department.

14. Grandfathering rules may apply.

15. This chart is for incoming Fall09 BTM Freshman and onwards.

Note: THIS CHART IS ALSO USED FOR ADVISEMENT AND BS BTM DEGREE REQUIREMENT AUDIT CHECKLIST. ALL INFORMATION IS SUBJECT TO REVISION.

PROGRAMS OFFERED AT THE OTHMER-JACOBS DEPARTMENT OF CHEMICAL AND BIOLOGICAL ENGINEERING

Academic Directors:
Walter Zurawsky (undergraduate)
Jovan Mijovic (graduate)

Chemical and biomolecular engineers rely heavily on science, engineering methods, experience and inventiveness to develop the processes and equipment required for economical production of new and useful products. Chemical and biomolecular engineers have contributed to developing virtually every material common to modern life. In addition to working with bulk chemicals and petroleum products, these engineers play key roles in producing plastics, pharmaceuticals, cosmetics, fertilizers and foodstuffs, synthetic rubber, rocket propellants, fuel cells, automatic controls, water desalination plants, missiles and artificial kidneys. New technologies, from sensors to the production of bulk chemicals from renewable bio-resources, require the unique skills of chemical and biomolecular engineers.

Chemical and biomolecular engineers may choose from a wide range of professional activities, including research, process and product development, design and supervision of the construction and operation of industrial plants, technical sales and services, consulting, management, teaching and entrepreneurship. Opportunities in chemical and biomolecular engineering are virtually unlimited.

The foundations of chemical and biomolecular engineering are the sciences, with emphasis on chemistry, biology, mathematics, physics and the engineering sciences including thermodynamics, fluid mechanics, kinetics and heat and mass transfer. Courses include the analysis, design and control of equipment, operations and processes. Students develop the knowledge and analytical skills necessary to bridge the gap between scientific advances and large-scale production of products.

UNDERGRADUATE PROGRAM

The undergraduate program in chemical and biomolecular engineering provides a solid foundation in science and the engineering sciences. An integrated set of chemical and biomolecular engineering courses is built upon this foundation. Students receive thorough instruction in chemistry, biology, physics, mathematics and engineering science, which are basic to understanding physical, chemical and biomolecular operations and processes. Courses in engineering science include engineering thermodynamics, reaction kinetics and engineering, process dynamics, fluid mechanics, heat and mass transfer.

The undergraduate program leads to a Bachelor of Science in Chemical and Biomolecular Engineering and is accredited by the Accreditation Board for Engineering and Technology (ABET).

EDUCATIONAL OBJECTIVES

The undergraduate program prepares graduates for careers in the chemical, biochemical, energy and related industries, for advanced study in graduate programs in chemical engineering and related fields, and in professional programs such as medicine, business and law.

CURRICULUM

Design is essential to chemical and biomolecular engineering education and is incorporated into many courses. Generally, as students progress through the curriculum and learn more fundamental engineering science, courses involve more design components and more complex design problems. Design elements are integral to many courses, which lead to the senior process-design courses. In these courses, students design chemical and biomolecular processes and their designs must include engineering, safety and economic considerations.

The chemical and biomolecular engineering curriculum provides a background that enables graduates to select professional careers from an extremely broad spectrum of opportunities. Graduates are prepared for employment in many industry capacities or to enter graduate school.

REQUIREMENTS FOR THE BACHELOR OF SCIENCE

In addition to the institute requirement of a 2.0 GPA or better for graduation, students also must meet the department's academic standards. For chemical and biomolecular engineering students to advance to senior-year courses, they must maintain a 2.5 GPA in courses CBE 1002, CBE 2124, CBE 3153, CBE 3313, CBE 3233, CBE 3223 and CBE 3323. The same course must not be failed twice. Students who fail to meet these requirements are not allowed to register for senior courses. All listed prerequisites must be satisfied before students may enroll in CBE courses.

UNDERGRADUATE ADVISING

All entering freshmen are advised through the Academic Advisement Center. Departmental academic advisers advise sophomores, juniors, seniors and transfer students. Students meet with their academic advisers at least once a semester, coincident with registration for the next term. At this meeting, the adviser discusses the student's work and checks progress towards meeting degree requirements. A graduation checklist is prepared for all students and updated when the students meet with the adviser for registration.

GRADUATE PROGRAMS IN CHEMICAL ENGINEERING

Chemical engineering graduate programs introduce advanced designs, research and development. The department offers graduate programs leading to a Master of Science in Chemical Engineering and Doctor of Philosophy in Chemical Engineering. A BS degree in chemical engineering or a related field of science or engineering is generally required for admission to graduate study. An applicant who has earned a bachelor's degree from a foreign institution must submit Graduate Record Examination and TOEFL scores. Applicants with degrees in other fields or from other colleges may be admitted with undergraduate or graduate deficiencies as evaluated by the graduate adviser. Students must have had at least one course in differential equations. NYU-Poly research areas include biopolymers at interfaces, bio-sensors, dynamics of complex fluids, nanotechnology and nanomaterials, process-systems engineering, protein engineering and biomolecular diagnostics.

GOALS AND OBJECTIVES

The objective of the MS degree in chemical engineering is to provide an understanding of the fundamental principles of chemical engineering subjects. The program enhances mathematical and analytical skills and emphasizes advanced design concepts. Students in the MS program develop a deeper understanding of engineering principles, and laboratory and research skills. They also conduct an in-depth study of a specialized chemical engineering topic through a guided studies project or a research thesis.

The PhD degree in chemical engineering provides advanced knowledge of fundamentals and research in emerging fields in chemical engineering. Research skills are refined, and the candidate performs original research that advances the understanding of a specific chemical engineering discipline. Faculty plan programs of study individually with each candidate. Systematic study toward

a doctorate is guided by a guidance committee appointed by the Office of Research and PhD Programs.

REQUIREMENTS FOR THE MASTER OF SCIENCE IN CHEMICAL ENGINEERING

Candidates for the MS in Chemical Engineering should plan their programs in accordance with the following list of requirements:

GUIDED STUDIES OPTION

Required (core) courses, 12 credits, 3 credits each

CBE 6153 Applied Mathematics in Engineering
CBE 6333 Transport Phenomena
CBE 6733 Chemical Engineering Thermodynamics
CBE 6813 Chemical Reactor Analysis and Design

Electives 12 credits:
At least two electives (6 credits) must be chosen from CBE 6003 - CBE 9413, while the other two (6 credits) may be chosen from other graduate programs with the approval of the graduate adviser in chemical engineering.

CBE 9023 Guided Studies in Chemical Engineering (6 credits)

Total: 30 credits

THESIS OPTION

Required (core) courses, 12 credits, 3 credits each

CBE 6153 Applied Mathematics in Engineering
CBE 6333 Transport Phenomena
CBE 6733 Chemical Engineering Thermodynamics
CBE 6813 Chemical Reactor Analysis and Design

Electives 9 credits:
At least two electives (6 credits) must be chosen from CBE 6003 - CBE 9413, while the other one (3 credits) may be chosen from other graduate programs with the approval of the graduate adviser in chemical engineering.

CBE 9973 Master's Thesis (9 credits)

Total: 30 credits

To meet graduation requirements, students must have an overall B average in all courses (excluding MS Thesis or Guided Study Project) and must not obtain more than two grades of C in required subjects.

REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY IN CHEMICAL ENGINEERING

Students must pass a comprehensive qualifying examination in chemical engineering and present a doctoral dissertation. The qualifying exam is given once a year. Additional details on the qualifying examination should be obtained from the graduate adviser. Each doctoral candidate must complete a minimum of 75 credits of academic work past the bachelor's degree, including a minimum of 45 credits of dissertation research. Although the student may elect to take more than 45 credits of PhD thesis, only 45 of those credits can be counted in the required 75 credits. Furthermore, of those 45 credits, at least 36 must be taken beyond MS thesis and at NYU-Poly. A minimum of 30 graduate credits beyond the bachelor's degree (not including PhD or MS thesis credits) are required in chemical engineering subjects and related subjects, of which at least 12 must be taken at NYU-Poly. Attendance is required at departmental seminars for at least four semesters.

To meet graduation requirements, students must have an overall B average in all courses, excluding thesis, and must not obtain more than two grades of C in required subjects. Candidates for the degree Doctor of Philosophy in Chemical Engineering should plan their programs in accordance with the following requirements:

Required Subjects: 12 credits, 3 credits each

CBE 6153 Applied Mathematics in Engineering
CBE 6333 Transport Phenomena
CBE 6733 Chemical Engineering Thermodynamics
CBE 6813 Chemical Reactor Analysis and Design
CBE 9910/9920*
Departmental Seminar (0 credits)

Electives 18 credits:
At least three electives (9 credits) must be chosen from CBE 6003-CBE 9413.

The remaining courses may be chosen from other graduate programs with the approval of the graduate adviser in chemical engineering.

CBE 9993 PhD Thesis (45 credits)

Up to 9 credits of Master's Thesis can be included here.

Total: 75 credits

* CBE 9910/9920 must be taken for two years.

UNDERGRADUATE COURSES

CBE 1002 Introduction to Chemical and Biomolecular Engineering *2:0:0:2*

This course introduces the chemical and biomolecular engineering profession, its history and its career potential. The course contains selected topics on basic chemical and biomolecular engineering and seminars covering the full range of chemical and biomolecular engineering profession from emerging areas to those found in more traditional positions. *Prerequisites: CM 1014 and EG 1003.*

CBE 2124 Analysis of Chemical and Biomolecular Processes *4:0:0:4*

This course prepares students to formulate and solve material and energy balances on chemical and biomolecular process systems and lays the foundation for subsequent courses in thermodynamics, unit operations, kinetics and process dynamics, and control. The course introduces the fundamental engineering approach to problem solving: breaking down a process into its components, establishing the relations between known and unknown process variables, assembling the information needed to solve for the unknowns and, finally, obtaining the solution using relevant computational methods. *Prerequisites: CM 1014 and MA 1024.*

CBE 3313 Transport I *3:0:0:3*

This course establishes fundamental concepts in momentum and mass transfer and their applications in chemical and biomolecular systems. Topics in Momentum Transfer include macroscopic (integral) balances on finite control volumes of fluids (determination of inflow, outflow quantities), and microscopic (differential) balances on infinitesimal volumes of fluids (determination of fluid-velocity profiles and pressure profiles). Topics in Mass Transfer include diffusion and convection with applications in separation processes and biomolecular systems. *Prerequisites: MA 2132 and CBE 2124.*

CBE 3323 Transport II *3:0:0:3*

This course expands understanding in mass transfer, establishes fundamental concepts in heat transfer, and introduces engineering aspects of transport. Topics in Mass Transfer include diffusion-limited reactions with applications in biomolecular systems, transport in porous media, and mass transfer across membranes with applications in chemical and biomolecular systems. Topics in Heat Transfer include the basic mechanisms of conduction and convection. Topics in engineering aspects of transport include flow in closed conduits, heat-transfer equipment, and examples of simultaneous Heat and Mass Transfer. *Prerequisite: CBE 3313.*

CBE 3153 Chemical and Biomolecular Engineering Thermodynamics *3:0:0:3*

This course covers thermodynamics of flow systems. Topics include properties of fluids with advanced equations of state; properties of non-ideal mixtures; activity-coefficient models for non-electrolyte and electrolyte solutions; phase-equilibrium calculations at low and elevated pressures by computer procedures; and chemical reaction equilibria. *Prerequisites: CBE 2124 and CM 2614.*

CBE 3223 Kinetics and Reactor Design *3:0:0:3*

This course provides the fundamentals of thermodynamics and kinetics of chemical and biomolecular reactions and the development of skills to analyze and design reactor systems. Typical topics include homogeneous and heterogeneous reactors of various types, catalyzed and non-catalyzed reactors, and the design of single and cascaded chemical and bio-reactors. *Prerequisites: CBE 3153 and CBE 3313.*

CBE 3233 Chemical and Biomolecular Engineering Separations *3:0:0:3*

This course introduces processes for chemical and biomolecular separations. Topics include thermodynamics of separation processes, and the analysis and design of processes such as distillation, absorption, extraction and crystallization. Analytical and computer techniques are emphasized. *Prerequisites: CBE 3153 and CBE 3313.*

CBE 401X Special Topics in Chemical and Biomolecular Engineering *(variable)*

Topics of special interest Topics of special interest in chemical and biomolecular engineering are explored. *Prerequisites: CBE 3313 or adviser's approval.*

CBE 4113 Engineering Laboratory I *1:6:0:3*

This course introduces the performance of experiments in unit operations, transport processes and unit processes. Students analyze and design experiments to meet stated objectives. Results are presented in written and oral form. *Prerequisite: CBE 3233.*

CBE 4143 Process Dynamics and Control *3:0:0:3*

This course introduces system dynamics and process control. Dynamic models of chemical processes are developed. The design and tuning of feed-back and feed-forward controllers are discussed, and students are introduced to multiple input/multiple output systems and large system control issues. *Prerequisites: CBE 3103 and CBE 3223.*

CBE 4163 Chemical and Biomolecular Process Design I *3:0:0:3*

This course provides the skills to synthesize and design chemical and biomolecular processes with considerations of site and process selections, process economics, construction materials, data requirements and acquisition flow sheeting and subsystems. Students receive computer procedures and case studies to gain experience in process simulation and analysis. *Prerequisite: CBE 3223.*

CBE 4173 Polymeric Materials *3:0:0:3*

This course examines processing, structure, properties and applications of polymers as engineering materials, including renewable-resource based biopolymers. Topics include fundamentals of processing-morphology/property correlations in materials, basic concepts of viscoelasticity, fracture behavior, and thermal and electrical properties of engineering polymeric materials. *Prerequisites: CBE 3313 and CBE 3223.*

CBE 4213 Engineering Laboratory II *1:6:0:3*

This course deals with continued experiments in unit operations, transport processes and process control. Students analyze and design experiments to meet stated objectives. Results are presented in writing and orally. *Prerequisites: CBE 4113 and CBE 4143.*

CBE 4263 Chemical and Biomolecular Process Design II *3:0:0:3*

This course provides the skills to optimally design industrial processes, synthesizing knowledge from previous chemical and biomolecular engineering courses. Students receive more advanced computer procedures and work on case studies to gain further experience in process simulation and analysis. Design projects are conducted in teams similar to those in industry. *Prerequisites: CBE 4163 and CBE 4143.*

CBE 481X/482X Chemical Engineering Project *(up to 4 credits)*

Students and faculty supervisors select independent chemical and biomolecular engineering projects. Not open to honors or senior thesis students. (X = 1, 2, 3 or 4 and designates the number of credits.) *Prerequisite: Adviser's approval.*

CBE 491X/492X Bachelor's Thesis in Chemical and Biomolecular Engineering *(up to 4 credits)*

In this course, students plan original problem investigations in chemical and biomolecular engineering guided by a faculty supervisor. A thorough literature search is required. Special apparatus is constructed as required for experimental work. (X = 1, 2, 3 or 4 and designates the number of credits.) *Prerequisite: Adviser's approval.*

CBE 4954 Chemical and Biomolecular Engineering Internship *(4 credits)*

This internship is a supervised, creative engineering experience of at least two months' duration, typically taken during the summer, culminating in written and oral reports presented to industrial and faculty supervisors. Faculty visitations and conferences during internships are arranged. *Prerequisites: Senior standing and adviser's approval.*

GRADUATE COURSES

CBE 6153 Applied Mathematics in Engineering *3:0:0:3*

This course covers mathematical formulation of chemical engineering problems in terms of ordinary and partial differential equations. Topics include solutions of boundary and initial value problems using Green's functions and other techniques; characterization of second-order partial differential equations and properties of their solutions; asymptotic methods and numerical techniques. *Prerequisites: MA 2122 and MA 2132 or adviser's approval.*

CBE 6333 Transport Phenomena *3:0:0:3*

The topics in this course include vector analysis review; diffusive fluxes; conservation equations for chemical species and thermal energy; boundary conditions; scaling and approximation techniques; solution methods for conduction and diffusion problems; transient unidirectional diffusion and conduction; momentum diffusion and viscous stress; conservation equation for momentum and the Navier-Stokes equations; unidirectional and lubrication flows; and low-Reynolds and high-Reynolds number flows. *Prerequisite: CBE 3313 or adviser's approval.*

CBE 6733 Chemical Engineering Thermodynamics *3:0:0:3*

This course covers advanced treatment of phase and chemical equilibria; ideal and non-ideal solutions; stability of thermodynamic systems; osmotic pressures; electrolyte solutions; solid-liquid equilibria; and biochemical applications. *Prerequisite: CBE 3153 or adviser's approval.*

CBE 6813 Chemical Reactor Analysis and Design *3:0:0:3*

The topics in this course include trends and issues in modern reactor design; kinetics of complex homogenous and heterogeneous reactions: determination of nonlinear kinetic parameters, effects of transport processes, and catalyst deactivation; analysis and design of reactors; laminar flow reactors; dispersion model; split boundary condition problems; effects of non-ideal flow on conversion; and fixed-bed, fluidized-bed and multiphase reactors. *Prerequisite: CBE 3223 or adviser's approval.*

CBE 7213 Polymer Rheology and Processing *3:0:0:3*

The topics in this course include science and engineering of polymer processing; Newtonian and non-Newtonian flow phenomena; molecular and phenomenological models of polymer rheology; experimental characterization of shear flows; and the theory and application of engineering principles to extrusion, co-extrusion, blown film extrusion, injection molding and fiber spinning. *Prerequisite: CBE 3313 and CBE 3233 or adviser's approval.*

CBE 7263 Engineering Physics of Synthetic and Biological Macromolecules *3:0:0:3*

This course covers physical states of synthetic and biological macromolecules; sizes, shapes and ordered structures; dynamics of non-entangled and entangled chains; amorphous and crystalline solids, networks and gels; mechanical, dielectric and optical properties; and viscoelasticity and fracture. *Prerequisite: CBE 4173 or adviser's approval.*

CBE 7283 Polymer Composites *3:0:0:3*

This course covers composites of linear or cross-linked polymer matrix and reinforcing fibers: carbon, graphite, Kevlar and glass; manufacturing of composites; autoclave bag molding, filament winding, pultrusion; science and engineering of processing of composites; chemorheology, heat and mass transfer, residual stresses, monitoring and optimization of processing; mathematical models; in-situ real-time sensing; nanocomposites and "green" composites. *Prerequisite: CBE 4173 or adviser's approval.*

CBE 7523 Air Pollution Engineering Control *3:0:0:3*

This course covers control of air pollutants in response to government regulation, regeneration; pollutant-emissions control and the U.S. Clean Air Act mandates; EPA control-technology approaches, BACT, MACT and RACT; analysis of pollutant properties, concentrations and atmospheric boundary conditions; absorptive and reactive recovery processes for moving and stationary sources; and formation and removal of gaseous oxides (NOx, SOx, CO) of VOC's, Hg and HAP's) and of aerosols and other particulates. *Prerequisite: Adviser's approval.*

CBE 8113 Optimization in Biological Systems *3:0:0:3*

This course introduces the mathematical programming approach. Topics include tree and network representations; review of the basic concepts in optimization; Kuhn-Tucker optimality conditions; non-linear programming algorithms; modeling techniques for formulating non-linear models; review of linear programming; modeling of continuous and discrete decisions; mixed-integer linear programming techniques (MILP); logical inference and MILP; mixed-integer non-linear programming algorithms (MINLP); applications in computational molecular biology; genotyping of pooled micro-satellite markers; genome rearrangement by DNA inversions; multiple alignment problems; optimization applications in protein systems; and optimization applications in metabolic networks. *Prerequisite: Adviser's approval.*

CBE 8313 Biointerfacial Engineering *3:0:0:3*

This course explores design, physical properties and experimental analysis of interfaces from a bioengineering perspective. The course comprises about two-thirds lecture and one-third laboratory. Topics covered incorporate experimental characterization including electrochemical, optical and spectroscopic methods; the biochemistry of surfaces; physical properties including surface thermodynamics, electrostatics and biomolecular properties at interfaces; and select biotechnological applications. *Prerequisite: CBE 3323, CBE 3223, CM 3314 or adviser's approval.*

CBE 8373 Engineering Principles of Drug Delivery *3:0:0:3*

This course covers fundamental concepts in drug delivery from an engineering perspective. Biological organisms are viewed as highly interconnected networks where the surfaces/interfaces can be activated or altered chemically and physically/mechanically. The course focuses on the importance of intermolecular and interfacial interactions on drug-delivery carriers. Topics include drug-delivery mechanisms (passive, targeted) for metastatic cancer, in particular, and for inflammatory-type-of-diseases, in general; therapeutic modalities and mechanisms of action; engineering principles of controlled release and quantitative understanding of drug transport (diffusion, convection); effects of electrostatics, macromolecular conformation and molecular dynamics on interfacial interactions; thermodynamic principles of

self-assembly; chemical and physical characteristics of delivery molecules and assemblies (polymer based, lipid based); significance of biodistributions and pharmacokinetic models; toxicity issues and immune responses. *Prerequisites: CBE 3313 and CBE 3323 or adviser's approval.*

CBE 8813 Biochemical Engineering *3:0:0:3*

This course covers biochemical and bioprocess engineering; enzyme kinetics; cellular control systems, genetic and protein engineering; metabolism, stoichiometry and metabolic engineering; cell growth kinetics; bioreactor design and operation; heat/mass transfer in biological system; and biological product purification and characterization. *Prerequisites: CBE 3223 and CBE 3233 or adviser's approval.*

CBE 9403/ 9413 Selected Topics in Chemical and Biomolecular Engineering I/II *3:0:0:3*

Topics of special interest in chemical and biomolecular engineering are announced in advance in each semester offering. *Prerequisite: Adviser's approval.*

PROJECTS, THESES AND SEMINARS

CBE 902X Guided Studies in Chemical Engineering *(6 credits, 3 each)*

These studies involve selections, analyses, solutions and presentations of engineering reports of problems in products, processes or equipment design, or other fields of chemical engineering practices under faculty supervision. Conferences are scheduled. Master's-degree candidates are required to submit three unbound copies of their reports to advisers one week before the last day of classes. *Prerequisite: Adviser's approval.*

CBE 903X Guided Studies in Biomolecular Engineering *(6 credits total, 3 each)*

These studies involved selections, analyses, solutions and presentations of engineering reports of problems in products, processes or equipment design, or other fields of biomolecular engineering practices under faculty supervision. Conferences are scheduled. Master's-degree candidates are required to submit three unbound copies of their reports to adviser one week before the last day of classes. *Prerequisite: Adviser's approval.*

CBE 9910/9920 Seminar in Chemical and Biomolecular Engineering *(0 credits)*

Recent developments in chemical and biomolecular sciences and engineering are presented by engineers and scientists from industry and academia. Four semesters are required for PhD candidates.

CBE 997X Thesis for Degree of Master of Science in Chemical Engineering *(9 credits total, 3 each)*

Theses for the master's degree in chemical engineering should give results of original investigation of problems in chemical engineering or the application of physical, chemical or other scientific principles to chemical engineering. Theses may involve experimental research, theoretical analyses or process designs, or combinations thereof. Master's-degree candidates are required to submit four unbound copies to advisers before the seventh Wednesday before commencement. *Prerequisite: Adviser's approval.*

CBE 999X Thesis for Degree of Doctor of Philosophy in Chemical Engineering *(45 credits total, each 3 credits)*

Theses for the PhD degree must give results of independent investigations of problems in chemical engineering and may involve experimental or theoretical work. Theses must show ability to do creative work and must show that original contributions, worthy of publication in recognized journals, are made to chemical engineering. Candidates are required to take oral examinations on thesis subjects and related topics. Doctoral-degree candidates must submit five unbound thesis copies to advisers before or on the seventh Wednesday before commencement. *Prerequisite: Adviser's approval and students must have passed the doctoral qualifying examination.*

Typical Course of Study for the Bachelor of Science in Chemical and Biomolecular Engineering

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Hours/Week Class	Lab.	Rec.	Cr.
MA 1024	Calculus I[1]	4	0	0	4
CM 1004	General Chemistry for Engineers	3	2	1	4
EN 1013W	College Writing Workshop[2]	3	0	0	3
EG 1003	Intro. Engineering and Design	0	3	2	3
EG 1001	Engineering and Technology Forum	1	0	1	1
					15

Spring Semester

Course No.	Course Title	Hours/Week Class	Lab.	Rec.	Cr.
MA 1124	Calculus II	4	0	0	4
BMS 1004	Intro. to Cell and Molec. Biology	3	3	0	4
CBE 1002	Intro. to Chem. and Bio. Engineering	2	0	0	2
HuSS 1023W	First-Year Writing Seminar	3	3	0	3
CS 1133	Eng. Prob. Solving and Progra.	3	1.5	0	3
					16

SOPHOMORE YEAR

Fall Semester

MA 2012	Linear Algebra I (½ semester)	4	0	0	2
MA 2132	Ordinary Diff. Equ. (½ semester)	4	0	0	2
PH 1013	Mechanics	3	0	1	3
CM 2213	Organic Chemistry I	3	0	0	3
CBE 2124	Analysis of Chem. and Bio. Proc.	4	0	0	4
Humanities and Social Sciences Elective[3]		3	0	0	3
					17

Spring Semester

MA 2112	Multi. Calculus A (½ semester)	4	0	0	2
MA 2122	Multi. Calculus B (½ semester)	4	0	0	2
CM 2614	Physical Chemistry I	4	0	0	4
CM 2223	Organic Chemistry II	3	0	0	3
PH 2023	Electricity, Magnetism and Fluids	3	0	1	3
PH 2021	Introductory Physics Lab I	0	1.5	0	.5
Humanities and Social Sciences Elective[3]					3
					17.5

JUNIOR YEAR

Fall Semester

CM 3314	Biochemistry I	4	0	0	4
CBE 3153	Chem. and Bio. Eng. Thermo	3	0	0	3
CBE 3313	Transport I	3	0	0	3
PH 2033	Waves, Optics and Thermodyn.	3	0	1	3
PH 2031	Introductory Physics Lab II	0	0	1.5	.5
Humanities and Social Sciences Elective[3]					3
					16.5

Spring Semester

CBE 3233	Chem. and Bio. Eng. Separations	3	0	0	3
CBE 3223	Chem. and Bio. Reactor Eng.	3	0	0	3
CBE 3323	Transport II	3	0	0	3
	Engineering Elective				3
Humanities and Social Sciences Elective[3]					3
					15

SENIOR YEAR

Fall Semester

CBE 4113	Engineering Laboratory I	1	6	0	3
CBE 4143	Process Dynamics and Control	3	0	0	3
CBE 4163	Chem. and Bio. Proc. Design I	3	0	0	3
	Free Elective				4
Humanities and Social Sciences Elective[3]					3
					16

Spring Semester

CBE 4123	Engineering Laboratory II	1	6	0	3
CBE 4173	Polymeric Materials	3	0	0	3
CBE 4263	Chem. and Bio. Proc. Design II	3	0	0	3
	Engineering Elective				3
Humanities and Social Sciences Elective[3]					3
					15

Total credits required for graduation: 128

1. Students who are placed by examination or by an adviser into MA 902, MA 912 or MA 914 must defer registration for MA 1024.

2. Students who are placed by examination or by an adviser into EN 1080W must subsequently register for EN 1034, rather than EN 1013W.

3. The requirements for Humanities and Social Sciences electives are described in the Undergraduate Academic Programs and Policies section of this catalog.

   TRANSFER STUDENTS may substitute engineering electives in place of EG 1003 and CBE 1002.

CHEMISTRY PROGRAM

Program Directors:
Bruce A. Garetz, Undergraduate
Jin K. Montclare, Graduate
Iwao Teraoka, Graduate

Chemistry is concerned with knowledge of the structures, properties and reactions of matter and evolving theories to explain observations, predict chemical behavior and suggest experiments.

Classical divisions of chemistry are (1) organic chemistry, dealing primarily with compounds of carbon; (2) inorganic chemistry, concerned with all other compounds; (3) analytical chemistry, concerned with quantitative determinations of composition; and (4) physical chemistry, which seeks to understanding matter, including chemical bonds and molecular interactions.

These classical fields have increasingly overlapped, and several interdisciplinary fields are now of great importance: biochemistry, electrochemistry, photochemistry, polymer chemistry, solid-state chemistry and chemical physics.

The Department of Chemical and Biological Sciences (CBS) offers a full complement of undergraduate and graduate courses in various aspects of modern chemistry. Graduates are prepared for positions at educational institutions, research institutes, industrial organizations and government laboratories. Staff members conduct and supervise research at undergraduate, graduate and postdoctoral levels. This research is combined with teaching so that courses at all levels are taught by chemists who are highly competent in their fields. Undergraduates participating in required research activities are stimulated and well prepared for graduate school or professional positions. The CBS department offers programs leading to a Bachelor of Science in Biomolecular Science, a Master of Science in Chemistry and a Doctor of Philosophy in Materials Chemistry.

GOALS AND OBJECTIVES

The goals of the Master of Science program are to advance students' knowledge and experience beyond the BS level and equip them with the needs of a changing industrial environment.

The goal of the PhD program is to offer candidates an opportunity to learn various aspects of materials chemistry especially associated with polymers and bio-active materials.

UNDERGRADUATE PROGRAM

The BS degree requirements are described in the Biomolecular Science Program section of this catalog. The BS in biomolecular science, with an option in chemistry with an approved selection of electives, is certified by the American Chemistry Society (ACS) to be a rigorous academic program, which is valued by both potential employers and graduate schools. ACS-certified graduates are immediately eligible for society membership.

GRADUATE PROGRAMS

Master of Science in Chemistry

Students are trained to perform at the mid-managerial level of the chemical industry and other organizations involved in chemically related work. Many students continue toward a doctoral degree and are already employed in chemistry-related institutions and will gain the knowledge to move ahead in these organizations. The MS program will allow graduate credit for special learning opportunities involving research as arranged with program advisers.

Doctor of Philosophy in Materials Chemistry

The PhD program in materials chemistry is highly interdisciplinary, exposing students to a wide range of exciting, cutting-edge science. The program's objective is to educate students through classroom and research experiences in the emerging discipline of materials chemistry.

Students engage in research topics that include chemical and biological synthesis of polymeric materials, structural and physical properties of synthetic and biological macromolecules, the interplay between molecular-level structure and function and the biological properties of macromolecules.

The program promotes interdisciplinary interactions among the students and faculty whose interests lie at the boundaries of chemistry, biology and engineering. In particular, the faculty specializes in the integration of biotechnology for creating new catalysts, sensors and macromolecules as well as in the detailed characterization and understanding of such polymers and novel super-molecular structures. The Materials Chemistry Program encompasses the Polymer Research Institute, the Center for Biocatalysis and Bioprocessing of Macromolecules and more.

REQUIREMENTS FOR THE MASTER OF SCIENCE

Candidates for the MS in Chemistry plan their programs in accordance with the following list of requirements:

A. Required (core) courses, 4 courses, 3 credits each:

1. Physical chemistry
   CM 7043 Statistical Thermodynamics and Kinetics

2. Organic chemistry
   CM 9033 Physical Organic Chemistry

3. Analytical chemistry (choose one of the following two)
   CM 8023 Principles of Spectroscopy
   CM 8073 Organic Spectroscopy

4. Inorganic chemistry, polymer chemistry, or biochemistry (choose one of the following three)
   CM 6013 Advanced Inorganic Chemistry
   CM 9413 Biochemistry I
   CM 7723 Synthesis of Macromolecules

B. Electives, 12 credits:
Two courses from CM listing and two courses from CM, BE, BT and CBE listings

C. Seminar, 1.5 credits:
CM 9731 Seminar in Chemistry I

D. Chemical Literature, 1.5 credits:
CM 5021 Information Sources for the Chemical Sciences

E. Chemical Colloquium, 0 credits
CM 9710 Chemical Colloquium

F. Chemical Laboratory Safety, 0 credits
CM 5040 Chemical Laboratory Safety

G. Guided Studies Project, 3 credits
CM 8713 Guided Studies in Chemistry I

Total: 30 credits

To meet graduation requirements, students must have an overall B average in all courses (excluding seminar, chemical information and guided studies). Where CM 9731 and CM 5021 are not offered, they may be replaced by an elective course or a second Guided Studies project (CM 8723 Guided Studies in Chemistry II). Students must be in continuous attendance at the departmental colloquia (CM 9710).

REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY

Candidates for the degree Doctor of Philosophy in Materials Chemistry are to plan their programs in accordance with the requirements listed below.

A. Required (core) courses, 4 courses 3 credits each:

1. Physical chemistry
   CM 7043 Statistical Thermodynamics and Kinetics

2. Organic chemistry
   CM 9033 Physical Organic Chemistry

3. Analytical chemistry (one of the following two)
   CM 8023 Principles of Spectroscopy
   CM 8073 Organic Spectroscopy

4. Inorganic chemistry, polymer chemistry, or biochemistry (one of the following three courses)
   CM 6013 Advanced Inorganic Chemistry
   CM 9413 Biochemistry I
   CM 7723 Synthesis of Macromolecules

B. Electives, 12 credits:
two courses from CM listing and two courses from CM, BE, BT and CBE listings

C. Seminar, 3 semesters, 4.5 credits:
CM 9731 Seminar in Chemistry I
CM 9741 Seminar in Chemistry II
CM 9751 Seminar in Chemistry III

D. Chemical Literature, 1.5 credits:
CM 5021 Information Sources for the Chemical Sciences

E. Chemical Colloquium, 0 credits
CM 9710 Chemical Colloquium

F. Chemical Laboratory Safety, 0 credits::
CM 5040 Chemical Laboratory Safety

G. Thesis Research, 36 credits (minimum):
CM 999x Research in Chemistry

H. The rest, if any, are electives (from CM, BE, BT, and CBE listings) up to 9 credits.

Total: 75 credits

Students must pass a comprehensive qualifying examination in chemistry and present a doctoral dissertation. The qualifying exam is given once a year. Additional details on the qualifying examination should be obtained from the graduate adviser. Each candidate for the doctorate must complete a minimum of 75 credits of academic work past the bachelor's degree, including a minimum of 36 credits of dissertation research. Of those 75 credits required, at least 45 credits must be taken at NYU-Poly. Of the total 36 to 45 credits for dissertation research, up 12 credits can be transferred from research credits taken at another institution before coming to NYU-Poly. If the courses transferred from another institution do not include all four core courses, the missing core courses must be taken at NYU-Poly. The remaining courses to satisfy the doctoral degree are selected in consultation with the student's adviser.

Candidates must have an overall B average in the core courses as well as in the core and elective courses (excluding seminar, chemical literature and thesis).

The student is required to declare a concentration by taking three courses from one of the following five areas: physical chemistry, organic chemistry, analytical chemistry, biochemistry and polymer chemistry. One of the three courses can be a core course. The course description indicates which courses qualify for the five areas. The GPA of the three courses must be B or better. Students must be in continuous attendance at the departmental colloquia (CM 9710).

UNDERGRADUATE COURSES

CM 1004 General Chemistry for Engineers *3:2:1:4*

This is a one-semester introductory course in general chemistry. It covers chemical equations, stoichiometry, thermodynamics, gases, atomic and molecular structure, periodic table, chemical bonding, states of matter, chemical equilibrium, organic, inorganic and polymeric materials and electrochemistry.

CM 1004H General Chemistry for Honors Engineers *3:2:1:4*

A one-semester introductory course in general chemistry. Chemical equations, stoichiometry, thermodynamics, gases, atomic and molecular structure, periodic table, chemical bonding, states of matter, chemical equilibrium, organic, inorganic, polymeric materials and electrochemistry. A discussion of chemical innovations will be introduced where appropriate.

CM 1014 General Chemistry I *3:2:1:4*

This course covers chemical equations, chemical conservation laws, stoichiometry, thermochemistry, properties of gases, atomic structure, periodic table, chemical bonding and molecular structure. The course is required for students in the Biomolecular Science Program.

CM 1024 General Chemistry II *3:2:1:4*

This course covers states of matter, chemical thermodynamics and equilibria, kinetics, acid-base chemistry, electrochemistry, introduction to organic chemistry, natural and synthetic polymers. The course is required for students in the Biomolecular Science Program. *Prerequisite: CM 1004 or CM 1014.*

CM 1032 Chemistry, the Central Science *2:0:0:2*

This is a one-semester overview course in chemistry, providing examples of important discoveries and important chemical innovators, with a strong emphasis on cutting-edge research. Field opportunities are developed to allow students to contribute to the discipline.

CM 1101 Numerical Methods for Chemistry *1:0:0:1*

This is a one-semester introductory course in numerical methods needed for BMS and CM courses. Students learn spreadsheet calculation, chart displays, curve fitting and good lab-record keeping. *Co-requisite: CM 1014.*

CM 2102 Molecular Modeling in Chemistry *2:0:0:2*

This one-semester introductory course covers computer modeling of organic compounds. Students learn to use Chem Draw and Chem3D, standard applications in chemistry. *Prerequisites: CM 1101 and CM 2213; Co-requisite: CM 2223.*

CM 2211 Organic Chemistry Laboratory I *0:3:0:1*

This Laboratory course teaches students how to prepare, isolate and purify typical organic compounds. Experiments illustrate basic techniques. Lab fee required. *Co/prerequisite: CM 2213.*

CM 2213 Organic Chemistry I *3:0:0:3*

This course covers chemistry of organic molecules: structure, nomenclature, properties and reactions of carbon compounds with emphasis on aliphatic compounds. It also introduces reaction mechanisms and stereochemistry. *Prerequisite: CM 1004 or CM 1024.*

CM 2221 Organic Chemistry Laboratory II *0:3:0:1*

This laboratory stresses complex preparation, purification, characterization and identification of organic compounds by chemical and physical means. It introduces instrumental methods of analysis and identification. Lab fee required. *Prerequisite: CM 2211; Co-/prerequisite: CM 2223.*

CM 2223 Organic Chemistry II *3:0:0:3*

This course continues CM 2213 and emphasizes finding the principles of organic chemistry in industrial practice and biochemical mechanisms. It introduces instrumental methods of analysis and identification. *Prerequisite: CM 2213.*

CM 2234 Industrial Organic Chemistry *4:0:0:4*

This course demonstrates the basic ideas of organic chemistry, using industrial processes and important commercial materials. It covers the petroleum-based foundations of organic materials and shows how these petroleum-derived molecules ultimately lead, via important chemical reactions and intermediates, to the commercial products produced by the chemical industry. The course demonstrates how the principles of organic chemistry are intertwined with the many changes that characterize the chemical industry. The material is couched in a historical context. *Prerequisite: CM 1004 or equivalent.*

CM 2614 Physical Chemistry I *4:0:0:4*

This course covers chemical thermodynamics with applications to solutions, phase and chemical equilibria. Molecular motion and transport properties are also covered. *Prerequisites: CM 1004 or CM 1024 and MA 1124 or MA 1154 and PH 1013.*

CM 3114 Inorganic Chemistry *3:3:0:4*

This course covers atomic structures of elements as the basis for periodic classification. Also covered is descriptive chemistry of elements and their compounds and theories of chemical bonds. Coordination chemistry is introduced. *Prerequisite: CM 2614.*

CM 3314 Biochemistry I *4:0:0:4*

This course surveys modern biochemistry and emphasizes current areas of research. Also covered are structure-function relationships in proteins; enzymes and their mechanisms of action; bioenergetics principles and energy production; and biochemical theories and techniques. *Prerequisites: CM 2213 and CM 2614 or instructor's permission.*

CM 3324 Biochemistry II *4:0:0:4*

This course continues Biochemistry I. It covers principles of intermediary metabolism: energetic membrane structure and transport; structure and function of DNA and RNA; principles of molecular biology; the immune system; and hormonal regulation and cancer. *Prerequisite: CM 3314 or instructor's permission.*

CM 3514 Analytical Chemistry *3:3:0:4*

This course covers theories and applications of instrumentation techniques in modern analytical chemistry, including spectroscopy (UVVIS absorption, infrared absorption, fluorescence, Raman scattering, nuclear magnetic resonance), chromatography (gas, liquid) and other techniques (mass spectroscopy, electrophoresis). The accompanying laboratory part focuses on practical skills. *Prerequisite: CM 2614.*

CM 3614 Physical Chemistry II *2:6:0:4*

This course covers chemical kinetics and molecular structures and interactions and their relationship to the bulk properties of matter. The laboratory component introduces the experimental quantitative methods of analytical and physical chemistry, including volumetric, calorimetric and optical techniques. Also covered are computer analysis of data and report writing. *Prerequisite: CM 2614.*

CM 4314 Biomaterials *4:0:0:4*

This course covers natural macromolecules, including polypeptides, polysaccharides, lignin, biodegradable polymers and special characterizations of these biopolymers. *Prerequisite: CM 4414 or CM 4413.*

CM 4413 Polymer Science *3:0:0:3*

This course provides a broad perspective of polymer science and its application in everyday life. The course has three major components: a survey of polymers, polymer synthesis and aspects of polymer physics. *Prerequisites: CM 2213 and CM 2614.*

CM 4414 Polymer Chemistry *3:3:0:4*

This course introduces polymer chemistry. It covers the principles of various polymerization methods, characterization and physical chemistry of polymers. A laboratory is included. *Prerequisites: CM 2211, CM 2213 and CM 2614.*

CM 471X Guided Studies in Chemistry *As arranged*

Special project (experimental, theoretical, computational or literature search). Maximum 6 credits (including the credits of BMS 471X) count toward the degree requirements. *Prerequisite: Adviser's approval; CM 5040, if project involves experiments, and either CM 1004 or CM 1014.*

CM 4914/ CM 4924 Undergraduate Research in Chemistry *each 4 credits*

In this course, students conduct original investigations guided by staff members. Careful literature research is required before laboratory work starts. Continued reference to chemical literature is expected as well as active participation in conferences and seminars, both of which are scheduled as work progresses. A written report is required. Full-time students are expected to register for 8 credits of thesis during senior year. A research (lab) fee is required. *Prerequisites: CM 5011 and CM 5040.*

CM 5011 Information Sources for the Chemical Sciences *1:0:0:1*

This hands-on course introduces methods and tools for searching. It includes both electronic (CD-ROM and online) and print databases. Students may emphasize topics related to their research. Required of all BS students in biomolecular science.

UNDERGRADUATE AND GRADUATE COURSES

CM 5040 Chemical Laboratory Safety *1:0:0:0*

This course discusses problems of health and safety in chemical laboratories, including how to work safely with dangerous chemicals. This course must be completed by graduate and undergraduate chemistry students before they begin laboratory research.

GRADUATE COURSES

CM 5021 Information Sources for the Chemical Sciences *1.5:0:0:1.5*

This course is a hands-on introduction to methods and tools for searching and includes both electronic (CD-ROM and online) as well as print databases. Students may emphasize topics related to their research. Graduate students are required to take this course.

INORGANIC CHEMISTRY

CM 6013 Advanced Inorganic Chemistry *3:0:0:3*

This course covers theories of bonding in inorganic compounds. It introduces group theory as applied to molecular orbital and ligand field theories. Also covered are spectra of inorganic compounds and non-aqueous solvent. The transition to metal chemistry is introduced. *Prerequisite: Adviser's approval.*

CM 6153 Special Topics in Inorganic Chemistry *3:0:0:3*

This course covers special topics in Inorganic Chemistry. *Prerequisite: Adviser's approval.*

PHYSICAL CHEMISTRY

CM 7033 Quantum Chemistry *3:0:0:3*

This course covers quantum structures of atoms and molecules. It covers fundamental ideas of quantum mechanics, applications to atomic and molecular structures and bonding, approximation methods and Interactions of light and matter. *Prerequisites: Undergraduate physical chemistry and physics or adviser's approval.*

CM 7043 Statistical Thermodynamics and Kinetics *3:0:0:3*

This course covers statistical mechanics for chemical systems. Also covered are ensembles, partition functions, thermodynamic functions, applications to various systems, including non-ideal gas, gas of diatomic molecules, polymer, surface phenomena, chemical equilibria, biophysics and reaction kinetics. *Prerequisites: Undergraduate physical chemistry and physics or adviser's approval.*

CM 7103 Biophysical Chemistry *3:0:0:3*

This course covers structure and properties of important biological macromolecules, including proteins, nucleic acids and polysaccharides; membranes and macromolecular complexes; applications of x-ray diffraction; NMR; vibrational and CD spectroscopy to the analysis of structure. *Prerequisite: CM 7043 or adviser's approval.*

CM 7503 Special Topics in Physical Chemistry *3:0:0:3*

This course covers special topics in Physical Chemistry. *Prerequisite: Adviser's approval.*

CM 8023 Principles of Spectroscopy
See ANALYTICAL CHEMISTRY section.

CM 7813 Characterization of Macromolecules
See POLYMER CHEMISTRY section.

ORGANIC CHEMISTRY

CM 9033 Physical Organic Chemistry *3:0:0:3*

This course covers molecular structure and bonding. Also covered are stereochemical and conformational principles; theories of bonding; physical parameters of stable and reactive molecular states; and applications in biochemistry and polymer chemistry. *Prerequisite: Undergraduate organic chemistry or adviser's approval.*

CM 9043 Synthetic Organic Chemistry *3:0:0:3*

This course covers reactivity of molecules. Also covered are methods of mechanistic study of reaction pathways and important reactions of organic and organometallic chemistry. The course introduces synthesis and applications in living systems and in polymer reactions. *Prerequisite: Undergraduate organic chemistry or adviser's approval.*

CM 9053 Enzyme Catalysis in Organic Synthesis *3:0:0:3*

This course provides students with a working knowledge of how to use biotransformations as a tool in organic chemistry. Students learn about general enzymatic reaction types that carry out the cleavage and formation of C-O bonds, P-O bonds, C-N bonds, C-C bonds, reduction reactions, oxidation reactions and isomerizations. In addition, students are taught about advanced principles currently being applied to the engineering of catalytic proteins. *Prerequisite: Adviser's approval.*

CM 9403 Special Topics in Organic Chemistry *3:0:0:3*

This course covers special Topics in Organic Chemistry *Prerequisite: Adviser's approval.*

CM 8073 Organic Spectroscopy
See ANALYTICAL CHEMISTRY section.

CM 7723 Synthesis of Macromolecules
See POLYMER CHEMISTRY section.

BIOCHEMISTRY

CM 9413 Biochemistry I *3:0:0:3*

This course covers structure and function of biological macromolecules: proteins, nucleicacids, polysaccharides. Also covered are enzymatic kinetics, mechanism and control. *Prerequisite: Undergraduate biochemistry or adviser's approval.*

CM 9423 Biochemistry II *3:0:0:3*

This course covers membrane structure and function and energy production, transformation and utilization. Also covered are the regulation of biochemical systems; the replication, transcription and translation of DNA; mutagenesis and carcinogenesis; and the Immune system. *Prerequisite: undergraduate biochemistry or adviser's approval.*

CM 9433 Protein Engineering *3:0:0:3*

This course introduces modern protein engineering techniques available to researchers to understand protein structure and function and to create entirely new proteins for a variety of purposes. This is a new field that lies on the interface of chemistry, biology and engineering. The first part of the course discusses protein composition and structure and various genetic, biochemical and chemical techniques required to engineer proteins—all followed by specific topics. Topics include designing proteins that are highly structured and active at high temperatures and in non-aqueous solvents; that selectively interact with other proteins, small molecules and nucleic acids for therapeutic purposes; and that catalyze new reactions. *Prerequisite: CM 9413 or adviser's approval.*

CM 9443 Tissue Engineering *3:0:0:3*

This course teaches: (1) basic biological processes that occur during blood contact with artificial surfaces, (2) critical review of the literature in the field of tissue engineering, (3) biocompatibility issues relevant to a variety of implant devices that the student may encounter in future endeavors and (4) current approaches directed toward the engineering of cell-based replacements for various tissue types. *Prerequisite: undergraduate biochemistry or adviser's approval.*

CM 9463 Recombinant DNA Technology *3:0:0:3*

The course consists of lectures and demonstrations and covers practical aspects of recombinant DNA technology, including fundamental aspects of gene expression, restriction enzyme cleavage, plasmids, cloning, genetic transformation of bacteria, protein

expression vectors, basic principles of protein purification and manipulation of cloned genes (site-directed mutagenesis). *Prerequisite: CM 9413 or instructor's permission.*

CM 9453 Special Topics in Biochemistry *3:0:0:3*

This course covers special topics in Biochemistry. *Prerequisite: Adviser's approval.*

CM 7103 Biophysical Chemistry
See PHYSICAL CHEMISTRY section.

CM 8213 Bioanalytical Chemistry
See ANALYTICAL CHEMISTRY section.

ANALYTICAL CHEMISTRY

CM 8023 Principles of Spectroscopy *3:0:0:3*

This course covers rotational, vibrational and electronic states of atoms and molecules. Also covered are the interaction of radiation with atoms and molecules; molecular symmetry; rotational and vibrational spectroscopy; and electronic spectroscopy. *Prerequisite: Undergraduate physical chemistry or adviser approval.*

CM 8073 Organic Spectroscopy *3:0:0:3*

This course covers structure elucidation by joint applications of spectroscopic techniques such as proton and carbon-13 magnetic resonance, infrared and mass spectroscopy and other methods. *Prerequisite: CM 9033 or Adviser's approval.*

CM 8103 Liquid Chromatography *3:0:0:3*

This course covers the fundamentals of liquid chromatography. Also covered are partitioning; physical and chemical properties of packing materials; size exclusion chromatography; normal-phase and reversed-phase chromatography; hydrophilic interaction liquid chromatography; hydrophobic interaction chromatography; ion-exchange chromatography; preparative chromatography; gradient elution; and method development. *Prerequisite: Adviser's approval.*

CM 8123 Mass Spectroscopy *3:0:0:3*

This course covers isotopes and molecular masses; various ionization methods and mass analyzers; application to biomolecules in sequential analysis of nucleic acids, peptides, proteins; and analysis of phospholipids, polysaccharides and fatty acids. *Prerequisite: Adviser's approval.*

CM 8213 Bioanalytical Chemistry *3:0:0:3*

This course covers exciting new analytical methods in biochemistry and biotechnology, including atomic force microscopy, capillary electrophoresis, surface plasmon resonance and microarrays. The course is based directly on current scientific literature. *Prerequisite: CM 9413 or adviser's approval.*

CM 8303 Nuclear Magnetic Resonance Spectroscopy *3:0:0:3*

This course covers principles of NMR, including NMR spectrometers; spin decoupling; multi-pulse experiments; 2D NMR; and solid-state NMR. *Prerequisite: Adviser's approval.*

CM 8323 Microscopy *3:0:0:3*

This course review of optics, including optical-microscope fundamentals; phase contrast microscopy; confocal microscopy; R and Raman microscopy; transmission and scanning electron microscopy; and atomic force microscopy. *Prerequisite: Undergraduate physics or adviser's approval.*

CM 8503 Special Topics in Analytical Chemistry *3:0:0:3*

This course covers Special Topics in Analytical Chemistry. *Prerequisite: Adviser's approval.*

POLYMER CHEMISTRY

CM 7723 Synthesis of Macromolecules *3:0:0:3*

This course covers organic aspects, including chemistry of monomer and polymer formation; modern mechanistic analyses of reactions; stereochemistry of polymer structures; forces of stereo regulation; condensation, free radical (bulk, suspension, emulsion, solution), ionic, ring-opening and non-classical polymerization reactions. *Prerequisite: Undergraduate organic chemistry or adviser's approval.*

CM 7813 Characterization of Macromolecules *3:0:0:3*

This course covers characterization methods for linear-chain polymer and macromolecules in solution such as static and dynamic light scattering, osmometry, size exclusion chromatography, viscometry. Also covered are characterization methods for macromolecules in solid state such as crystallography and mechanical and thermal analysis. *Prerequisite: Undergraduate physical chemistry or adviser approval.*

CM 7923 Natural Polymers and Materials *3:0:0:3*

This course introduces natural and biomimetic polymers and is taught with an interdisciplinary view of biology, chemistry and macromolecular science. Topics covered include natural building blocks and methods by which nature carries out polymer synthesis and modification reactions; DNA; structural proteins; plant proteins; polysaccharides; polyesters; biosurfactants; polymers built from natural monomers and a wide variety of renewable resources; uses of these polymers as fibers, films, rheological modifiers, flocculants, foams, adhesives and membranes; special applications of natural polymers in medicine and as biodegradable plastics. *Prerequisite: Undergraduate physical chemistry or Adviser approval.*

CM 7853 Special Topics in Polymer Chemistry *3:0:0:3*

This course covers special topics in polymer chemistry. *Prerequisite: Adviser's approval.*

PROJECTS, THESES AND SEMINARS

CM 8713, CM 8723 Guided Studies in Chemistry I, II *3:0:0:3*

This is a special project (experimental, theoretical, computational or literature search). *Prerequisite: Adviser's approval.*

CM 9731, CM 9741, CM 9751 Seminar in Chemistry I, II, III *1.5:0:0:1.5*

This course covers chemical topics of current interest and is presented by participating students, staff and outside speakers. One semester is required for MS chemistry students; three semesters required for PhD candidates.

CM 999X Research in Chemistry *36 credits minimum*

This course requires original experimental or theoretical research, guided by a chemistry faculty member), that may serve as basis for a PhD. The minimum research registration requirement is 36 credits. Registration is required each semester consecutively until students complete adequate research projects and acceptable theses and have passed required oral examinations. A research fee is required. *Prerequisite: Doctoral qualifying examination.*

CIVIL ENGINEERING PROGRAM

Program Advisers
Roger P. Roess, Undergraduate
José M. Ulerio, Undergraduate
Magued G. Iskander, Graduate

UNDERGRADUATE PROGRAM

The Department of Civil Engineering develops engineering graduates capable of contributing to and advancing the practice of civil engineering and its subdisciplines. Through its research programs, the department strives to be at the forefront in selected areas in the development of new knowledge and applications in civil engineering. Through its educational programs, graduates will be well rounded in state-of-the-art techniques and will develop the skills needed to apply them in a complex profession. Among these skills are the abilities to communicate effectively in written and verbal form and understand the context of civil engineering projects in a complex society.

PROGRAM EDUCATIONAL OBJECTIVES

Program educational objectives relate to where the Department of Civil Engineering expects its graduates to be within three to five years of earning undergraduate degrees. NYU-Poly's undergraduate program in civil engineering is strongly practice-oriented, heavily emphasizing design, to prepare students for entry-level positions in any civil engineering subdiscipline or for graduate study. While some graduates eventually may work in other professions, the specific educational objectives of the program are as follows:

1. For 75% of its graduates to be working in a responsible position in civil engineering or a closely-related profession (not including those who are engaged in full-time graduate study).
2. For 50% of its graduates to have advanced in their careers to a position of higher responsibility.
3. For 75% of its graduates to be engaged in some form of continuing education, including, but not limited to, graduate education, professional development programs, relevant short courses and seminars, in-house training programs or similar activities.

PROGRAM OUTCOMES

Program outcomes are those abilities and skills that graduates are expected to have upon graduation with a BS in Civil Engineering degree. For these, the Department has adopted the 11 fundamental outcomes specified by the Accreditation Board for Engineering and Technology (ABET). They cover the full breadth and depth of the abilities and skills needed by modern engineering professionals. They are listed below with brief discussions of how each relates to the civil engineering profession.

a. *An ability to apply knowledge of mathematics, science and engineering.* Virtually all of civil engineering involves the application of mathematics and basic sciences to the solution of real-world infrastructure problems. Fundamental engineering skills evolve directly from science and mathematics. Students are immersed in these applications across all subdisciplines of civil engineering.

b. *An ability to design and conduct experiments, as well as to analyze and interpret data.* Civil engineers must engage in a number of basic experiments, and be aware of how to collect, organize, report and interpret the results of basic experiments and direct field observations of infrastructure operations. In the program, students are exposed to a wide range of laboratory experiments, including experiments in fluid mechanics, material behavior under loading, soil properties and behavior and others. They also are exposed to the collection of field data related to environmental conditions and problems, highway and street traffic and the monitoring of structures.

c. A*n ability to design a system, component, or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.* The program is heavily design-oriented. Several courses include full design-project laboratories, including Steel Design, Reinforced Concrete Design, Design of Traffic Facilities, Foundation Design and others. Many additional courses have design components, and all students finish their academic programs with a comprehensive group civil engineering capstone project. As the student progresses, the complexity of design applications increases, as do the number and breadth of practical constraints on potential solutions.

d. *An ability to function on multidisciplinary teams.* Modern engineering is not done by stand-alone engineers. Any significant project involves several engineers, perhaps with different engineering backgrounds, as well as non-engineers (planners, architects, financiers, managers, etc). Students have the opportunity to work in teams in several courses, but particularly in the capstone design project.

e. A*n ability to identify, formulate and solve engineering problems*. Engineers do not just solve problems brought to them by others. Engineers must spot problems before they become evident and describe them in terms that expedite their solution. As students progress through the program, they increase their participation in identifying and framing problems, as well as in developing comprehensive solutions.comprehensive solutions.

f. *An understanding of professional and ethical responsibility.* All professionals must be keenly aware of their general and professional ethical responsibilities to society in general, and to others who require and pay for their services. Like many professions, engineers, and civil engineers in particular, have specific ethical codes issued by professional societies with which they must comply. General ethical considerations are discussed throughout the curriculum, and several courses have a strong focus n the basis for, and application of, professional ethical code.

g. *The ability to communicate effectively.* To be an effective professional in the modern world, one must be an effective communicator. Engineers must explain their views and solutions to problems in ways that can be understood clearly by other professionals and by the public. Modern communication involves written and oral forms, and a wide variety of electronic media. NYU-Poly students are exposed to, and are required to use, all of these methods to prepare for their careers.

h. *The broad education necessary to understand the impact of engineering solutions in a global, environmental and societal context.* Engineers do not solve problems in a vacuum. Everything engineering professionals do affects the world around them. In the modern world economy, the "world" includes local neighborhoods, regions, states, nations and, indeed, the world. Solutions must be couched in a firm understanding of the impacts they will have on the environment, the economy and society.

i. *A recognition of the need for, and an ability to engage in, lifelong learning.* The engineering profession changes rapidly with the technological world. While general principles tend to change slowly, the specific materials, analysis techniques and approaches to engineering change quite rapidly. The body of knowledge graduates leaves with must be updated constantly and expanded during their professional

lives. The program provides opportunities for students to appreciate this need, and develop useful skills for self-learning, now and in the future.

j. *Knowledge of contemporary issues*. Engineering students study in a context in which local, regional and national infrastructure issues are in the forefront. Current issues and problems are discussed in virtually all courses, and students' attention is called to immediate issues as they arise.

k. *An ability to use the techniques, skills and modern engineering tools necessary for professional practice.* The program is frequently updated to incorporate the latest approaches to engineering solutions, and to include the use of modern engineering tools. Important "tools" include a variety of computer programs for data analysis, simulation and design. Many course laboratories use the most up-to-date techniques and software packages available to engineering professionals.

REQUIRED COURSES

The undergraduate curriculum provides a solid foundation in all major subdisciplines through required courses.

Four courses provide the engineering-science and professional underpinnings for all subdisciplines: CE 2113 Statics, CE 2123 Mechanics of Materials, CE 2213 Fluid Mechanics and CE 1002 Introduction to Civil Engineering. Structural engineering is covered in CE 3122 Structural Dynamics, CE 3133 Structural Analysis, CE 3143 Steel Design, CE 3163 Materials Engineering and CE 4183 Reinforced Concrete Design. The required environmental and water resources sequence includes CE 3223 Environmental Engineering I and CE 3243 Water Resources Engineering. Soils engineering is covered in CE 3153 Geotechnical Engineering. Transportation Engineering is introduced in CE 2323 Traffic Engineering I and CE 3343 Design of Traffic Facilities. Because the department also has a full undergraduate program in Construction Management, civil engineering students must select two construction engineering courses from an approved list. All students take the capstone course, CE 4184 Civil Engineering Design.

Design is covered in many of these courses, exposing students to design in various subdisciplines. An introduction to design is provided by EG1003 in the freshman year. Courses CE 3143, CE 3223, CE 3243, CE 3153, CE 3343 and CE 4183 all have significant design content. Most elective courses also have strong design components. All students must complete a 4-credit senior design project (CE 4814) during their senior year.

Thus, students have progressive design exposure in each program year.

Undergraduate elective courses are provided in structural, geotechnical, environmental, water resources, construction management and engineering. These allow students to gain significant depth in these areas. Selected students with sufficient grade-point averages may take beginning graduate courses in these areas. Special topics courses are provided in each major subdiscipline and are offered as needed.

Communication skills are emphasized throughout the curriculum. The humanities and social sciences portions of the curriculum focus strongly on developing writing and oral skills. The freshman engineering program also includes substantial emphasis on oral presentations and written report assignments. CE 1002 Introduction to Civil Engineering includes numerous written assignments and oral presentations and encourages discussion. All courses with associated laboratories require written laboratory or project reports; many design courses require formal submission of design reports, some with oral presentations. The senior design-project experience includes many oral and written progress reports and is formally presented and defended as part of final submission.

Humanities and social sciences courses also help students to understand the societal context of their profession. CE 1002 Introduction to Civil Engineering reinforces this understanding with specific civil engineering references and provides a focused treatment of professional ethics. These aspects are also highlighted in other civil-engineering curriculum courses.

OTHER REQUIREMENTS

The BS in Civil Engineering program has three additional requirements:

1. Because a sound foundation in Statics is essential to progress in civil engineering, students must achieve a grade of C or better in CE 2113 Statics to register for subsequent courses in the structures sequence: CE 2123 Mechanics of Materials, CE 3133 Structural Analysis, CE 3143 Steel Design, and CE 3183 Reinforced Concrete Design;
2. Since the capstone design course, CE 4814 Civil Engineering Design, requires a thorough understanding of all aspects of civil engineering, students must have a cumulative average of 2.0 or better in all civil engineering courses in order to enroll in it; and
3. To promote interest in professional registration, students must sit for the Fundamentals of Engineering (FE) exam, which is administered by the National Council of Examiners for Engineering and Surveying (NCEES). CE 4092 includes a 0-credit recitation that provides preparation for the exam. Students who are not legally eligible to hold a professional engineer's (PE) license are exempt from this requirement, but should still take CE 4092.

ACCREDITATION

The BS in Civil Engineering is accredited by the Accreditation Board for Engineering and Technology (ABET).

CURRICULUM

The curriculum for the BS in Civil Engineering is described in the tables that follow. Table 1 summarizes the curriculum and its requirements in subject-area categories. Table 2 summarizes elective courses in construction management, engineering and civil engineering. A typical four-year course of study for civil engineering majors is shown on the full-page chart at the end of this section.

TABLE 1: CURRICULUM FOR THE BS IN CIVIL ENGINEERING

Table on the following page.

TABLE 2: APPROVED CONSTRUCTION MANAGEMENT, ENGINEERING AND CIVIL ENGINEERING ELECTIVES

Construction Management and Engineering Electives

CE 1502	Leadership and Foundations of Construction Management
CE 2503	Construction of Modeling and Data Structures I
CE 2513	Construction Materials and Methods
CE 2523	Contracts and Construction Documents
CE 3503	Cost Estimating
CE 3513	Construction Scheduling
CE 3532	Site Planning, Layout and Design
CE 3541	Surveying
CE 3553	Non-Structural Building Systems
CE 3563	Construction Modeling and Data Structures II
CE 4503	Construction Engineering
CE 4513	Construction Project Administration
CE 4533	Construction Law

Civil Engineering Electives

CE 3313	Introduction to Transportation Systems
CE 3353	History of the NYC Transit System
CE 4033	Introduction to Urban Infrastructure Systems Management
CE 4043	Sustainable Cities
CE 4053	Biosoma: Environmental Design of the City of the Future
CE 4173	Foundation Engineering
CE 4193	Timber and Masonry Structures
CE 4333	Traffic Engineering II
CE 4253	Hydraulic Systems
CE 4273	Environmental Engineering II

Additional electives for CE undergraduates are available from courses in the Construction Management curriculum. Consult the Construction Management section of the catalog.

TABLE 1: CURRICULUM FOR THE BS IN CIVIL ENGINEERING

Area	No.	Title	Lec	Lab	Rec	Cr
MATHEMATICS						
	MA 1024	Calculus I	4.0	0.0	0.0	4.0
	MA 1124	Calculus II	4.0	0.0	0.0	4.0
	MA 1012	Linear Algebra	4.0	0.0	0.0	2.0
	MA 2132	Ordinary Differential Equations	4.0	0.0	0.0	2.0
	MA 2212	Data Analysis I	4.0	0.0	0.0	2.0
	MA 2222	Data Analysis II	4.0	0.0	0.0	2.0
		TOTAL				**16**
SCIENCES						
	CM 1004	General Chemistry for Engineers	3.0	2.0	1.0	4.0
	PH 1013	Mechanics	3.0	0.0	0.0	3.0
	PH 2021	Introductory Physics Lab I	0.0	1.5	0.0	0.5
	PH 2023	Electricity, Magnetism and Fluids	3.0	0.0	1.0	3.0
	PH 2031	Introductory Physics Lab II	0.0	1.5	0.0	0.5
	PH 2033	Waves, Optics and Thermodynamics	3.0	0.0	1.0	3.0
	Science	Basic Science Elective[2]	3.0	0.0	0.0	3.0
		TOTAL				**17**
GENERAL ENGINEERING, COMPUTER SCIENCE						
	EG 1001	Engineering and Technology Forum	1.0	0.0	0.0	1.0
	EG 1003	Introduction to Engineering and Design	1.0	3.0	2.0	3.0
	CS 1133	Engineering Problem Solving and Prog.	0.5	2.5	3.0	3.0
		TOTAL				7
HUMANITIES and SOCIAL SCIENCE						
	EN 1013W	College Writing Workshop	3.0	0.0	0.0	3.0
	HuSS 1023W	First-Year Writing Seminar	3.0	0.0	0.0	3.0
		Humanities and Social Sciences Electives[3] (6 courses)	3.0ea	0.0	0.0	18
		TOTAL				**24**
CIVIL ENGINEERING						
	CE 1002	Introduction to Civil Engineering	1.5	1.5	0.0	2.0
	CE 2113	Statics	3.0	0.0	1.0	3.0
	CE 2123	Mechanics of Materials	3.0	0.0	1.0	3.0
	CE 2213	Fluid Mechanics	2.5	1.5	0.0	3.0
	CE 2323	Traffic Engineering I	3.0	0.0	0.0	3.0
	CE 3122	Structural Dynamics	2.0	0.0	0.0	2.0
	CE 3133	Structural Analysis	3.0	0.0	1.0	3.0
	CE 3143	Steel Design	2.0	3.0	0.0	3.0
	CE 3153	Geotechnical Engineering	2.0	3.0	0.0	3.0
	CE 3163	Materials Engineering	2.0	3.0	0.0	3.0
	CE 3223	Environmental Engineering I	2.0	3.0	0.0	3.0
	CE 3243	Water Resources Engineering	3.0	0.0	0.0	3.0
	CE 3343	Design of Traffic Facilities	3.0	0.0	1.0	3.0
	CE 4092	Leadership, Business Principles, Policy and Ethics in Civil Engineering	2.0	0.0	3.0	2.0
	CE 4183	Reinforced Concrete Design	2.0	3.0	0.0	3.0
	CE 4814	Civil Engineering Design	3.0	3.0	0.0	4.0
	CE XXXX	Construction Management and Engineering Electives (See Table 2)				6.0
	CEE XXXX	Civil Engineering Electives (See Table 2)				6.0
	CE XXXX	Construction Management and Engineering or Civil Engineering Elective (See Table 2)				3.0
		TOTAL				**61**
FREE ELECTIVE		Free Elective[4]				3.0
		TOTAL CREDITS FOR DEGREE				**128**

Footnotes for Table 1

1. All students, except those who have earned a grade of 4 or 5 on the Calculus AB or BC AP Exam, take a mathematics placement examination. Students may be placed in an alternative course, which may not carry degree credit, based up the results of such placement examination. Students also may be advance-placed based upon AP or college math credit earned in high school. Students may substitute MA 1324, which includes two additional contact hours, for MA 1024.

2. Students may select a basic science elective from one of the following areas: biology, astrophysics and astronomy or geology and earth science.

3. Students must take six (6) elective courses in the humanities and social sciences. Consult the Technology, Culture and Society portion of the catalog for details. At least one humanities and social sciences elective must be a 3xxx/4xxx level course. At least one humanities and social sciences elective must be a writing-intensive course, labeled by "W."

4. A free elective is any course in any department of NYU-Poly for which the student has the prerequisites.

MINOR IN CONSTRUCTION MANAGEMENT

An undergraduate minor in Construction Management enhances the capability of students who may seek employment in the construction industry or who may be interested in studying Construction Management at the graduate level. The requirements for a minor in Construction Management are set forth in the Construction Management section of the catalog.

TRANSFER STUDENTS AND CREDITS

Potential transfer students should refer to the Institute guidelines in this catalog. The Department of Civil Engineering has established additional requirements and interpreted the Institute guidelines as indicated in this section.

The 128-credit curriculum is fulfilled by combining transfer credits, credits by examination and courses taken at NYU-Poly. Transfer credits in mathematics, chemistry, physics, humanities and social sciences are evaluated by the Office of Academic Affairs with faculty guidance from specific departments. Transfer credits in civil engineering and other technical areas are evaluated by the faculty of the Department of Civil Engineering.

The length of time for a transfer student to complete the BS in Civil Engineering depends upon three factors:

1. The total number of transfer credits awarded;
2. The particular courses required to complete degree requirements; and
3. Enrollment status (part-time or full-time).

Transfer Notes

Transfer students should understand that they can be awarded transfer credits for courses with a C grade or better and then only for courses that are applicable toward the BS in Civil Engineering as described in this catalog.

A residency requirement also must be fulfilled. To earn a BS, a student must complete a minimum of 30 credits at NYU-Poly at the junior or senior level (courses numbered CE 3XXX or CE 4XXX). These credits must include the design project, CE 4814.

PART-TIME STUDENTS

Students may register as part-time students (fewer than 12 credits a semester). Such students are advised, however, that the department does not offer many undergraduate courses in the evening and that part-time students must take most courses during the day. Part-time students should maintain close contact with their academic advisers to work out the details of course sequencing efficiently and effectively.

PREVIOUS CURRICULA

It is a generally accepted rule that students are subject to the requirements of the catalog in effect when they enrolled initially at NYU-Poly. In many cases, however, it will be easier to complete the current curriculum. Academic advisers work with students to make sure that they fulfill the proper requirements for graduation.

MASTER OF SCIENCE PROGRAM IN CIVIL ENGINEERING

The Master of Science in Civil Engineering allows students to specialize in one of the following six areas of concentration:

- Construction Management and Engineering
- Structural Engineering
- Geotechnical Engineering
- Environmental and Water Resources Engineering
- Urban Systems Engineering and Management
- Highway and Traffic Engineering

Students also may elect to follow a general program by taking two courses across several areas of concentration. The Department of Civil Engineering also offers graduate programs in transportation planning and engineering and transportation management (see the Transportation section in this catalog), environmental science and engineering (see Environmental Science and Engineering section in this catalog), construction management and engineering (see the Construction Management section of this catalog), and urban systems engineering and management (see Urban Systems Engineering and Management section in this catalog).

GOALS AND OBJECTIVES

The degree MS in Civil Engineering prepares graduates to practice their profession at an advanced level. Specific program objectives are to provide the skills and knowledge necessary to:

- Specialize in one of the primary subdisciplines of civil engineering or to achieve depth across a number of the subdisciplines;
- Design and analyze civil engineering infrastructure;
- Understand civil engineering materials, technologies and processes as applied to modern civil engineering infrastructure;
- Obtain civil engineering project management skills; and
- Provide a basis for continued, lifelong learning in the civil engineering profession.

ADMISSION

Students seeking admission to the MS program should hold a bachelor's degree in civil engineering from a program accredited by the Accreditation Board for Engineering and Technology (ABET) and have a 3.0 GPA or better. Applicants lacking a BS from an ABET-accredited program in civil engineering (including those possessing undergraduate degrees in other engineering disciplines, engineering science, engineering technology and architecture, or from a foreign university) have their qualifications reviewed by a graduate adviser. Admission may be granted and may include the requirement for additional undergraduate courses to correct deficiencies. These additional courses are not counted toward the MS degree, nor are undergraduate courses included in computing graduate grade-point averages.

Applicants from universities outside the United States should take the Graduate Record Examination (GRE advanced tests) and achieve a minimum grade of 700 on the quantitative section. They also must take the Test of English as a Foreign Language (TOEFL) and achieve a minimum grade of 550/213/79 (paper/CBT/IBT). In rare cases, the department head may waive the GRE and/or TOEFL after a graduate adviser examines the student's transcripts and interviews the candidate.

Foreign candidates who meet all other admission requirements but who fail to satisfy the TOEFL requirement may be required to take one or more remedial courses in English before admission.

GRADE REQUIREMENTS

To earn a MS degree from NYU-Poly, students must maintain a B average (3.0 GPA) or better in (1) all graduate courses taken at NYU-Poly, (2) all graduate courses taken in the Department of Civil Engineering and (3) all graduate guided studies (readings, project, thesis). Poor scholastic performance (under 3.0 GPA) may lead to a student being placed on graduate probation. If students' grades do not improve, they may be disqualified from further graduate study in the department. Students may repeat a course with their adviser's approval. When a course is repeated, only the later grade counts toward the GPA. If a course is repeated more than once, only the first grade is dropped from the GPA computation.

In the event that an applicant is required to take undergraduate prerequisite courses as a condition of admission, a grade of B- or better is required for every prerequisite course taken, and the cumulative GPA of all required prerequisite courses must be at least 3.0.

ADVISING

Students are responsible for following the departmental rules outlined in this catalog. While academic advisers consult with and advise students, students are responsible for ensuring that all degree requirements are fulfilled and for submitting all proper forms and applications.

Students must meet with an academic adviser when they first enroll. Students must have a detailed program of study formally approved by an academic adviser before registration.

The academic adviser also handle requests for waivers of certain degree requirements, where warranted. Such waivers must be in writing and must be entered into the student's departmental record. Where specific courses are waived, approval of the course instructor may also be required. When waivers are granted, students may be required to take other specific courses in their place or to select additional electives. Students registering for guided studies (readings, projects, theses) are assigned advisers for each such activity. To register for guided study, students must submit written proposals for the topic(s) to be covered to such advisers before registration. To register, students must obtain written approval of the project adviser and the academic adviser.

TRANSFER CREDITS

The residency requirement for the MS degree is 24 credits. Students may transfer up to 6 credits of acceptable courses toward a MS degree, subject to their academic adviser's approval. To be transferred, the course(s) must relate to the student's program and be from an accredited institution. A grade of B or better is required for granting of transfer credit. Courses graded on a pass/fail basis are not considered for transfer unless accompanied by a detailed written evaluation by the course instructor. All transfer requests must be accompanied by an official transcript from the transferring institution. Applications for transfer credits are accepted only after the student has earned 9 credits at NYU-Poly.

Validation credits by examination may not be used toward any civil engineering graduate degree program.

DEGREE REQUIREMENTS

All MS (Civil Engineering) students must complete either the single area of concentration or general program requirements as described in Table 3:

TABLE 3: AVENUES FOR OBTAINING MS (CIVIL ENGINEERING)

Students Selecting a Single Area of Concentration

Core Courses:	12 credits (min.)
Courses Within Concentration:	12 credits (min.)
Technical Electives:	6 credits

Students Selecting the General Program

Core Courses:	12 credits (min.)
Two Courses in each of 3 Concentration Areas:	18 credits (min.)
Credits Required for MS Degree:	**30 credits**

A. CORE COURSES: 12 CREDITS

Students must complete at least four of the following six core courses.

TABLE 4: CORE COURSES IN CIVIL ENGINEERING

Course #	Course Title	Credits
CE 6023	Materials Engineering for Civil Engineers	3
CE 6073	Instrumentation, Monitoring and Condition Assessment of Civil Infrastructure	3
CE 7673	Environmental Impact Assessment	3
CE 7843	Introduction to Urban Systems Engineering	3
CE 8253	Project Management for Construction	3
CE 8283	Risk Analysis	3

B. CONCENTRATION AREA COURSES: 12 to 18 credits

Students selecting a single area of concentration must complete: (1) at least one core course in their concentration area; and (2) at least four additional concentration area courses. The course requirements of various concentration areas are listed in Tables 3-8. All students must satisfy all course prerequisites.

C. TECHNICAL ELECTIVES: 0 to 6 credits

Depending upon the choice of a concentration, area, a student may have up to an additional 6 credits of course work, which may be satisfied from the following:

- Electives: Electives are normally selected from the courses given by the Department of Civil Engineering. However, electives may be selected from courses offered by other departments with written consent of the graduate adviser.
- Project: CE 9963 Project for the MS in Civil Engineering (3 credits).
- Thesis: CE 9976 Thesis for the MS in Civil Engineering (6 credits).

TABLE 5: GEOTECHNICAL ENGINEERING CONCENTRATION

Select at least four courses from:

CE 8423	Ground Improvement
CE 8663	Advanced Foundation Design
CE 8673	Excavation Support Systems
CE 8403	Geotechnics and Geomaterials
CE 8433	Urban Geotechnology
CE 8493	Environmental Geotechnology
CE 7233	Groundwater Hydrology and Pollution
CE 8603	Selected Topics in Geotechnical Engineering

TABLE 6: STRUCTURAL ENGINEERING CONCENTRATION

CE 6013	Theory of Structural Analysis
CE 6163	Finite Element Analysis
CE 6033	Selected Topics in Struct. Engineering I
CE 6043	Selected Topics in Struct. Engineering II
CE 6063	Bridge Engineering
CE 6133	Stability of Structures
CE 6143	Steel Structures
CE 6183	Concrete Structures
CE 6193	Wind and Earthquake Engineering

TABLE 7: CONSTRUCTION MANAGEMENT AND ENGINEERING CONCENTRATION

Graduate Construction Management and Engineering courses, including Exec 21 courses, listed are in the Construction Management section of this catalog.

TABLE 8: ENVIRONMENTAL/ WATER RESOURCES ENGINEERING CONCENTRATION

Select at least four courses from:

CE 7223	Hydrology
CE 7233	Groundwater Hydrology and Pollution
CE 7373	Environmental Chemistry and Microbiology
CE 7423	Water and Wastewater Treatment
CE 7353	Special Topics in Water Resource and Hydraulic Engineering
CE 7393	Advanced Environmental Chemistry and Microbiology
CE 7433	Advanced Water and Wastewater Treatment
CE 7453	Water and Wastewater Treatment Laboratory
CE 7473	Analysis of Stream and Estuary Pollution
CE 7533	Hazardous/Toxic Waste Management
CE 7703	Solid Waste Management
CE 7753	Environmental System Management
CE 8493	Environmental Geotechnology

TABLE 9: HIGHWAY AND TRAFFIC ENGINEERING CONCENTRATION

Select at least four courses from:

TR 6313	Traffic Control and Signalization I
TR 6323	Traffic Control and Signalization II
TR 6013	Fundamental Concepts in Transportation
TR 6023	Analytic Methods in Transportation
TR 6223	Intelligent Transportation Systems and Their Applications
TR 7033	Transportation Safety
TR 7123	Transportation Planning and Congestion Management
TR 7323	Design of Parking and Terminal Facilities
TR 7333	Design and Management of Arterial and Street Networks
TR 7343	Urban Freeways and Intercity Highways

TABLE 10: URBAN SYSTEMS ENGINEERING AND MANAGEMENT CONCENTRATION

Select at least four courses from:

CE 7813	Infrastructure Planning, Engineering and Economics
CE 7853	Concepts and Implementation of Infrastructure Management Systems
CE 6073	Instrumentation, Monitoring and Condition Assessment of Civil Infrastructure
CE 7753	Environmental Systems Management
CE 8713	Construction and the Law*
CE 8733	Infrastructure Financing: the Art of the Deal*
TR 6223	ITS and Their Applications

** Students must meet the requirements for enrollment in Exec 21 courses.*

DOCTORAL PROGRAM IN CIVIL ENGINEERING

The Department of Civil Engineering currently offers two doctoral degree programs: PhD in Civil Engineering and PhD Transportation Planning and Engineering. Requirements for the Civil Engineering degree are detailed here. For information on the Transportation Planning and Engineering program, see the "Transportation" section of this catalog.

GOALS AND OBJECTIVES

The PhD in Civil Engineering is research-oriented and intended for those whose goal is a career in civil engineering research and/or teaching at the university level or in private research organizations. Specific doctoral-program objectives are to develop the skills and knowledge necessary to:

- Specialize within one of the subdisciplines of civil engineering;
- Perform independent fundamental research in one of the subdisciplines of civil engineering;
- Produce a piece of fundamental research that advances meaningfully the state of the art of one of the subdisciplines of civil engineering and is publishable in a first-tier refereed civil engineering–related journal.

A PhD is granted for the invention or creation of new knowledge in civil engineering. This knowledge may result from analytical, numerical or experimental research. The knowledge may be practical or fundamental in nature.

AREAS OF CONCENTRATION

Students pursuing the PhD in Civil Engineering must choose to specialize in one of the following subdisciplines of civil engineering:

- Structural Materials and Engineering
- Geotechnical and Geo-environmental Engineering
- Environmental and Water Resources Engineering
- Construction Management and Engineering
- Highway and Traffic Engineering
- Urban Infrastructure Systems Engineering and Management

Other focus areas are possible and can be developed with the assistance of faculty advisers. All subject areas must be relevant to the degree sought, and a faculty member must be willing and able to guide the student's research.

PROGRAM ADMINISTRATION

The Department of Civil Engineering has five graduate program coordinators:

- Graduate Program Coordinator for Civil Engineering (MS and PhD)
- Graduate Program Coordinator for Environmental Engineering/ Environmental Science (MS)
- Graduate Program Coordinator for Urban Systems Engineering and Management (MS)
- Graduate Program Coordinator for Transportation (MS and PhD)
- Graduate Program Coordinator for Construction Management and Engineering (MS)

The graduate coordinators form the departmental Graduate Committee. The Committee reviews all PhD applications and makes admissions decisions, which are implemented by a graduate coordinator. For each registration, the student's program must be approved by the academic adviser and signed by the graduate coordinator.

ADMISSION CRITERIA

1. Admission to the PhD in Civil Engineering requires an MS in Civil Engineering or equivalent with a GPA of 3.5 or better (on a 0-4 scale).
2. Applicants to the PhD programs are not required to take the Graduate Record Examination (GRE); however, it is encouraged. If the GRE is taken, the applicant must submit the results for consideration.
3. Foreign applicants must take the TOEFL examination and submit the results for consideration.

In criteria 1 and 2 above, the "equivalent" can be achieved in several ways. The candidate may have a MS degree with a different title that covers substantially the same material. In more general terms, the applicant must demonstrate that he or she has the equivalent of all undergraduate and master's-level course work to be able to pursue doctoral-level work in the chosen major area, as well as in a minor area within the umbrella of civil engineering. Further, "equivalence" is evaluated based on the totality of the student's undergraduate and graduate record, not course by course. Thus, an applicant who wishes to pursue doctoral work in Environmental Engineering, for example, must have the entire undergraduate and master's-level course background expected in Environmental Engineering, but need not demonstrate such a background in structures. Because admission to a PhD program requires a relevant MS (or equivalent), an applicants who has not yet earned a master's degree will be admitted as MS students and is expected to earn a MS degree while completing the major and minor course

requirements. In rare cases, an applicant with only a BS degree may be directly admitted into the PhD program with the written approval of the department head.

Doctoral Program of Study

Every PhD student upon admission is assigned an academic adviser, who is designated by the department head. Any member of the civil engineering faculty may be an academic adviser to a PhD student. The first meeting should take place shortly after receiving an acceptance letter from the Admissions Office. During this first meeting the student's Program of Study should be established. The Program of Study should include a list of the fundamental and advanced topics that will comprise the specific courses, the subject matter for the qualifying exam and possible research areas.

In cases where a student is supported on a research contract, the principal investigator of the contract will normally be the student's academic adviser. Where a student has a particular research interest and is working with a particular faculty member, the student may request that faculty member for his or her academic adviser. In rare cases, when a PhD student enters the program without a prior selection of a major area of study, the initial academic adviser will be the graduate coordinator of the program area. Each PhD candidate reports to two advisory committees: an Academic Advisory Committee and a Dissertation Committee.

ACADEMIC ADVISORY COMMITTEE

The student's academic adviser plans a program to fulfill major and minor requirements for the PhD degree. The Academic Advisory Committee generally consists of the academic adviser and one faculty member for each minor area of study. The Academic Advisory Committee guides the PhD student's work through the successful completion of a qualifying examination. A letter signed by the academic adviser and approved by the department head is placed in the student's file indicating the composition of the Academic Advisory Committee.

DOCTORAL DEGREE REQUIREMENTS

To earn a doctoral degree in Civil Engineering, the following requirements must be met:

1. 54 credits of graduate course work (not including the PhD dissertation) in relevant major and minor areas of study beyond the bachelor's degree, with an average grade of B or better (cumulative average of 3.0 or better on a 0-4 scale). Up to 6 credits of the 54 credits may be satisfied by individual guided studies, readings, projects and theses.
2. Completion and successful defense of a 21-credit dissertation related to the major area of study. Dissertations must consist of original research that meaningfully advances the state of the art in the research subject area and should result in the publication of at least one paper in a strictly peer-reviewed technical journal related to the subject. A grade of B or better must be achieved for the dissertation. There are two types of dissertation credits:
   - CE 9998: Independent original investigation demonstrating creativity and scholarship worthy of publication in a recognized engineering journal. Registration for a minimum of 6 credits is required before registering for CE 9999.
   - CE 9999: Independent original investigation demonstrating creativity and scholarship worthy of publication in a recognized engineering journal. Candidates must successfully defend dissertations orally. Registration for 3 to 6 credits per semester is permitted after successfully completing the doctoral qualifying examination, but a minimum of 12 credits must be completed before the defense. Registration must be continuous (excluding summer semesters), unless a formal leave of absence is requested and approved. Registration for 3 to 12 credits per semester is permitted. In the final semester of work, registration for credit is permitted with the approval of the department head. *Prerequisites: CE 9998 (6 credits), degree status, successful completion of doctoral qualifying examinations and approval of the dissertation adviser.*
3. Completion of two minor areas of study, as follows:
   - Out of Department Minor: Completion of 9 credits of graduate or undergraduate course work in one or two technical areas of study.
   - In-Department Minor: Completion of 6 credits of graduate course work in a minor area outside the major subdiscipline in civil engineering.
4. Residency requirements for the PhD in Civil Engineering include the 21-credit dissertation plus a minimum of 15 credits of applicable graduate course work taken at NYU-Poly.
5. In satisfying the 54-credit course requirement (requirement 1), the student must satisfy all requirements for the major and minor areas selected, or their equivalents.
6. In satisfying these basic PhD requirements, students also must satisfy one of the two following conditions:
   a) 48 credits of relevant graduate course work, not including individual guided studies (readings, projects, theses, etc.) beyond the bachelor's degree, with an average grade of B or better (cumulative average of 3.0 or better on a 0-4 scale).
   b) 24 credits of approved graduate course work, not including individual guided studies (readings, projects and theses) beyond the master's degree, with an average grade of B or better (cumulative average of 3.0 or better on a 0-4 scale). Satisfying condition 2 requires that the department accept the student's MS degree in toto without regard to its specific content. This acceptance requires a recommendation from the department's Graduate Committee and department head approval.
7. Although publication is not required as a condition for graduation at this time, journal publication is strongly encouraged. Every PhD candidate is expected to generate knowledge worthy of publication in two or more reputable journals.

TRANSFER CREDITS

A maximum of 39 credits of approved graduate work may be transferred. Transfer credits for PhD students may be awarded on a course-by-course basis or by the transfer of a MS degree from another institution in satisfaction of 30 graduate credits. The latter requires a recommendation from the department's Graduate Committee and the approval of the department head. Transfer credits are generally awarded at the time of admission and must be approved by the academic adviser, the graduate coordinator and the department head.

QUALIFYING EXAMINATIONS

A student must register for RE 9990 PhD Examination in the semester in which the qualifying exam will be taken. This course carries no credit, and the student incurs no fees. It provides a place in the student's official transcript to record when the qualifying exam was taken and the result.

Every student pursuing a PhD must pass a qualifying examination before becoming a candidate for the PhD. The qualifying examination consists of a six-hour written portion (generally given in two three-hour blocks on the same day), and an oral portion which may be given before or after the written portion. Both written and oral portions focus on fundamental and advanced civil engineering topics relevant to the student's specific program of study.

The oral portion may also explore specific skill areas required to conduct successful independent research. Students are deemed to have passed the examination based upon an overall evaluation of both the written and oral portions of the examination.

The qualifying examination is a pass/fail milestone in the PhD process. A letter indicating the result of each examination is placed in the student's graduate file. In rare cases, a student may be deemed to have conditionally passed the qualifying exam.

This may occur when the student does extremely well in all but one area. Such a student must follow a prescribed plan to strengthen his or her knowledge and skills in the weak area and pass a special examination in the weak area within one calendar year. A student who conditionally passes the qualifying exam may register for dissertation credits and may form a Dissertation Committee.

While each student will take a different qualifying examination based upon an individual program of study, the exam is considered a departmental examination. All department faculty members in each civil engineering sub-discipline may participate in submitting written problems. Each student's academic advisory committee will review the entire exam before it is administered, and may suggest changes if it deems the examination, as presented, tp be an inequitable test of the student's abilities. Recommendations on examination results are submitted by each student's Academic Advisory Committee. The departmental faculty, acting as a whole, votes to accept or reject such recommendations at a meeting scheduled for this purpose. Additionally:

1. According to NYU-Poly policy, students should take the qualifying exam within their first year of study at NYU-Poly.
2. A student may take the qualifying exam twice. A third attempt is permitted only with written permission from the Academic Advisory Committee and the approval of the department head. Under no circumstances may a student take the examination more than three times.
3. No student may register for CE 999X Dissertation credits until passing the qualifying exam.
4. A Dissertation Committee cannot be formed until the student passes the qualifying exam.
5. Any student who cannot pass the qualifying exam will be disqualified from the program.

Dissertation Committee

A Dissertation Committee is formed immediately after a student passes the qualifying exam to guide the student's course of study and research work. This committee will serve as a panel of experts to aid the candidate throughout his or her research.

The Dissertation Committee shall have no less than five members, including a chairperson, a major adviser, and an adviser for each minor the student is pursuing, one of whom must be on the faculty in another NYU-Poly department. One external member who is either a faculty member at another academic institution or a noted PhD-level practitioner is encouraged. Additional faculty members may also serve on the Dissertation Committee.

The members of the Academic Advisory Committee may also serve on the Dissertation Committee. The membership of the Dissertation Committee must be approved by the department head and recorded with the Office of Graduate Academics.

The major adviser, who may also serve as chairperson, must be a full-time faculty member of the Department of Civil Engineering.

Dissertation Proposal

Upon passing the qualifying exam and the appointment of a Dissertation Committee, the PhD candidate must submit a written Dissertation Proposal outlining the subject of the proposed research. This proposal should be 15 to 20 pages long and should address the following specific items:

1. Description of the topic;
2. Literature review sufficient to ensure original work;
3. Method(s) for the research;
4. Data and/or laboratory needs and their availability; and
5. Anticipated outcomes.

Dissertation Committee

The Dissertation Proposal must be submitted within one semester of full-time study after passing the qualifying exam, or before 9 credits of dissertation credit are completed.

The Dissertation Proposal is presented orally and defended before the Dissertation Committee and other interested departmental faculty. The date of the oral defense and copies of the draft Dissertation Proposal must be available to departmental faculty at least two weeks (14 calendar days) before the defense.

When the Dissertation Proposal is formally accepted and defended successfully, the chairperson of the Dissertation Committee shall enter a letter into the student's graduate file, indicating this acceptance, together with a copy of the Dissertation Proposal. While the Dissertation Committee has reasonable flexibility to modify the Dissertation Proposal during the research, any significant change in focus area or methodology requires submission of an amended Dissertation Proposal and formal acceptance as described herein.

DISSERTATION DEFENSE

The culmination of the student's PhD work is the oral presentation and defense of the final draft dissertation. A defense is generally scheduled after the Dissertation Committee reviews the draft dissertation and determines that it is complete and of sufficient quality to be presented and defended.

The defense is organized and scheduled by the Dissertation Committee. All Institute faculty members may observe and ask questions at all NYU-Poly dissertation defenses. Therefore, the date of the defense must be announced Institute-wide at least one month before the event, and copies of the draft dissertation must be available to any faculty member who requests one in a timely fashion and in no case less than two weeks before the defense.

UNDERGRADUATE COURSES

GENERAL COURSES

CE 1002 Introduction to Civil Engineering *1.5:1.5:0:2*

This course introduces the student to the profession and practice of civil engineering. The course has four primary components: (1) a review of the principal subdisciplines of civil engineering and their relationship to urban and regional infrastructure; (2) a review of professional ethics and the responsibilities of engineers to their profession and to the general public, which includes a detailed study and discussion of the American Society of Civil Engineers (ASCE) and National Society of Professional Engineers (NSPE) codes of practice, and the use of case studies for illustration and discussion; (3) the use of AutoCAD as a tool for computer-based drawings, and the use of spreadsheets to develop analytic algorithms to solve simple engineering problems; and (4) an introduction to the use of GIS. The course includes a laboratory on the use of AutoCAD, as well as on GIS. Each laboratory is 6-7 weeks long.

CE 4033 Introduction to Urban Infrastructure Systems Management *3:0:0:3*

This course provides students with an overview of key issues involved in the planning, management, operations and maintenance of urban infrastructure systems, including transportation, water supply, power, communications and information systems. It includes elements of engineering and technology, management, economics, finance, regulatory and public policy that have an impact on the sustainable development of the urban environment. The course features several distinguished guest lecturers from infrastructure industries and public agencies who share significant case studies with students. The course includes a component on GIS, with a focus on how to collect, integrate and share spatial data in urban infrastructure management. Group projects are required.

CE 4043 Sustainable Cities *3:0:0:3*

The course provides an overview of issues that need to be addressed to make a city sustainable, beginning with a definition of what is intended by the concept of sustainability and a discussion of what is the essence of a city. Students are asked to become familiar with the major challenges in making a city sustainable, and to provide, as part of their homework, a paper addressing a topic covered by the course through research and, where necessary, proposed solutions.

CE 4053 Biosoma – Environmental Design of the City of the Future *3:0:0:3*

The goal of this course is to improve the engineering design of a city and its components. The course focuses on the city as an entity that concentrates living organisms, societal organizations and activities and machines, interacting with the environment both outside and inside the city. A number of essential questions about the future of cities will be examined, such as: (1) what does urbanization mean for the future of humankind in terms of resources, capabilities, ideologies and culture? (2) How can the design of cities affect their future? (3) What should be the role of the engineer? (4) How can the engineer of the future be prepared for that role? (5) What critical engineering interventions are needed to influence the future of today's cities? Each student will select a project that deals with some aspects of the course and present its results to the class.

CE 4092 Leadership, Business Principles, Policy and Ethics in Civil Engineering *2:0:3:2*

This course is in seminar form and is required of all senior students in Civil Engineering. It focuses on various aspect of professional practice in civil engineering, and it augments and enriches the student's educational experience, including the capstone design course. Topics include professional roles and responsibilities, professional registration and its importance, continuing education, engineering ethics, procurement of work, competitive bidding, quality-based selection processes and construction management. Students are also introduced to the design and construction processes used by federal, state and local agencies, as well as private owners. The course includes a no-credit recitation that prepares students for the Fundamentals of Engineering (FE) examination, which Civil Engineering students must take before graduation. *Prerequisite: Senior status or permission of instructor.*

STRUCTURAL AND GEOTECHNICAL ENGINEERING

CE 2113 Statics *3:0:1:3*

This course covers: Vector treatment of static and dynamic equilibrium of particles and rigid bodies; equivalent forces and couple systems; distributed forces; static analysis of determinate trusses, frames and machines; friction; centroid and center of gravity, and moment of inertia. *Co-Requisite: PH 1013 or equivalent.*

CE 2123 Mechanics of Materials *3:0:0:3*

This course introduces basic principles of stress and strain in axial loading, shear, torsion and bending, along with principles of transformation of stress for design. Laboratory experiments provide hands-on experience. *Prerequisites: PH 1013 and CE 2113 or equivalents.*

CE 3122 Structural Dynamics *2:0:0:2*

This course covers: Three-dimensional treatment of the kinetics of particles and rigid bodies using various coordinate systems; Newton's law, work, energy, impulse and momentum; and an introduction to dynamics of one, two and multi-degree of freedom systems, with and without damping. *Prerequisite: CE 2113 or equivalent. Co-requisite: CE 3133 or equivalent.*

CE 3133 Structural Analysis *3:0:1:3*

This course offers in-depth coverage of structural analysis techniques. Topics: analysis of statically determinate structures; deflection calculations using energy methods; analysis of statically indeterminate structures using superposition; influence lines; and slope deflection, moment distribution and matrix analysis of structures. Computer applications are included. *Prerequisites: MA 2012 and CE 2123; or CE 2113 with a grade of B+ or better.*

CE 3143 Steel Design *2:3:0:3*

This course examines structural design principles and techniques. Topics: Design of steel tension members, beams and columns; design of beam-columns; and design of bolted and welded connections for steel design. The course includes a design laboratory in which students, working in groups, develop design projects. *Prerequisite: CE 3133 or equivalent.*

CE 3153 Geotechnical Engineering *2:3:0:3*

This course covers: Introduction to soil mechanics and foundation engineering, including origin of soils; phase relationships; classification of soils; permeability; effective stress; seepage; consolidation; shear strength; slope stability; and bearing capacity. *Prerequisites: CE 2123 and CE 2213 or equivalents.*

CE 3163 Materials Engineering *2:3:0:3*

This course covers the mechanical behavior and durability of structural materials. Properties of steel, concrete, wood, asphalt and fiber composites are discussed. Material processing, optical metrology and stress analysis laboratories are conducted by students working independently and in groups on material preparation and evaluation topics. *Prerequisite: CE 2123 or equivalent.*

CE 4173 Foundation Engineering *2:3:0:3*

This course introduces the development of foundation engineering, including: site exploration; soil sampling; interpretation of boring logs; bearing capacity of footings; settlement of structures; lateral earth pressure; design of retaining walls, braced excavations and sheet pile walls; and design of deep foundations. *Prerequisite: CE 3153 or equivalent.*

CE 4183 Reinforced Concrete Design *2:3:0:3*

This course offers a detailed treatment of reinforced concrete design: Material properties, American Concrete Institute (ACI) load factors and design strength; shear and diagonal tension in beams; reinforced concrete columns; two-way slabs; footings; shear walls; and torsion. *Prerequisite: CE 3133 or equivalent.*

CE 4193 Timber and Masonry Structures *3:0:0:3*

This course covers: Properties and classification of structural lumber; design of timber connectors; design and construction of residential and industrial timber buildings; beams, frames, columns and trusses of sawn lumber and glued laminated construction; manufacture and properties of concrete masonry units; properties of mortar and grout; and design and construction of load-bearing, reinforced and unreinforced masonry structural elements. *Prerequisite: CE 3143 or equivalent.*

ENVIRONMENTAL AND WATER RESOURCES ENGINEERING

CE 2213 Fluid Mechanics and Hydraulics *2.5:1.5:0:3*

This course examines the basic principles of fluid mechanics with beginning applications to hydraulic design. Topics include fluid properties, fluid statics, elementary fluid dynamics and Bernoulli equation, continuity, energy and momentum equations and fluid kinematics. Additional topics are laminar and turbulent flow, boundary layer characteristics, drag and lift concepts (flow over immersed bodies), dimensional analysis and fluid measurements. *Prerequisite: CE 2113 or equivalent.*

CE 3223 Environmental Engineering I *3:3:0:3*

This course introduces water and wastewater treatment. Topics: Stream assimilation and public health; introduction to air pollution and solid waste management; and laboratory analysis of water and wastewater samples and treatment process tests. *Prerequisite: CE 2214 or equivalent.*

CE 3243 Water Resources Engineering I *3:0:0:3*

This course provides a detailed overview of water resources engineering, including both analysis and design elements. Topics covered: open-channel flow; pipe networks; reservoir balances; hydrologic techniques; surface water and ground-water supplies; water demand; and development of water resources for multiple purposes. *Prerequisite: CE 2213 or equivalent.*

CE 4253 Hydraulic Systems *3:0:0:3*

The application of basic principles of fluid mechanics and water resources in hydraulic engineering and design. Topics covered include: laminar and turbulent flow; boundary layer characteristics; subcritical and super critical flow; applications to pipe and open channel flow; pipe networks; hydraulic machinery and structures; river and canal systems and flood plains; safety; and reliability issues. *Prerequisite: CE 3243 or equivalent.*

CE 4263 Environmental Geotechnology *2:3:0:3*

This course benefits students who are entering the consulting industry. It is difficult to separate environmental and geotechnical concerns in the urban environment. This course teaches students what environmental concerns to expect when planning construction projects, investigating sites and overseeing construction. The course covers methods for addressing these concerns. Topics covered include clay mineralogy, soil/water/contaminant interactions, interfacial tension and capillarity and remediation techniques. *Prerequisite: CE 3153 or equivalent.*

CE 4273 Environmental Engineering II *3:0:0:3*

This course offers detailed coverage of water and wastewater treatment unit operations and includes a laboratory on processes and process design. Experiments are performed to evaluate laboratory-scale conventional water and waste treatment processes. Lectures cover detailed theory, design and advanced concepts. *Prerequisites: CE 2213 and CE 3223 or equivalents.*

HIGHWAY AND TRANSPORTATION ENGINEERING

CE 2323 Traffic Engineering I *3:0:0:3*

This course introduces the profession of traffic engineering and its components. The characteristics of road users, vehicles, highways and control devices and their impact on traffic operations are discussed. Quantification of traffic stream characteristics is treated in detail. The design and use of traffic control devices is covered, including a detailed treatment of traffic signal timing and design for both pre-timed and actuated signals. Coordination of signal systems on arterials and in networks is treated. A broad overview of highway traffic safety issues, policies, programs and mitigation measures are included. *Prerequisite: Sophomore status or permission of instructor.*

CE 3313 Introduction to Transportation Systems *3:0:0:3*

This course focuses on the fundamental conceptual elements of transportation systems and describes the approaches used to analyze and design transportation systems. The course covers the basic material about transportation systems, the context within which they operate and a characterization of their behavior. *Prerequisite: Junior status.*

CE 3343 Design of Traffic Facilities *3:0:1:3*

This course introduces the design of traffic facilities with emphasis on highway design. Students will be introduced to the basic design concepts of horizontal and vertical alignment, superelevation and cross-section design. The course also covers fundamentals of intersection and interchange design, pavement design, design of parking facilities, as well as bikeway and walkway design. Lectures are supplemented by a design laboratory. *Prerequisite: CE 2323, or equivalent, or permission of instructor.*

CE 3353 A History of the NYC Transit System *3:0:0:3*

This course traces the technological history of public transportation in New York City and investigates its role in the development of the city, its economy and its social fabric. From the early days of horse-drawn public carriages to the modern subway system, the role of the public transit in the historical development patterns of New York City is treated. The course covers trolley systems, the age of the elevated railways and the subway system. Political, social and economic issues involved in the development of these critical infrastructures are discussed. Students develop independent project reports on aspects of the NYC public transit system, or on public-transit systems in other major world cities. *Prerequisites: Junior status.*

CE 4333 Traffic Engineering II *3:0:0:3*

This is a second semester traffic engineering course for undergraduate students. It focuses on highway capacity and level of service analysis on uninterrupted and interrupted flow facilities. Additional analysis of signalized and unsignalized intersections is included using current computer software packages. Facility types include freeways, freeway weaving areas and ramp junctions, rural and suburban multilane highways, two-lane rural highways, suburban and urban arterials and intersections. *Prerequisite: CE 2323 or permission of instructor.*

CONSTRUCTION MANAGEMENT AND ENGINEERING

All course descriptions for Construction Management and Engineering are found in the "Construction Management" section of this catalog.

SELECTED TOPICS, READINGS AND PROJECTS

CE 4613 Selected Topics in Structural and Geotechnical Engineering *3:0:0:3*

This course discusses unique topics of current interest in structural and geotechnical engineering. The course may feature a detailed look at a single topic or a series of focused topical presentations. *Prerequisite: Adviser's approval.*

CE 4623 Selected Topics in Environmental and Water Resources Engineering *3:0:0:3*

This course examines unique topics of current interest in environmental and water resources engineering. The course may feature a detailed look at a single topic or a series of focused topical presentations. *Prerequisite: Adviser's approval.*

CE 4633 Selected Topics in Transportation Engineering *3:0:0:3*

This course explores unique topics of current interest in transportation engineering. The course may feature a detailed look at a single topic or a series of focused topical presentations. *Prerequisite: Adviser's approval.*

CE 4643 Selected Topics in Construction Management *3:0:0:3*

This course covers unique topics of current interest in construction management. The course may feature a detailed look at a single topic or a series of focused topical presentations. *Prerequisite: Adviser's approval.*

CE 4710 Readings in Civil Engineering *variable credit (1-4)*

These readings in subjects related to the civil engineering curriculum are individually guided. Topics arise from a regular course and must extend and transcend material covered in the traditional curriculum. Students need prior approval of the instructor with whom he or she is to work and a topic approved by that instructor before registering for a readings course. Such courses require a written report on the subject of the student's readings before a grade is given. A student may take this course more than once.

CE 4814 Civil Engineering Design *3:3:0:4*

This is the senior Capstone design experience in civil engineering. A project (or projects) involving integration of the civil engineering sub-disciplines is described and presented. Working groups are established. All groups may work on a single project or several may be prescribed, depending upon the semester. Lectures cover project details and present specific design applications that may not have been included in other courses. Each group must submit a full design report and present it orally. *Prerequisites: CE 3143 and CE 3153 or equivalents. Co-requisites: CE 3223 and CE 3243 or equivalents.*

GRADUATE COURSES

CORE COURSES

CE 6023 Materials for Civil Engineers *3:0:0:3*

This course covers: Materials composition and production of cementitious materials; polymeric composites and metals; mechanical properties subject to short-term and long-term loads, impact and fire; fatigue and fracture; transport properties, chemical degradation and long-term durability. *Prerequisite: Graduate Status.*

CE 6073 Instrumentation, Monitoring and Condition Assessment of Civil Infrastructure *3:0:0:3*

This course covers: A systematic approach to planning and executing instrumentation, monitoring and condition assessment programs; strain measurements; civil engineering sensors (static, dynamic, optical); environmental measurements; mechatronic sensors; signal conditioning, information measurements and error analysis; business aspects; advanced-measurement systems.

CE 7673 Environmental Impact Assessment *3:0:0:3*

This course examines legal and technical requirements in preparing environmental-impact statements. Considerations include legal and technical requirements, the procedure and the interdisciplinary nature of the analysis. Topics include overall impact evaluation, categories of impacts, problem definition, quantification of impact, methods used in analysis, field evaluations, mitigations, hearing procedures and management. Practical examples and case studies are used.

CE 7843 Introduction to Urban Systems Engineering *3:0:0:3*

This course provides a descriptive overview of key infrastructure systems and technologies that must be managed, operated and maintained. Systems treated include buildings and structures, water supply, solid and liquid waste handling and disposal, transportation, power, communications and information systems, health and hospitals, police and pre-protection. The course explores the financial, political, administrative, legal and institutional settings of these systems and technologies. A portion of the course features distinguished guest lecturers who are experts in some of the systems and technologies included.

CE 8253 Project Management for Construction *3:0:0:3*

This course covers topics specific to developing and coordinating large projects, including organizational structures, management functions, pricing and estimating project costs, bidding and contracting, risk allocation, scheduling, time and cost control, labor relations, quality management and project life-cycle activities. *Also listed under MG 8253.*

CE 8283 Risk Analysis *3:0:0:3*

This course investigates the ever-rising importance of risk analysis in project management. Topics: Analysis of qualitative and quantitative risk; techniques in probability analysis, sensitivity analysis, simulation of risk and utility theory; and computational methods for calculating risk. Students are exposed to the complexity of real-world corporate and public problems through case investigations.

CONSTRUCTION MANAGEMENT AND ENGINEERING

For courses in this area, consult the MS in Construction Management section of this catalog.

ENVIRONMENTAL AND WATER RESOURCE ENGINEERING

CE 7223 Hydrology *3:0:0:3*

This course covers: Hydraulic cycle; meteorological considerations; analysis of precipitation, runoff, unit hydrographs, flood routing and reservoir storage; principles of groundwater hydrology; and an introduction to frequency analysis of floods and droughts. *Prerequisites: Adviser's approval and MA 1124 and CE 2213 or equivalents.*

CE 7233 Groundwater Hydrology and Pollution *3:0:0:3*

This course looks at the characteristics of confined and unconfined flow of water through porous media; groundwater and well hydraulics; quality of groundwater; environmental influences; groundwater pollution; management aspects of groundwater and groundwater modeling. *Prerequisite: CE 2213 or equivalent, or instructor's permission.*

CE 7353/ CE 7363 Selected Topics in Water Resources and Hydraulic Engineering I / II *3:0:0:3*

This course examines topics of current interest in water resources and hydraulic engineering. Topics vary with each offering and are disseminated before the semester of offering. *Prerequisite: Instructor's permission.*

CE 7373 Environmental Chemistry and Microbiology *1.5:1.5:0:3*

This course introduces the chemistry and microbiology of polluted and natural waters, including applications of principles developed.

CE 7393 Advanced Environmental Chemistry and Microbiology *3:0:0:3*

This course explores advanced topics in chemistry and microbiology of polluted and natural wastewater treatment. *Prerequisite: CE 7373 or equivalent.*

CE 7423 Water and Wastewater Treatment *3:0:0:3*

This course covers the physical, chemical and biological principles of process design and treatment of water and wastewater. Topics include aeration, filtration, softening, chemical treatment, coagulation, occulation, desalination, and taste and odor control. *Co-requisite: CE 7373.*

CE 7433 Advanced Water and Wastewater Treatment *3:0:0:3*

This course covers further the processes discussed in CE 7423. Topics include sedimentation, adsorption, aerobic and anaerobic biological treatment, sludge treatment and disposal. *Prerequisite: CE 7423. Co-requisite: CE 7393.*

CE 7453 Water and Wastewater Treatment Laboratory *1:2:0:3*

This laboratory course covers processes in water and wastewater engineering, dealing with physical, chemical and biological methods and principles. Processes include disinfection, softening, sedimentation, oxygen transfer, coagulation, adsorption, filtration and aerobic and anaerobic biological treatment systems and Warburg analysis of waste. *Co-requisite: CE 7433.*

CE 7463 Industrial Waste Treatment *3:0:0:3*

This course explores sources of industrial wastewaters and their treatability by physical, chemical and biological processes. Topics: Problems and solutions involved in combining municipal and industrial waste treatment; and status of government regulations imposed on industries in prevention of water pollution.

CE 7473 Analysis of Stream and Estuary Pollution *3:0:0:3*

This course covers dispersal and decay of contaminants introduced into lakes, streams, estuaries and oceans, and the effects of pollutants on chemical quality and ecology of receiving waters.

CE 7513 Environmental Health Engineering *3:0:0:3*

This course covers theory, methodology and instrumentation associated with environmental health. Topics include epidemiology, food vectors, radiation, pest control, heating, ventilation, noise, illumination, hazards of home and community environment and other subjects affecting public health.

CE 7523 Air Pollution *3:0:0:3*

This course discussed the causes and effects of air pollution, methods of sampling, interpretation of data, meteorological aspects and methods of air-pollution control.

CE 7533 Hazardous/Toxic Waste Management *3:0:0:3*

This course looks at methods in the management of hazardous/toxic waste sites. Topics covered include health and safety, legal aspects, contamination of the environment, treatment processes and toxicology and risk assessment.

CE 7543 Site Remediation *3:0:0:3*

This course covers: treatment and disposal technologies for hazardous waste site remediation; in-situ and ex-situ processes; physicochemical processes, stabilization and solidification; biological processes, including aerobic and anaerobic systems for degradation and detoxification; thermal processes and incineration; and storage, land disposal and containment. Remediation planning and technology selection for hazardous waste containment and clean up for typical case studies are examined. The study of decision-making and technology selection is a key course component. *Prerequisite: CE 3153 or equivalent.*

CE 7553 Environmental Toxicology *3:0:0:3*

This course stresses basic concepts essential to understanding the action of exogenous chemical agents on biological systems. The course covers principles of absorption and the effects of chemical agents on metabolism. The pathways of metabolism of these compounds and the principles of elimination from biological systems are discussed. The course includes discussion of toxicokinetics, types of toxic responses and the current experimental methods of toxicity.

CE 7563 Environmental Law *3:0:0:3*

This course presents legal principles and issues relating to environmental law. Historical perspectives and case laws will be considered. Topics include the Clean Water Act, nonpoint sources and water quality laws, the Clean Air Act and its amendments, the National Ambient Air Quality Standards and the National Environmental Policy Act. The above legislation and its impact on policy and technology also will be considered.

CE 7583 Air Pollution Engineering Control *3:0:0:3*

Topics include: Pollutant emissions control; analysis of pollutant properties, concentrations and boundary conditions; absorptive and reactive recovery processes for moving and stationary sources; and formation and removal

of gaseous oxides (NO, SO, CO, etc.) and of aerosols and other particulates. *Prerequisite: Adviser's approval.*

CE 7703 Solid Waste Management *3:0:0:3*

This course covers engineering aspects of solid waste collection, transport and disposal, including incineration, sanitary landfill, composting, recovery and reutilization. Also covered is the economic evaluation of factors affecting selection of disposal methods.

CE 7713/ CE 7723 Selected Topics in Environmental and Water Resources Eng I/II *3:0:0:3*

This course explores nitrification in natural and treated waters, hazardous and toxic wastes, organic removal from water supplies, water reuse, specialized aspects of biological wastewater treatment, environmental health, solids disposal, modeling natural waters and treatment systems, hydro-economic models, finite-difference and finite-element models, synthetic hydrology and desalinized and recycled-water systems. *Prerequisite: Instructor's permission.*

GEOTECHNICAL AND GEOENVIRONMENTAL ENGINEERING

CE 8403 Geotechnics and Geomaterials *3:0:0:3*

This course examines index properties of soil, mechanical behavior, shear strength, stress-strain characteristics, drained and undrained soil behavior, permeability, seepage, groundwater flow and control and consolidation of soils. *Prerequisite: CE 3153 or equivalent.*

CE 8423 Ground Improvement *3:0:0:3*

This course discusses foundation engineering practice, foundation rehabilitation and emerging ground- improvement technologies. Topics covered are the selection, design and analysis of ground-improvement techniques for different foundation problems, as well as the construction, monitoring and performance evaluation of such solutions. *Prerequisites: CE 3153 and CE 4173 or equivalents.*

CE 8433 Urban Geotechnology *3:0:0:3*

This course looks at case histories on geotechnical design, construction and rehabilitation in the urban environment. Topics covered: Special construction problems and innovative solutions; unforeseen ground conditions; performance monitoring; remedial planning and implementation; and geotechnical design and construction issues from a practicing engineer's perspective. *Prerequisites: CE 3153 and CE 4173 or equivalents.*

CE 8493 Environmental Geotechnology *3:0:0:3*

This course covers: Clay mineralogy; soil-water interaction processes; chemical transport through soils; hydraulic conductivity, diffusion and attenuation mechanisms; water-disposal systems; design of land-fills, seepage barriers and cut-off walls; geo-environmental site characterization techniques; and soil-remediation techniques. *Prerequisite: CE 3153 or equivalent.*

CE 8603 Selected Topics in Geotechnical Engineering *3:0:0:3*

This course explores current special interest topics, such as ground improvement, geotechnical earthquake engineering, site characterization and remediation. Topics vary with each offering and are disseminated before registration. *Prerequisite: CE 4173 or equivalent.*

CE 8663 Advanced Foundation Design *3:0:0:3*

Topics covered: Advanced analysis of foundations, shallow foundations, bearing capacity, settlement, deep foundations, axial and lateral loading of piles, wave equation analysis, drilled piers, design and construction issues and case histories. *Prerequisite: CE 3143 or equivalent.*

CE 8673 Excavation Support Systems *3:0:0:3*

This course covers advanced analysis of foundations, shallow foundations, bearing capacity, settlement, deep foundations, axial and lateral loading of piles, wave-equation analysis, drilled piers and design and construction issues. *Prerequisites: CE 3153 and CE 4173 or equivalents.*

STRUCTURAL ENGINEERING

CE 6013 Theory of Structural Analysis and Design *3:0:0:3*

This course discusses theories of structural analysis and their relationship to design. Topics: Classical structural mechanics, matrix procedures and numerical methods in problem-solving; and analysis of statically indeterminate beams, frames and trusses using force and displacement methods. Also considered are elastic supports, movement of supports and temperature effects. *Prerequisite: CE 3133 or equivalent.*

CE 6033/ CE 6043 Selected Topics in Structural Analysis I/II *3:0:0:3*

This course discusses special current interest topics. It is offered at irregular intervals by advance announcement. Graduate advisers may approve repeat registration for different topics. *Prerequisite: Adviser's approval.*

CE 6063 Bridge Engineering *3:0:0:3*

This course covers types of bridges; geometric design of bridges; construction materials and techniques; simplified bridge analysis; special problems in the design of steel and reinforced-concrete bridges; bridge inspection policies; bridge rehabilitation procedures; bridge management systems; and the effects of wind and earthquakes on long-span bridges. *Prerequisites: Undergraduate structural analysis and steel design.*

CE 6133 Stability of Structures *3:0:0:3*

This course addresses the stability of structural systems. Topics: Investigation of buckling of structural configurations composed of beams, plates, rings and shells; effects of initial geometric imperfections, load eccentricities and inelastic behavior; and the application of energy measures and numerical techniques. *Prerequisite: Adviser's approval.*

CE 6143 Steel Structures *3:0:0:3*

This course explores compression members; elastic and inelastic buckling of columns and plates; lateral support of beams; torsion of open and closed sections; warping; lateral torsional buckling of beams; and bi-axial bending. Other topics include: Plate girders, including stability of webs and flanges; combined bending and axial load; instability analysis; and design of rigid and semi-rigid mechanisms of continuous beams and rigid frames. Both elastic and plastic design criteria are discussed. *Prerequisite: CE 3143 or equivalent.*

CE 6163 Finite Element Methods *3:0:0:3*

Students study the basic theory of the finite element method and learn how to apply it using widely used engineering programs. The course emphasizes developing finite element models and executing the analysis. Students learn to recognize modeling errors and inconsistencies that could lead to either inaccurate or invalid results. *Prerequisite: Adviser's approval.*

CE 6183 Concrete Structures *3:0:0:3*

This course covers design principles and construction methods for reinforced and pre-stressed concrete structural elements; response of members subject to axial loading, shear and flexure; design of columns, deep beams and shear walls; design and detailing for connection regions; design of pre-tensioned and post-tensioned beams and slabs; and the effect of short-term and long-term deformations. *Prerequisite: Graduate status.*

CE 6193 Wind and Earthquake Engineering *3:0:0:3*

This course examines characteristics of wind and earthquake loads; atmospheric motions and boundary layer theory; response of structures to wind forces; code treatments of wind loads on structures; calculation of lateral forces from seismic events; lateral force-resisting systems; diaphragms and center of rigidity; response spectrum and time-history; ductility; concrete and steel frame structures; braced frames; shear walls; dual systems; story drift; detailing requirements. *Prerequisite: Graduate status.*

CE 6253 Structural Dynamics *3:0:0:3*

This course covers: Dynamic response of single degree of freedom systems; theory of vibration of finite degree of freedom systems; influence coefficient method; analytical and numerical solutions to dynamic response problems; and nonlinear analysis of single degree of freedom systems. Emphasis also on computer analysis of large complex systems.

CE 7823 Forensic Engineering *3:0:0:3*

This course emphasizes lessons learned by analyzing structural failures and studying the work of outstanding practicing professional engineers. Also covered is the application of engineering principles for proper performance of civil engineering structures.

HIGHWAY AND TRAFFIC ENGINEERING

For courses in this area, please consult the Transportation section of this catalog.

URBAN INFRASTRUCTURE SYSTEMS ENGINEERING AND MANAGEMENT

CE 7753 Environmental Systems Management *3:0:0:3*

This course provides an overview of information technologies as applied to the remote sensing of environmental infrastructure systems, and includes the development of infrastructure system databases to assist complex decision-making on environmental infrastructures.

CE 7813 Infrastructure Planning, Engineering and Economics *3:0:0:3*

This course covers methods for identifying, formulating, preliminarily appraising and analyzing in detail individual projects and systems of civil engineering projects. Different approaches relevant to government agencies, public utilities, industrial firms and private entrepreneurs are discussed, as well as planning of projects to satisfy single and multiple purposes and objectives, meet local and regional needs and take advantage of opportunities for development. Also covered are financial and economic analyses, including sensitivity and risk analysis; mathematical models for evaluation of alternatives and optimization; and environmental, social, regional economic growth, legal and institutional and public involvement impacts of projects.

CE 7833 Infrastructure Rehabilitation: A Practical Approach *3:0:0:3*

Upgrading the nation's aging infrastructure is a national priority well into the 21st century. In this course, a preeminent civil engineer who has overseen major rehabilitation projects focuses on the direct practical application of engineering principles required to address today's infrastructure rehabilitation needs. The course emphasizes conceptual thinking, brainstorming techniques, team evaluation of alternative solutions, oral and written communication and intensive classroom participation.

CE 7853 Concepts and Implementation of Infrastructure Management Systems *3:0:0:3*

This course reviews state-of-the-art, performance-monitoring and system-condition assessment methodologies as part of infrastructure management systems. Emphasis is on information technologies as applied to remote sensing and database development for urban systems management. Tools, such as GIS and dedicated databases for condition assessment are presented in a laboratory environment. Invited experts participate in such areas as transportation, water distribution and utilities.

CE 7863 Infrastructure Monitoring and Performance Assessment *3:0:0:3*

This course introduces the physical nature of infrastructure materials and systems. The concept of performance is introduced from the viewpoint of strength and durability. Lectures and laboratory demonstrations identify the mechanisms of degradation and cover techniques for condition assessment and quality assurance.

CE 7983 / CE 7993 Special Topics in Infrastructure Systems and Construction I/II *3:0:0:3*

This course discussed contemporary topics of interest, such as methodologies and procedures for analysis of existing infrastructure systems, geographic information, data and management systems, photogrammetric and remote sensing techniques and use and design of infrastructure facilities and systems. Other topics include, but are not limited to, intelligent buildings and other modern constructed works, temporary structures for construction and problems in construction engineering, new approaches in construction management and integration and automation of construction processes.

CE 9903 Case Study in Urban Systems Engineering and Management *3:0:0:3*

This comprehensive independent case study involves a specific urban infrastructure engineering and management project under faculty adviser guidance and generally is coordinated with a participating infrastructure agency. Case studies are submitted as formal reports and must be presented and defended formally. Students are expected to prepare a project report on a selected IMS in cooperation with an infrastructure agency.

CE 9913 MS Thesis in Urban Systems Engineering and Management *6 credits*

This 6-credit thesis focuses on a topic of current importance in infrastructure engineering and management. The thesis generally involves developing a systems approach to some aspect of infrastructure and may include elements of case studies. The thesis is guided by a faculty adviser and thesis committee and may involve cooperation with an infrastructure agency. All theses are submitted formally as bound reports (see Institute requirements for bound theses and dissertations).

GENERAL COURSES

CE 5983 Selected Topics in Civil Engineering I *3:0:0:3*

Special topics in current areas of civil engineering that cover more than one sub-disciplinary category are examined. Open to undergraduate students with exceptional records upon approval of the undergraduate adviser.

CE 5993 Selected Topics in Civil Engineering II *3:0:0:3*

Special topics in current areas of civil engineering that cover more than one sub-disciplinary category are examined. Open to undergraduate students with exceptional records upon approval of the undergraduate adviser.

GUIDED STUDIES AND RESEARCH

CE 901X Readings in Civil Engineering *Variable credit (1-3 credits)*

This individual study of selected civil engineering literature is guided by a faculty adviser. Requirement: An acceptable written report or successful completion of an examination. Only one registration permitted, except with the permission of the department head. *Prerequisite: Instructor's permission.*

CE 9963 Project for the MS in Civil Engineering *3 credits*

This project involves analytical, design or experimental studies in civil engineering guided by a faculty adviser and following departmental guidelines. A written report is required. *Prerequisites: Degree status and project adviser's approval.*

CE 9973 Thesis for the MS in Civil Engineering *6 credits*

This course is an original investigation or design in the student's principal field of study prepared and closely supervised by a faculty adviser. Candidates must successfully defend theses orally. Registration for a minimum of 6 credits is required. *Prerequisites: Degree status and thesis adviser's approval.*

RE 9990 PhD Examination *0 credits*

PhD students register for this course in any semester in which a PhD qualifying exam is taken. This course carries no credit, and the student incurs no fees. It provides a place in the student's official transcript to record when the qualifying exam was taken and the result.

CE 9993 Dissertation Level Research *Var 3-6 credits*

This course involves an independent, original investigation that demonstrates creativity and scholarship worthy of publication in a recognized engineering journal. Registration for a minimum of 6 credits is required before registering for CE 9998. Registration for 3-6 credits per semester is permitted before the successful completion of the doctoral qualifying examinations. *Prerequisites: Degree status and approval of the dissertation adviser.*

CE 9998 Dissertation for the PhD in Civil Engineering *Var 0.5-12 Credits*

This independent, original investigation must demonstrate creativity and scholarship worthy of publication in a recognized engineering journal. Candidates must successfully defend dissertations orally. Registration for a minimum of 15 credits is required before the defense.

Registration must be continuous (excluding summer semesters), unless a formal leave of absence is requested and approved. Registration for 3 to12 credits per semester is permitted. In the final semester, registration for 0.5 credits is permitted with department head approval. *Prerequisites: CE 9998, degree status, successful completion of doctoral qualifying examinations and approval of the dissertation adviser.*

Typical Course of Study for the Bachelor of Science in Civil Engineering

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Hours/Week Class	Lab.	Rec.	Cr.
MA 1024	Calculus I	4	0	0	4
CM 1004	General Chemistry for Engineers	2	2	1	4
EN 1013W	College Writing Workshop	3	0	0	3
EG 1001	Engineering and Technology Forum	1	0	0	1
EG 1003	Introduction to Engineering and Design	1	3	1	3
					15

Spring Semester

Course No.	Course Title	Hours/Week Class	Lab.	Rec.	Cr.
MA 1124	Calculus II	4	0	0	4
PH 1013	Mechanics	3	0	0	3
HuSS 1023W	First-Year Writing Seminar	3	0	0	3
CS 1133	Engineering Problem Solving and Programming	2	0	3	3
CE 1002	Introduction to Civil Engineering	1.5	1.5	0	2
					15

SOPHOMORE YEAR

Fall Semester

MA 1012	Linear Algebra (1/2 semester)	4	0	0	2
MA 2132	Ordinary Diff. Equ. (1/2 semester)	4	0	0	2
PH 2021	Introductory Physics Lab I	0	1.5	0	.5
PH 2023	Electricity, Magnetism and Fluids	3	0	1	3
CE 2113	Statics	3	0	1	3
CE 2323	Traffic Engineering I	3	0	0	3
Humanities and Social Sciences Elective I		3	0	0	3
					16.5

Spring Semester

PH 2031	Introductory Physics Lab II	0	1.5	0	.5
PH 2033	Waves, Optics and Thermodynamics	3	0	1	3
CE 2123	Mechanics of Materials	3	0	1	3
CE 2213	Fluid Mechanics	2.5	1.5	0	3
	Science Elective	3	0	0	3
Humanities and Social Sciences Elective II		3	0	0	3
					15.5

JUNIOR YEAR

Fall Semester

MA 2212	Data Analysis I (1/2 semester)	4	0	0	2
MA 2222	Data Analysis II (1/2 semester)	4	0	0	2
CE 3133	Structural Analysis	3	0	1	3
CE 3122	Structural Dynamics	2	0	0	2
CE 3223	Environmental Engineering I	2	3	0	3
CE 3163	Materials Engineering	2	3	0	3
Humanities and Social Sciences Elective III		3	0	0	3
					18

Spring Semester

CE 3153	Geotechnical Engineering	2	3	0	3
CE 3143	Steel Design	2	3	0	3
CE 3343	Design of Traffic Facilities	3	0	1	3
CE 3243	Water Resources Engineering	3	0	0	3
CE	Constr. Management Elective	3	0	0	3
Humanities and Social Sciences Elective IV		3	0	0	3
					18

SENIOR YEAR

Fall Semester

CE 4183	Reinforced Concrete Design	2	3	0	3
CE 4092	Leadership, Business Principles Policy and Ethics in CE	2	0	3	2
CE	Civil Engineering Elective I	3	0	0	3
	Free Elective I	3	0	0	3
Humanities and Social Sciences Elective V		3	0	0	3
					14

Spring Semester

CE 4814	Civil Engineering Design	3	3	0	4
CE	Civil Engineering Elective II	3	0	0	3
CE	Civil Engineering/Construction				
CE	Construction Management				
	Management Elective I	3	0	0	3
	Elective II	3	0	0	3
Humanities and Social Sciences Elective VI		3	0	0	3
					16

Total credits required for graduation: 128

COMPUTER ENGINEERING PROGRAM

Program Directors:
Ramesh Karri and Haldun Hadimioglu (undergraduate)
Ramesh Karri (graduate)

The Department of Electrical and Computer Engineering and the Department of Computer Science and Engineering offer a Computer Engineering Program for the degree of Bachelor of Science. The Department of Electrical and Computer Engineering also offers a Computer Engineering Program for the Master of Science degree.

COMPUTER ENGINEERING PROFESSION

As digital computer use pervades daily life, computer engineers have designed computers and devised applications to improve the efficiency and quality of nearly all activities in business, industry, government, education and entertainment. Computer engineering draws heavily on electrical engineering topics, including electronic circuit design and analysis of physical communication and control systems, and on computer science topics, including logic design, system architecture, computer software and algorithms.

Computer engineers are in the midst of exciting times with unlimited, rapidly expanding opportunities. Engineers interact with and design supercomputers and the ubiquitous personal and portable computers. Computer engineers also play a key role in networking computers with other computers and intelligent devices. Computer engineers undertake a range of projects—from designing specialized computer hardware and reconstructing the human genome, to monitoring and controlling industrial plants and the environment, to computer graphics, robotics and the design of biomedical devices and computer networks. In addition, computer engineers design and develop hardware and embedded software-hardware systems. Importantly, computer engineers collaborate on projects that advance biology, medicine and nanoscience.

The Computer Engineering Program provides an outstanding, cutting-edge education in computer systems with emphasis on hardware and software. Toward that goal, the Computer Science and Engineering and Electrical and Computer Engineering departments incorporate the latest market and technology trends and combine the traditional disciplines of electronics, communications, control and computer programming with newer courses that include Cyber Security, Nanoscale Circuit Design, Parallel Computers, Image Processing, Biomedical Instrumentation, Web Search Engines, Wireless Networks, Peer-to-Peer Networks, SoC (System-on-a-Chip), VLSI (Very Large Scale Integration) and Game Development.

NYU-Poly has developed a strong design faculty through sponsored research programs, many of which are coordinated in NYU-Poly's Center for Advanced Technology in Telecommunications (CATT), Information Systems and Internet Security (ISIS) Lab and Wireless Internet Center for Advanced Technology (WICAT).

Additional information about computer engineering careers can be found online at www.careercornerstone.org/compeng/compeng.htm.

UNDERGRADUATE PROGRAM

The Bachelor of Science program in computer engineering gives a broad-based background in computer engineering to prepare students for immediate employment as entrepreneurs or in industry and government or for graduate study.

GOALS AND OBJECTIVES

The undergraduate program achieves the following objectives for students:

- Graduates are expected to be engaged and advancing in their professional careers in a profession that utilizes their NYU-Poly degree, in Computer Engineering or other career path, that include industry, academia and governmental or non-governmental organizations.
- Graduates are expected to be seeking continuous professional development and life-long learning through graduate school studies, continuing education credits and/or professional registration.

The BS program includes analysis and design courses in major computer engineering areas that build on fundamental courses in mathematics and science. Many courses include hands-on laboratory components. A variety of electives provide depth and specialization, many in commercially viable areas such as high-speed networks, databases, embedded control systems, VLSI, image processing , computer and network security and Web search.

Since most current engineering design is computer facilitated, the department includes computer-aided design (CAD) programs in many undergraduate courses to emphasize possibilities for large-scale design, corrections for unmodeled complexities, trade-offs among performance criteria and real-time simulations. The senior design project challenges each student to integrate analytical and design concepts from earlier courses to design a device or system to meet specified performance requirements.

The program recognizes that communication and interpersonal skills are essential to a successful career. Students are required to take writing-intensive courses and electives in the humanities and social sciences. They also develop those skills in design-course team projects. The Computer Engineering Program stays current with market changes through the CATT Industrial Affiliates Program, hiring professors and part-time adjunct teachers with industrial experience, frequent contacts with alumni, review of professional journals and by encouraging faculty to work in industry part-time or while on sabbatical. Where possible, classroom work challenges students to apply knowledge to current design situations. The curriculum, reflecting industry's need for the engineering-systems approach, employs senior projects in control and robotics, advanced hardware design, imaging and embedded controllers. Economic aspects of engineering are addressed by allowing undergraduates to choose electives such as economics/finance, psychology and ethics. Cost evaluation is required in design projects for EG 1003 Introduction to Engineering Design. Senior projects emphasize time management and planning. EG 1001 Engineering and Technology Forum examines the impact of technology on society. EE/CS 1012 Introduction to Computer engineering introduces students to the field of computer engineering. Exceptional undergraduate students may do advanced study in two programs:

- The BS/MS Program (please refer to the section "Undergraduate Academic Programs and Policies" section in the catalog).
- The summer junior-research internship program, in which undergraduates work with faculty on research projects.

Up-to-date information about program requirements, course offerings, senior project topics and research projects is available online from the Department of Electrical and Computer Engineering at www.poly.edu/academics/departments/electrical and from the Department of Computer Science and Engineering at www.poly.edu/academics/departments/computer.

UNDERGRADUATE DEGREE REQUIREMENTS

The BS program in computer engineering gives students broad preparation for a career in computer engineering in any of its specialization and readies them for immediate employment in industry, business and government, or for further graduate education. The program is accredited by the Accreditation Board for Engineering and Technology (ABET).

The table at the end of this section outlining the Typical Course of Study for a BS shows a sample semester-by-semester program for students entering as freshmen in fall 2009 or later. The notes accompanying the table are an essential part of the table. Students are responsible for making themselves aware of changes made in this program after this catalog is published. Those changes are posted outside the department's advising offices and on the department's Web page. (Students who started their studies before fall 2009 should consult the department's advisers and Web pages for program and course requirements applicable to them.)

SENIOR DESIGN PROJECT

The two-semester Senior Design Project allows students to focus on an application of computer engineering. In the first semester, students concentrate on hardware and/or software. They develop skills using specialized laboratory equipment and computer-design packages and are introduced to techniques for planning projects and making effective presentations. They also learn to balance design requirements such as performance, safety, reliability and cost effectiveness.

In the second and final semester, students design, build or simulate and test a device or system to meet prescribed engineering specifications. Informal and formal written and public oral presentations help prepare students for professional careers. Design-project students frequently work in groups or pairs to develop interaction skills essential to good engineering.

GRADUATION REQUIREMENTS

The Institute requires a 2.0 GPA in all courses and specifies other general requirements in the section "Undergraduate Academic Programs and Policies," which describes the core curriculum for all engineering majors, including placement procedures in writing, mathematics and programming; course credits by transfer and advanced placement; and credit by examination.

To graduate, students must (1) have a C-grade or better in CS 1114, CS 1124, CS 2134 and CS 2204 and in EE 2013 and EE 2024 and (2) have a technical GPA of 2.0 based on all courses prefixed EE, CS or EL. Seniors may elect graduate courses labeled EL 5XX3, but not CS 5XX3. To enroll in other graduate courses, student must meet required department GPA standards and adviser approval.

Students are expected to meet degree requirements in effect at the time when they first enrolled in a NYU-Poly program. Those requirements apply as long as a student remains in good standing and less than eight years have elapsed since entering the program. The period for unchanged requirements is proportionately less for a transfer student.

GOOD STANDING, PROBATION AND DISQUALIFICATION

Students who fail to meet Institute GPA requirements or other conditions of adequate progress toward completing a degree are put on probation. (See the "Undergraduate Academic Programs and Policies" section in this catalog for more details.) Students on final probation may not register for courses in one semester until grades are available from their previous semester's courses, and they are limited to a reduced number of credits per semester. Students who improve academic performance are removed from probation and returned to good standing. Continued poor academic performance can lead to final probation and, eventually, disqualification from the Institute. To remain in good standing in the undergraduate Computer Engineering Program, students must:

- Maintain, term-by-term and cumulatively, a technical GPA (based on EE/EL and CS Earn a C- or better in CS 1114, CS 1124 and CS 2204 and in EE 2013 and EE 2024; and
- Fulfill all course pre- and co-requisites.

Students who face difficulties, whether educational or personal, should consult their instructor or a departmental adviser at the earliest possible time. Students who do not meet program conditions are placed on departmental probation.

Probation conditions may require students to:

- Repeat courses, including courses in which they received transfer credits and courses in which they received a C grade or less at NYU-Poly;
- Specify their credit load and permissible withdrawals; and
- Take other remedial programs.

Students who fail to meet departmental probation requirements, fail three times to earn the required grade in any one course or do not conform to the University Code of Conduct are subject to disqualification from working toward a bachelor's in computer engineering or taking further computer engineering courses. Actions taken depend on individual cases. Disqualified students may appeal in writing. Students also may apply for readmission after two terms (fall, spring or summer) have passed if they can demonstrate an improved chance of success.

DUAL UNDERGRADUATE MAJORS

With departmental permission, students may earn a single bachelor's degree in electrical and computer engineering. This degree requires a total 142 credits rather than the usual 128 required for individual bachelor's degrees.

SENIOR THESIS

Undergraduate computer engineering students wishing to do a Senior Thesis (BS thesis) instead of Design Project (DP) must:

- Complete 6 total credits of Senior Thesis (EE 397);
- Complete EE 4001, "ECE Professional Development";
- Make a presentation to their thesis adviser, with attendance open to other students and faculty; and
- Bind their thesis according to university guidelines for MS and PhD theses.

Note: Such students need not register for Design Project I or Design Project II.

Before registering for Senior Thesis, the student must find a faculty member to serve as thesis adviser. In addition, students must have a 3.0 GPA in order to register for Senior Thesis instead of Design Project.

Additional notes:

- The Senior Thesis must be design oriented.
- The 6 credits of DP-1 and DP-2 are replaced by 6 credits of Senior Thesis (EE 397).
- Students are advised not to take all 6 credits of Senior Thesis during a single semester.

MINOR IN COMPUTER ENGINEERING

Students may obtain a minor in Computer engineering by taking the following courses.

Course	Credits	
EE 2013	Electric Circuits I	3
EE 2024	Electric Circuits II	4
CS 2204	Digital Logic	4
EE 4144	Embedded Systems	4
Total credits		**15**

For students not earning the BS degree in computer science, EE 4144 may be replaced by CS2214 Computer Architecture. A GPA of 2.0 or better in the entire minor is required. Students must take a minimum of 8 credits at NYU-Poly. Students for whom CS1133/CS1114 is not required for major should note that CS 1133/CS 1114 is a prerequisite for CS 2204.The minor in computer engineering is not open to students earning the BS degree in electrical engineering.

SENIOR HONORS STUDENTS

Each spring, the Department of Electrical and Computer Engineering selects senior honors students with high GPAs who will complete their degree requirements in the following academic year. Such students are listed as honor students in that year's commencement program and are given special permission to substitute courses in their senior year. Most often these students substitute more advanced graduate courses in place of usual requirements in the same study area. Transfer students are eligible for this designation after they complete half of the credits needed to satisfy NYU-Poly degree requirements (e.g., 64 of 128 total credits).

TRANSFER STUDENTS

Transfer credits for courses taken at other schools are based on evaluation of content and level. Students completing the same program at another school, but in different years, may receive different amounts of transfer credits. Students should consult with a computer engineering undergraduate adviser for current information.

Transfer students must arrive and present their records for evaluation at least one week before the regular registration period of their first semester at NYU-Poly. Transfer credits are awarded only for courses completed with C grades or better. Qualified students from two-year pre-engineering programs, such as those at liberal arts and community colleges, may fulfill the requirements for the BS in computer engineering in two additional years. Since pre-engineering programs vary, a prescribed program is not possible; consequently, students should consult with an NYU-Poly undergraduate adviser at the beginning of their pre-engineering program.

GUIDANCE FOR UNDERGRADUATE STUDENTS

Instructors help students in their courses during hours posted on their doors or by appointment. Students taking project or thesis courses work closely with faculty project advisers. Computer engineering advisers in the undergraduate ECE office are available to advice on courses and program adjustments resulting from academic needs or personal problems. The Office of Special Services sponsors a peer-tutoring program. The Polytechnic Tutoring Center provides drop-in tutoring. Personalized career counseling is available at the Career Management Center. The EG 1001 Engineering and Technology Forum and EE/CS 1012 Introduction to Computer Engineering introduce students to NYU-Poly and its curricula. Fellow students are an excellent source of advice on adjusting to the Institute environment and the demands of an engineering program. In addition to meeting students in class, students are urged to meet others who can offer experienced advice by joining clubs such as the student branches of the Institute for Electrical and Electronics Engineers (IEEE) and Association for Computing Machinery (ACM) professional societies or other technical, sport, religious and ethnic clubs.

Students are encouraged to meet with other students to form study groups. In doing so, they benefit both from explanations provided by others and by the deeper understanding they get when they explain a concept or technique to someone else.

UNDERGRADUATE ADVISING

Undergraduate advising information is available on the Department of Electrical and Computer Engineering's website, www.poly.edu/academics/departments/electrical. Students should consult that page for further details on honors, probation, approved electives, projects, elective concentrations, course offerings, senior project topics and other interests. Curriculum and prerequisite changes, new courses, special sections and other last-minute announcements are also posted on the bulletin boards outside the Office of Electrical and Computer Engineering.

INFORMATION

All students are responsible for keeping informed about current procedures and regulations. Descriptions of undergraduate electrical engineering and computer science courses used in the Computer Engineering Program are in the program sections of this catalog.

GRADUATE PROGRAM

The MS in Computer Engineering educates professionals in computer engineering by offering graduate courses that meet the current and projected needs of industry and government in the metropolitan New York area and beyond. The program promotes computer engineering through basic and applied research by faculty and students in collaboration with industry and government agencies.

NYU-Poly's MS program in computer engineering targets two important needs:

- The program leads to a terminal degree for students intending to round out their education and seek employment.
- The program provides the tools and background to carry out self-directed research for students planning a PhD. Outstanding students should apply for financial aid, including research fellowships, teaching fellowships or partial tuition remission. Students who wish to continue graduate study toward a PhD in computer engineering may do so in the PhD in the Electrical Engineering Program.

The electrical engineering and computer science faculty's research and teaching interests include computer networks, VLSI design and CAD, verification and testing of VLSI systems, embedded systems design and computer architecture. The MS in Computer Engineering focuses on the principles and concepts underlying the design and integration of computer hardware and software into components and systems.

Modern society's need for sophisticated and efficient electronically controlled systems and devices is increasing exponentially. Advanced studies in computer engineering provide a needed bridge between the Institute and industry. The Department of Electrical and Computer Engineering develops and administers an exceptional academic and research program in computer engineering with strong focus on telecommunications, computer networks and microelectronics.

GOALS AND OBJECTIVES

The MS program in computer engineering prepares graduates to practice computer engineering at an advanced level. The program's specific goals and objectives provide students with:

- Opportunities to specialize in primary sub-disciplines of computer engineering (VLSI, High-Speed networking, etc.), or to achieve breadth across a number of the sub-disciplines;
- Analysis and design knowledge necessary to design general-purpose as well as specialized application-specific computer hardware;
- Knowledge and skills to design embedded software-hardware systems;
- Exposure to state-of-the-art computer engineering techniques and technologies such as new computer architectures and design styles; and
- A basis for continued lifelong learning in the profession.

ADMISSION REQUIREMENTS

Admission to the MS program requires a bachelor's degree in computer engineering, electrical engineering or computer science from an accredited institution. Students not meeting these requirements are considered individually for admission and may be admitted after completion of courses to remove preparation deficiencies, including courses in logic circuit design, state analysis and synthesis techniques, computer architecture, data structures and algorithms and C or C++ programming.

DEGREE REQUIREMENTS

To satisfy the MS degree requirements, students must complete 30 credits as described below. Of these, at least 18 credits should be EL credits and at least 6 credits should be CS credits.

GROUP 1: Core courses (Choose 3 of the following)

EL 5363 Principles of Communication Networks
EL 5473 Introduction to VLSI design
EL 5493 Advanced Hardware Design (VHDL)
CS 6133 Computer Architecture I
Total: 9 credits

GROUP 2

Two sequences in this group each containing two courses; one course in each sequence may be a core course in Group l. Both sequences must be in EL or CS courses and at least one must be an EL sequence. Approved course sequences are detailed in the ECE Graduate Student Manual.
Total: 6-12 credits

GROUP 3

Electives may be chosen with adviser approval from graduate offerings in EL, CS and, occasionally, pertinent courses from other departments. With adviser approval, students may select other groups or individual courses if they relate to computer engineering.
Total: 6-12 credits

GROUP 4

Students must take a project (EL 9953) that relates to the computer engineering discipline and is adviser-approved.
Total: 3 credits

Minimum total: 30 credits

Thesis option:

A 6-credit thesis (EL997x) may be selected and used to replace:

(1) one elective from Group 3
(2) The 3-credit project from Group 4

NYU-Poly requires a GPA of 3.0 in all graduate courses, except those used for the undergraduate degree. No more than 9 of 30 credits may be taken outside NYU-Poly. Also, such credits are not used in computing the GPA. An average of 3.0 is required in courses taken to satisfy groups 1 and 2 above. These courses must be taken at NYU-Poly. If some courses are excused because the student took them in an undergraduate program or received transfer credits, adviser-approved substitute courses are used to calculate this average. Overall, 30 credits are required for the degree. Students should consult the Department of Electrical and Computer engineering Graduate Student Manual(www.poly.edu/academics/departments/electrical/graduate-resources). The manual provides detailed rules and procedures, including student status, transfer credits, recommended electives and one-year sequences, current areas of research and disqualification for low grades.

Typical Course of Study for the Bachelor of Science in Computer Engineering

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Class	Lab.	Rec.	Cr.
		Hours/Week			
MA 1024	Calculus I	4	0	0	4
CS 1114	Introduction to Programming and Problem Solving[2]	3	3	0	4
EG 1003	Introduction to Engineering and Design[4]	.5	2.5	2	3
EG 1001	Engineering and Technology Forum[4]	1	0	0	1
EN 1013W	College Writing Workshop	3	0	0	3
					15

Spring Semester

Course No.	Course Title	Class	Lab.	Rec.	Cr.
		Hours/Week			
MA 1124	Calculus II	4	0	0	4
PH 1013	Mechanics	3	0	1	3
CS 1124	Object-Oriented Programing[2]	3	3	0	4
EE/CS 1012	Introduction to Computer Engineering[4]	2	0	0	2
HuSS 1023W	First-Year Writing Seminar	3	0	0	3
					16

SOPHOMORE YEAR

Fall Semester

MA 2012	Elements of Linear Algebra I	4	0	0	2
MA 2132	Ordinary Differential Equations	4	0	0	2
PH 2023	Electricity, Magnetism and Fluids	3	0	1	3
PH 2021	Introductory Physics Laboratory I	0	1.5	0	.5
CS 2134	Data Structures and Algorithms[2]	4	0	0	4
EE 2013	Fundamentals of Electric Circuits I[2]	3	0	1	3
Humanities and Social Sciences Elective Course[1]					3
					17.5

Spring Semester

MA 2112	Multivariable Calculus A	4	0	0	2
MA 2312	Discrete Mathematics I	4	0	0	2
PH 2033	Waves, Optics and Thermodynamics	3	0	1	3
PH 2031	Introductory Physics Laboratory II	0	1.5	0	.5
CS 2204	Digital Logic and State Machine Design[2]	3	3	0	4
EE 2024	Fundamentals of Electric Circuits II[2]	3	1	1	4
					15.5

JUNIOR YEAR

Fall Semester

MA 2212	Data Analysis I	4	0	0	2
MA 2222	Data Analysis II	4	0	0	2
EE 3114	Fundamentals of Electronics I	3.5	1.5	1	4
CS 2214	Computer Architecture and Organization	3	0	2	4
Humanities and Social Sciences Elective Course[1]					3
					15

Spring Semester

CS 3224	Operating Systems	4	0	0	4
EE 136	Communication Networks	3	0	0	3
EE 3193	Introduction to Very Large Scale Integrated Circuits	3	0	0	3
CM 1004	General Chemistry for Engineers	3	2	1	4
Humanities and Social Sciences Elective Course[1]					3
					17

SENIOR YEAR

Fall Semester

EE 4144	Introduction to Embedded System Design	3.5	1.5	0	4
EE/CS 4XX3	Design Project I				3
EE 4001	ECE Professional Development and Presentation	1	0	0	1
EE/CS/EL	Elective				3
	"Special" Elective[3]	3	0	1	3
Humanities and Social Sciences Elective Course[1]					3
					17

Spring Semester

EE/CS 4XX3	Design Project II	3
EE/CS/EL	Elective	3
EE/CS/EL	Elective	3
Humanities and Social Sciences Elective Course[1]		3
Humanities and Social Sciences Elective Course[1]		3
		15

Total credits required for graduation: 128

Note: A GPA (Technical) of at least 2.0 is required in all EE, CS and EL courses.

1. Choice of humanities and social sciences electives must conform to the established requirements of the Technology, Culture and Society Department. After the first-year writing courses, students will need one writing intensive elective course (W).
2. Grades of at least C- are required in CS 1114, CS 1124, CS 2134, CS 2204, EE 2013 and EE 2024. C if repeated twice.
3. "Special" elective is any course that a student has the prerequisites for and cannot be used to satisfy humanities and social sciences requirements. For example, it can be a course in natural science, mathematics, engineering, management, finance, digital media, etc.
4. For transfer students and students changing major, "Introduction to Computer Engineering" is not required. "Engineering and Technology Forum" and "Introduction to Engineering and Design" may also be excused depending upon transfer credits.

COMPUTER SCIENCE PROGRAM

Program Director: Keith Ross

Computer science examines the theory and practice of designing, building and using computers. The field includes the design and analysis of algorithms, principles of programming languages and compilers, operating systems, software engineering, artificial intelligence, computer organization and architecture, computational geometry, database systems, parallel and distributed computing, and image analysis and understanding. The Computer Science Program is administered by the Department of Computer Science and Engineering.

UNDERGRADUATE PROGRAM

Computer science focuses on how to design, build, and effectively use the computers and systems that we interact with every day — from the smart phones in our hands to the complex databases in our banks and hospitals. Because computer technology powers the most essential functions of business, industry, government and entertainment, computer scientists have tremendous opportunities for growth and exploration.

The Bachelor of Science in Computer Science is a rigorous program that not only covers fundamental computer science subjects –such as object-oriented programming, computer architecture, and operating systems–but also provides a number of exciting avenues for specialization including:

- Cyber Security
- Digital Game Design and Development
- Computer Hardware
- Web Engineering
- Internet and Computer Networks
- Building Systems Software
- Real-Time and Embedded Systems
- Algorithms and Theory
- Artificial Intelligence
- Computer Graphics and Vision
- Data Management and Mining
- Management Information Systems

The Computer Science BS program is extremely flexible. NYU-Poly also offers a BS/MS Program that enables students to earn both a BS and an MS degree at the same time. For instance, a student can receive a BS in Computer Science and MS in Computer Science, a BS in Computer Engineering and MS in Computer Science, or a BS in Electrical Engineering and MS in Computer Science. Depending on the student's preparation and objectives, they can complete both degrees in as little as four years. More information on the BS/MS program can be found on the "Undergraduate Academic Programs and Policies" section of the catalog.

The program provides research labs for specialized study in areas such as cyber-security, a field in which our department has a distinctive strength. In addition, the program's close ties to our graduate division immerse students in a vibrant, intellectual atmosphere.

ONCE YOU HAVE THE DEGREE

Computer science jobs are challenging and diverse, but they are also plentiful. Once a student graduates, they can explore a number of possible occupations, including applications programmer, database manager, systems administrator, or IT analyst. They will also be ready to purse advanced studies toward a master's or doctorate degree.

GOALS AND OBJECTIVES

With the BS program in Computer Science, the department aims to:

- Provide a deep understanding of fundamental computer science subjects;
- Provide avenues of specialization, such as digital games, cyber security, and Internet systems;
- Achieve a proper balance between theoretical study and practical design in order to solve problems effectively;
- Supplement technical skills with courses in humanities, social science, and business; and
- Pursue independent study, as well as directed research, with faculty members who are internationally recognized in their fields.

CURRICULUM OVERVIEW

The Computer Science and Engineering Department has recently modified the BS in Computer Science curriculum. The new curriculum provides both a rigorous education in computer science as well as enormous flexibility, permitting specialization in a myriad of areas as well is inter-disciplinary study with other fields. The incoming class of 2012 and future classes will follow the new curriculum.

Below is an overview of the Computer Science BS curriculum. The full description of the program and its requirements can be obtained from the Computer Science and Engineering Department. A typical course schedule is located at the end of this section.

Required Computer Science Courses

CS 1122	Computer Science and Engineering, Credits: 2.00
CS 1114	Intro to Programming and Problem Solving, Credits: 4.00
CS 1124	Object Oriented Programming, Credits: 4.00
CS 2134	Data Structures and Algorithms, Credits: 4.00
CS 2214	Computer Architecture and Organization, Credits: 4.00
CS 3224	Operating Systems, Credits: 4.00
CS 3413	Design and Analysis of Algorithms, Credits: 3.00
CS 3513	Software Engineering I, Credits: 3.00
CS 4523	Design Project II, Credits: 3.00

Required Mathematics Courses

MA 1024	Calculus I, Credits: 4.00
MA 1124	Calculus II, Credits: 4.00
MA 2312	Discrete Math I, Credits: 2.00
and	
MA 2322	Discrete Math II, Credits: 2.00
MA 2212	Data Analysis I, Credits: 2.00
and	
MA 2222	Data Analysis II, Credits: 2.00
MA 2012	Linear Algebra, Credits: 2.00

Required Engineering Courses

EG 1001	Engineering and Technology Forum, Credit: 1.00
EG 1003	Introduction to Engineering and Design, Credits: 3.00

Science Requirement

Students may choose any 3 science courses from the courses offered for credit to engineering or natural science majors. For example, a student might choose to take a sequence of three physics courses, three biology courses or three chemistry courses, or they may choose to take introductory courses in physics, chemistry, and biology, or they might choose to take two courses in one science and another course in a different science.

Humanities and Social Sciences Requirement

Students are required to take eight courses in humanities and social sciences. Ideally, they will take one humanities or social science course each semester. Three of these courses are specified below; the remaining five courses are electives.

EN 1013W	College Writing Workshop, Credits: 3.00
HuSS 1023W	First-year Writing Seminar, Credits: 3.00
PL 2143	Ethics and Technology, Credits: 3.00

Electives
- 18 additional credits in computer science electives.
- 9 additional credits from mathematics, science, or humanities.
- 15 credits of free electives.

CONCENTRATION AREAS

Students must also choose a concentration area and fulfill its requirements. Specifically, they must use their electives to take three courses from the menu of courses for their chosen concentration.

Cyber Security

CS 392 Information, Security and Privacy, Credits: 3.00
CS 6843 Computer Networking, Credits: 3.00
CS 393 Network Security, Credits: 3.00
CS 6803 Information Systems Security Engineering and Management, Credits: 3.00

Digital Game Design and Development

CS 3113 Game Programming, Credits: 3.00
CS 3233 Game Development Studio I, Credits: 3.00
CS 6533 Interactive Computer Graphics, Credits: 3.00
CS 6613 Artificial Intelligence I, Credits: 3.00

Computer Hardware and Embedded Systems

CS 2204 Digital Logic and State Machine Design, Credits: 4.00
CS 205 Assembly Language, Credits: 3.00
EL 5493 Advanced Hardware Design, Credits: 3.00
EL 5483 Real Time Embedded Systems, Credits: 3.00

Web Systems and Applications

CS 308 Introduction to Databases, Credits: 3.00
CS 3254 Introduction to Parallel and Distributed Systems, Credits: 4.00
CS 6913 Web Search Engines, Credits: 3.00
CS 6843 Computer Networking, Credits: 3.00
CS 391 Java and Web Design, Credits: 3.00
CS 9013 Selected Topics in Computer Science, Credits: 3.00

Algorithms and Theory

MA 4423 Intro Numerical Methods, Credits: 3.00
CS 6753 Theory of Computation, Credits: 3.00
CS 6703 Computational Geometry, Credits: 3.00
CS 6903 Modern Cryptography, Credits: 3.00

Digital Media and Art

CS 6533 Interactive Computer Graphics, Credits: 3.00
DM 1123 Visual Foundation Studio, Credits: 3.00
DM 2193 Web Studio I, Credits: 3.00
DM 3193 Web Studio 2, Credits: 3.00

Data Management and Mining

CS 308 Introduction to Databases, Credits: 3.00
CS 6093 Advanced Database Systems, Credits: 3.00
CS 6913 Web Search Engines, Credits: 3.00
CS 6923 Machine Learning, Credits: 3.00

Management Information Systems

CS 308 Introduction to Databases, Credits: 3.00
CS 6843 Computer Networking, Credits: 3.00
MG 1002 Foundations of Management, Credits: 2.00
MG 4014 Introduction to E-business, Credits: 4.00
MG 2004 Management of Information Technology and Systems, Credits: 4.00

Programming Language Environments

CS 205 Assembly Language, Credits: 3.00
CS 3314 Design and Implementation of Programming Languages, Credits: 4.00
CS 6413 Compiler Design and Construction, Credits: 3.00
CS 9013 Selected Topics in Computer Science, Credits: 3.00

Artificial Intelligence

CS 6613 Artificial Intelligence I, Credits: 3.00
CS 6923 Machine Learning, Credits: 3.00
CS 6673 Neural Network Computing, Credits: 3.00

ELECTIVE OFFERINGS

The following table lists electives offered by the Computer Science and Engineering department. They consist of undergraduate courses as well as graduate courses open to undergraduates.

UNDERGRADUATE COURSES

CS 205 Assembly Language and Systems Programming, Credits: 3.00
CS 239 Unix System Programming, Credits: 3.00
CS 308 Introduction to Databases, Credits: 3.00
CS 391 Java and Web Design, Credits: 3.00
CS 392 Computer Security, Credits: 3.00
CS 393 Network Security, Credits: 3.00
CS394 Special Topics in Computer Science, Credits: variable
CS 2204 Digital Logic and State Machine Design, Credits: 4.00
CS 3254 Introduction to Parallel and Distributed Systems, Credits: 4.00
CS 3714 Secure Information Systems Engineering I, Credits: 4.00
CS 3734 Scientific and Engineering Computing I, Credits: 4.00
CS 4724 Secure Information Systems Engineering II, Credits: 4.00
CS 4744 Scientific and Engineering Computing II, Credits: 4.00
EE 136 Communication Networks, Credits: 3.00
MA 4423 Intro Numerical Methods, Credits: 3.00

GRADUATE COURSES **
(open to undergraduates)

CS 6093 Advanced Database Systems, Credits: 3.00
CS 6913 Web Search Engines, Credits: 3.00
CS 6273 Performance Evaluation of Computer Systems, Credits: 3.00
CS 6533 Interactive Computer Graphics, Credits: 3.00
CS 6613 Artificial Intelligence I, Credits: 3.00
CS 6643 Computer Vision and Scene Analysis, Credits: 3.00
CS 6673 Neural Network Computing, Credits: 3.00
CS 6843 Computer Networking, Credits: 3.00
CS 9013 Selected Topics in Computer Science, Credits: 3.00
CS 9023 Applied Electronic Commerce, Credits: 3.00
CS 9033 Programming Workshop, Credits: 3.00
CS 9043 Cryptography with Financial Applications, Credits: 3.00
CS 9053 Introduction to Java, Credits: 3.00
CS 9073 Human Computer Interaction, Credits: 3.00
CS 9093 Biometrics, Credits: 3.00
CS 9103 Object Oriented Design in Java, Credits: 3.00
CS 6923 Machine Learning, Credits: 3.00
CS 9153 Game Programming, Credits: 3.00
CS 9163 Application Security, Credits: 3.00
CS 9963 Advanced Project in Computer Science, Credits: 3.00
EL 5143 Multimedia Laboratory, Credits: 3.00
EL 5473 Introduction to VLSI System Design, Credits: 3.00

** To enroll in graduate courses juniors and seniors must have a 3.0 GPA or better and adviser approval.

MINOR IN COMPUTER SCIENCE

The minor in Computer Science consists of a minimum of 15 credits including CS 1124 and CS 2134. Students would need to obtain a grade of C- or better in *CS 1114 (Intro. to Programming and Problem Solving) and satisfy the pre-requisite requirements before enrolling in these courses. Students must maintain an average of 2.0 or better in the entire minor. In addition, a required CS course in a BS curriculum cannot be used to satisfy the course requirements in the CS minor. For transfer students, a least three of the five courses must be taken at NYU-Poly.

For more information about the minor contact the academic adviser.

Note: *CS 1114 is a prerequisite for CS 1124 therefore it does not count towards the minor.

TRANSFER STUDENTS

Transfer students are accepted into the undergraduate Computer Science Program on the same basis described in the admissions section of this catalog. In addition, the department requires that at least 28 credits in computer science, as well as CS 3513 and CS 4523, be completed at NYU-Poly. Graduates of technology programs may be able to fulfill the requirements for the BS in Computer Science in two to three and one-half years, depending on the scope and level of their previous education. Students should consult an undergraduate adviser for details.

Courses taken at other schools may be granted transfer credit after an evaluation of the content and level of material covered. Periodic re-evaluation of courses taken at other institutions may lead to a variation in the number of credits granted year to year. Thus, students completing the same program, but in different years, may receive different numbers of transfer credit. Students should consult a computer science undergraduate adviser for current information. All computer science courses are evaluated by the Department of Computer Science and Engineering. Transfer students exempted from EG 1003, Introduction to Engineering and Design, must take a substitute course that includes the preparation of presentations. Students should meet with their undergraduate adviser for more information.

DEPARTMENTAL STANDARDS, PROBATION AND GRADES OF I (INCOMPLETE)

To remain in good academic standing, computer-science majors must satisfy the requirements listed below in addition to maintaining a minimum cumulative GPA of 2.0 in all courses.

The following requirements apply to all undergraduate computer science students:

1. Students must maintain an average of C (2.0 GPA) or better in CS.
2. Students must earn a grade of C- or better in the following courses: Calculus I (MA 1024); Calculus II (MA 1124); Introduction to Programming and Problem Solving (CS 1114); Object Oriented Programming (CS 1124); and Data Structures and Algorithms (CS 2134).
3. Students may repeat a course in which they earned a substandard grade, but no CS course may be taken more than three times (grades of W and AUDIT are not counted for the purpose of this rule).
4. A course in which the student received an incomplete (I) grade may not be used to satisfy any prerequisites until the incomplete is resolved. See "Policies on Undergraduate Grading and Grades" in the "Academic Policies and Degree Requirements" section of this catalog for additional information on incomplete grades.

Students failing to meet any of the above requirements are placed on departmental probation as a warning that they are not progressing acceptably toward their degree. Repeated failure to meet probation requirements may lead to disqualification from the undergraduate computer science program and courses.

INFORMATION

For more information related to curriculum and prerequisite changes, new courses, special sections and other last minute announcements go to the Computer Science and Engineering's website.

GRADUATE PROGRAMS GOALS AND OBJECTIVES

MS IN COMPUTER SCIENCE

The goals and objectives of the Master of Science in Computer Science program are to provide students with the following:

- Maximum curriculum flexibility, allowing students to adapt their program to their ambitions and goals as well as to their educational and professional backgrounds;
- A solid grounding in computer-science fundamentals;
- Professional-level courses in computer science;
- Opportunity to specialize in selected technology areas of utmost interest; and
- Opportunities for a research-oriented program, in preparation for the PhD program in computer science.

MASTER'S DEGREE REQUIREMENTS

To satisfy the requirements for the master's degree, the student must complete 30 credits, as described below, with an overall average of B. In addition, a B average is required across the six core courses, as indicated below. The master's curriculum has two components: 18 credits of core elective courses and 12 credits of general elective courses.

Core Electives and Requirements

Core electives are organized into three core areas: Computer Systems, Progra ming/Software and Theory. Students must take at least six core elective courses, with two courses coming from each of the core areas.

Systems Core Area

CS 6133	Computer Architecture I
CS 6143	Computer Architecture II
CS 6233	Operating Systems I
CS 6243	Operating Systems II
CS 6253	Distributed Operating Systems
CS 6843	Computer Networking
CS 6813	Information, Security and Privacy
CS 6823	Network Security

Theory Core Area

CS 6003	Foundations of Computer Science
CS 6033	Design and Analysis of Algorithms I
CS 6043	Design and Analysis of Algorithms II
CS 6753	Theory of Computation
CS 6903	Modern Cryptography
CS 6703	Computational Geometry

Programming/Software Core Area

CS 6063	Software Engineering I
CS 6073	Software Engineering II
CS 6083	Principles of Database Systems
CS 6373	Programming Languages
CS 6413	Compiler Design and Construction I
CS 6533	Interactive Computer Graphics
CS 6613	Artificial Intelligence I
CS 9163	Application Security

Additionally, for each of the courses, Discrete Mathematics (CS 6003), Computer Architecture I (CS 6133), Operating Systems I (CS 6233), Design and Analysis of Algorithms I (CS 6033), Programming Languages (CS 6373), the following rule applies:

Students are not permitted to repeat any of the above courses if they have already taken it or its equivalent at the undergraduate or graduate level and received a grade of B or better.

General Electives Requirements

In addition to the core electives, students are required to take four general elective courses but have considerable flexibility; the only restriction is that no more than two of the courses may be taken from outside the Department of Computer Science and Engineering. In particular:

- Master's thesis (6 credits) and/or independent study courses may be part of a student's four elective courses.
- Any of the courses in the three core areas may be chosen as electives.
- Graduate-level courses from outside of the department (at most two) may be chosen as electives.
- Any CS graduate course not included in the core areas may be chosen as electives.

These courses include:

CS 6273	Performance Evaluation of Computer Systems
CS 6643	Computer Vision and Scene Analysis
CS 6673	Neural Network Computing
CS 9013	UNIX Systems (Perl)
CS 9053	Introduction to Java
CS 9073	Human and Computer Interaction
CS 6093	Advanced Database Systems
CS 9093	Computer Simulation
CS 9093	Biometrics
CS 9103	Object Oriented Design with Java
CS 6923	Machine Learning
CS 6913	Web Search Engines

REQUIREMENTS FOR MS IN COMPUTER SCIENCE

Entrance Requirements

For entrance into the Master of Science degree programs, students are required to have an undergraduate degree in computer science, mathematics, science or engineering, with a superior undergraduate record from an accredited institution. Applicants with degrees in other fields are considered individually for admission. Generally, entering students are expected to know mathematics through calculus.

Additional Entrance Requirements

1. At least one year of university-level science.
2. A working knowledge of a high-level, general-purpose programming language (preferably C++).
3. A basic understanding of computer fundamentals such as computer organization and operation, data structures and computer architecture. Students entering with a bachelor's in computer science or with a bachelor's in a technical area and a strong minor in computer science should be able to satisfy entrance requirements for the master's degree program. Students who have superior academic credentials but who lack sufficient background are admitted with conditional status, pending satisfactory completion of several individ-

ually specified preparatory courses. In some cases, such students are interviewed to determine the preparatory courses they need to complete. Successful completion of the preparatory courses with a B or better average grade is a necessary condition for transfer to regular status. The demonstrated ability to communicate in written and spoken English is essential for success in pursuing graduate studies in computer science and information-systems engineering; such fluency is required for regular status. Foreign students and others for whom English is a second language may be required to undertake preparatory work to improve their language skills. Admission with advanced standing is accepted in accordance with NYU-Poly regulations published in the catalog. A maximum of 9 credits may be applied to the MS degree from previous graduate work at an acceptable institution.

Preparatory Courses
The Department of Computer Science and Engineering offers two preparatory bridge courses for students without a working knowledge of a high-level, general-purpose programming language:

CS 5303	Introduction to Programming and Problem Solving
CS 5403	Data Structures and Algorithms

Master's Thesis
Exceptional students may elect to write a master's thesis, for which no more than 6 credits may be earned toward the degree. Such students should find an adviser who agrees to monitor the thesis research. Such research need not be original, but should demonstrate adequately the student's proficiency in the subject. An oral defense of the master's thesis before at least three professors is required.

PHD PROGRAM IN COMPUTER SCIENCE

Graduate students who exhibit a high degree of scholastic proficiency and demonstrate an ability for independent scholarship may consider extending their goals toward the degree of Doctor of Philosophy.

REQUIREMENTS FOR PHD IN COMPUTER SCIENCE

Entrance Requirements
The preliminary requirements for admission to the program include the following:

1. A Bachelor's degree in science, engineering or management from an accredited school and a superior academic record, or
2. A Master's degree or one year of graduate work in an analytically based area and a superior academic record. Applicants must submit GRE general exam scores, at least two letters of recommendation, a statement of purpose and all relevant academic records, in addition to the completed application form.

The PhD program consists of four parts:
A) Courses
B) Qualifying exams
C) Dissertation Proposal
D) Dissertation

Core Electives and Credits Requirements
A minimum of 75 credits of graduate work is required beyond the BS degree, including at least 21 credits of dissertation. A Master of Science in Computer Science degree may be transferred in as 30 credits without taking individual courses into consideration. Other graduate course work may be transferred in on an individual-course basis. This transfer includes courses taken for degrees other than a Master of Science in Computer Science.

Students must take at least two courses in each of the following three areas. In the theory area, one of these two courses must be Theory of Computation (CS 6753), unless an equivalent course has been taken. In selecting these courses, students should not choose courses that overlap substantially with previous courses at NYU-Poly or elsewhere.

Systems Core Area

CS 6143	Computer Architecture II
CS 6243	Operating Systems II
CS 6253	Distributed Operating Systems
CS 6843	Computer Networking
CS 6813	Computer Security
CS 6823	Network Security

Theory Core Area

CS 6043	Design and Analysis of Algorithms II
CS 6753	Theory of Computation
CS 6903	Modern Cryptography
CS 6703	Computational Geometry

Programming/Software Core Area

CS 6063	Software Engineering I
CS 6073	Software Engineering II
CS 6083	Principles of Database Systems
CS 6413	Compiler Design and Construction I
CS 6533	Interactive Computer Graphics
CS 6613	Artificial Intelligence I
CS 9163	Application Security

The CSE faculty may modify these area course offerings from time to time. Certain selected topics courses may be used to fulfill these requirements, with prior written permission from the CSE Department.

Students must receive at least a grade of B in each of the six courses; further, the grade-point average over these six courses must be at least a 3.5. Full-time students must complete these course requirements by the end of their second year.

Additionally, for each of the courses Computer Architecture I (CS 6133), Operating Systems I (CS 6233), Design and Analysis of Algorithms I (CS 6033), Programming Languages (CS 6373), the following rule applies: The student must take the course unless it was taken as an equivalent course (at either the graduate or undergraduate level) with a grade of B or higher; if the student took an equivalent course and received a B grade or higher, he or she is not be permitted to take the course at the Institute as part of this PhD program without special permission.

Qualifying Exam
The qualifying exam assesses the student's knowledge of computer science and ability to perform dissertation-level research. The student's evaluation is based on two components: a research exam and course work.

Research Exam
After entering the PhD program, each student works on a research project directed by a research adviser. By the end of the second year, the student must take a research exam based on this work. The research exam is tailored to the student's research and has the following three parts:
(1) Written report
(2) Oral presentation
(3) Answering of questions posed by the research exam committee

The written report must be submitted to the research-exam committee at least one week before the oral presentation. The oral presentation is open to the public. Following the presentation, the student answers questions posed by the research-exam committee.

The research exam assesses the student's ability to do dissertation-level research. The exact format of the report and presentation may vary depending upon the student's focus area and previous research accomplishments. The student must have the format approved by his/her research adviser. If students have their research results by the time of the research exam, then they should focus their report and presentation on those results and discuss related work and ideas for future research. If students have not yet obtained research results

or have only preliminary results, their report and presentation should consist of a survey of related work, a discussion of ideas pursued so far, and ideas for future research.

Students may schedule research exams during two time periods in the year; a range of dates near the end of the Fall and Spring semesters will be announced in advance by the graduate director. To take the research exam, a student, in consultation with his/her research adviser, must form (at least one month before the exam) a research exam committee comprising three faculty members—one is the research adviser and, at most, two are from outside the department or from outside the Institute.

Course Component

The student's overall course performance is evaluated as part of the qualifying exam. Special emphasis is placed on performance in PhD core courses. Students taking the research exam in their third semester must complete at least four PhD core courses by the end of the third semester for their course performance to be evaluated at the end of the third semester. Otherwise, their evaluation is delayed until the end of the fourth semester, by which time they must have taken all six PhD core courses.

Evaluation of the student's course performance usually is based on a review of the student's transcript and possible consultation with course instructors. However, in special cases, students may be subject to additional evaluation and/or additional written exams in some core course areas.

Evaluation of Performance on the Qualifying Exam

The overall decision on whether a student passes or fails the qualifying exam is determined at a meeting of the CSE faculty, which examines the research-exam result and evaluates the student's course performance. The faculty may issue a grade of pass, fail or conditional pass. The faculty may use the grade of conditional pass to impose additional specific and time-restricted requirements on the student. Such a grade is converted to a pass or a fail, depending on whether the student meets these requirements.

Students who do fail the qualifying exam on the first attempt may retake it once. The second attempt must be made by the end of the student's fifth semester. Students who do not pass the qualifying exam on their second attempt are dismissed from the PhD program.

Note: A student may take thesis credits only after passing the qualifying exam. Students entering the PhD program with a master's degree in CS are urged to take the research exam and at least four of the required PhD core courses by the end of the third semester. In this way, the student has the potential to pass the qualifying exam by the end of the third semester and to begin taking thesis credits in the fourth semester.

Dissertation

The last, and most substantial, aspect of the PhD program is the dissertation. The dissertation must embody a significant original research contribution and must be written in accepted scholarly style. The research should be conducted in close consultation with the student's adviser. It is strongly recommended that at least one paper on the research be submitted to a refereed archival journal or refereed conference. When the adviser feels that the student has obtained sufficiently significant research results and has written an acceptable dissertation, a public dissertation defense is scheduled. The defense includes the candidate's oral presentation and questions from the dissertation committee.

Additional requirements for the PhD dissertation are available from the office of the Associate Provost of Research and PhD Programs.

CERTIFICATES IN INFORMATION ASSURANCE

As a National Security Agency–designated Center of Academic Excellence in Information Assurance, NYU-Poly offers NSA-approved certificates in information assurance. The certificates are awarded to students who pursue a bachelor's or master's degree in computer science, computer engineering, telecommunication or electrical engineering and who complete the following course requirements:

NSTISSI 4011: Information Security

Requirements for the Information Security Professional Certificate (27 Credits)

CS 392	Computer Security
CS 6813	Information, Security and Privacy
CS 393	Network Security
CS 6823	Network Management and Security
CS 6843	Computer Networks[2]
CS 6803	Information Security Management
CS 2134/CS 5403	Data Structures and Algorithms
CS 2214/CS 6133	Computer Architecture[1]
CS 3224/CS 6233	Operating Systems[1]
CS 3314/CS 6373	Programming Languages[1]
EE 136/ EL 5363	Principles of Communication Networks[1]

NSTISSI 4013: Information Systems Administration

Requirements for the Information Systems Administration Certificate

4011: Information Systems Administration Certificate

CS 6573	Penetration Testing and System Analysis
CS 6243	Operating Systems II[3]

NOTE:

[1]These courses may be waived if the student has taken a comparable course and has demonstrated proficiency in the required topics/subjects.
[2]May be replaced with EL 5373.
[3]May be replaced with CS 3254.

For more information, contact Professor Nasir Memon at memon@poly.edu.

GRADUATE CERTIFICATE IN CYBER SECURITY

The demand for skilled information-security professionals is growing significantly. This graduate certificate allows technical professionals to obtain key knowledge and specializations in cyber security. Students acquire an understanding of various technologies in emerging areas of security, including computer and network security, digital forensics, cryptography and biometrics. Students are able immediately to apply their knowledge to manage the risk of cyber attacks. Courses are developed and taught by NYU-Poly faculty in the Information Systems and Internet Security (ISIS) Laboratory. Those choosing to work toward a master's degree may, upon admission, apply all certificate courses toward fulfillment of a degree program.

Admission to the certificate program requires a bachelor's degree in a related preparatory discipline from an institution acceptable to Polytechnic Institute of NYU.

Course Requirements for the Cyber Security Certificate (15 credits)

Core Courses (9 credits)

CS 6803*	Information Systems Engineering and Management
CS 6813*	Information, Security and Privacy
CS 6823*	Network Management and Security

Electives (6 credits)

CS 9093*	Biometrics
CS 6903*	Modern Cryptography
CS 9163*	Application Security
CS 6963*	Digital Forensics

* available online.

For more information, contact Professor Nasir Memon at memon@poly.edu.

Graduate Certificate in Software Engineering

The advanced certificate in software engineering comprises five graduate-level courses that give students the knowledge and skills to compete successfully in the software development arena. Students who want to continue their studies may apply these courses to the MS program in computer science.

NYU-Poly, responding to the importance of high-quality software development and integration industry, offers a certificate program in software engineering. This course module provides the knowledge and skills needed to compete successfully in this arena. Topics covered include object-oriented software design, software validation and project management.

The software-engineering certificate is a series of five graduate-level courses. Three required core courses prepare the computer-science professional for a career in advanced software-development. In addition, students choose two other courses from a variety of rotating electives. The elective courses cover areas of current interest to the software-engineering community and allow students to customize their education.

Core Courses **(9 credits)**

CS 6063	Software Engineering I
CS 6073	Software Engineering II
CS 6083	Principles of Database Systems

Electives **(6 credits)**

CS 9963	Advanced Project in Computer Science*
CS 9103	Object Oriented Design with Java
CS 9163	Application Security
CS 6813	Information Security and Privacy

*Highly recommended

Entrance requirements for the certificate program are the same as for the MS program. Students who have superior academic credentials but who lack sufficient background in computer science take two prerequisite courses (CS 5303 Introduction to Programming and Problem Solving and CS 5403 Data Structures and Algorithms).

UNDERGRADUATE COURSES

Students are advised to consult the Schedule of Classes for changes in prerequisites effective after publication of this catalog. Students may not register for any junior- or senior-level courses until they complete all freshman requirements.

CS 205 Assembly Language and Systems Programming *3:0:0:3*

This course covers internal representation of numeric and character data. Topics: Machine organization and machine language programming. Assembly language, assemblers. Assembly language programming: branching, arrays, lists, arithmetic and bit manipulation, macros, stacks, subroutines, parameter passing, recursion. Linking and loading, position independent and reentrant code. Traps and interrupts. *Prerequisite: CS 2134 (C- or better).*

CS 239 UNIX System Programming *3:0:0:3*

This course covers programming and system administration of UNIX systems. Also covered: Shell programming, special purpose languages, UNIX utilities, UNIX programming tools, systems programming and system administration. *Prerequisites: CS 3224 and junior status.*

CS 308 Introduction to Databases *3:0:0:3*

This course introduces database systems and their approach as a mechanism to model the real world. The course covers data models (relational, object-oriented), physical database design, query languages, query processing and optimization, as well as transaction management techniques. Implementation issues, object oriented and distributed databases also are introduced. *Prerequisite: CS 2134.*

CS 391 Java and Web Design *3:0:0:3*

Programmers familiar with C or C++ learn to develop Java applications and applets. This course teaches the syntax of the Java language, object-oriented programming in Java, creating graphical user interfaces (GIU) using the Java 2 Platform technology event model, Java exceptions, file input/output (I/O) using Java Foundation Class threads and networking. *Prerequisite: CS 2134.*

CS 392 Computer Security *3:0:0:3*

This course covers cryptographic systems. Topics: Capability and access control mechanisms, authentication models, protection models. Database and operating system security issues, mobile code, security kernels. Malicious code, Trojan horses and computer viruses. Security policy formation and enforcement, legal aspects and ethical aspects. *Prerequisites: CS 2214 and MA 2312. Co-requisite: CS 3224.*

CS 393 Network Security *3:0:0:3*

This course covers reviews networking. Topics: Basic notations of confidentiality, integrity, availability; cryptographic systems, coding and decoding messages. Cryptographic protocols for privacy, integrity, key exchange and access control. TCP/IP security; Firewalls, IPSec; secure ecommerce. Intrusion detection, prevention, response. Advanced topics are included. *Prerequisites: CS 3224 and CS 6843, or EE 136, EL 5363 or EL 5373.*

CS 394 Special Topics in Computer Science

This variable-credit special topics course is for juniors and seniors. *Prerequisite: Departmental permission.*

CS 1012 Introduction to Computer Engineering

This course helps students to understand computer engineering as a balance among hardware, software, applications and theory, the notion of abstraction, computer layers and how they related to various aspects of computer engineering, implementation of abstract and physical computer layers: Number systems, digital logic, basic processor structure, instruction set architecture, machine learning, assembly languages and high-level programming in C. Other computer concepts, including compilers, operating systems, and algorithms presented, along with the simulator concept and its usage for understanding computer design, testing and analysis. Experts present special topics in the area. Also discussed are invention, innovation, entrepreneurship and ethics in these topics and in Computer Engineering. *Also listed under EE 1012.*

CS 1114 Introduction to Programming and Problem Solving *3:3:0:4*

This course introduces problem solving and computer programming and is for undergraduate Computer Science and Computer Engineering majors who have limited prior experience in programming in any language. The course covers fundamentals of computer programming and its underlying principles using the Python programming language. Concepts and methods introduced in the course are illustrated by examples from various disciplines. Weekly laboratory required.

CS 1122 Computer Science and Engineering *2:0:0:2*

This is a breadth-first course that introduces computer-science majors to several subdisciplines in the computer-science field. The course is built around the theme that computer science is the study of algorithms and includes much more than programming. The course introduces hardware, virtual machines, software, applications and social issues in computing.

CS 1124 Object Oriented Programming *3:3:0:4*

This intermediate-level programming course teaches object-oriented programming in C++. Topics: Pointers, dynamic memory allocation and recursion. Classes and objects including constructors, destructors, methods (member functions) and data members. Access and the interface to relationships of classes including composition, association and inheritance. Polymorphism through function overloading operators. Inheritance and templates. The standard template library is used to introduce elementary data structures and their use. Grade of C- or better required of computer science and computer engineering majors. Weekly laboratory required. *Prerequisite: CS 1114 (C- or better).*

CS 1133 Engineering Problem Solving and Programming *2:0:3:3*

This introductory course in engineering problem solving and computer programming is for all undergraduate engineering students without prior programming experience in any language. The course covers the fundamentals of computer programming and its underlying principles using the MATLAB programming language. Concepts and methods are illustrated by examples from various engineering disciplines. Useful numerical techniques and their applications to real-world problems in science and engineering are also discussed. Weekly laboratory required.

CS 1213 Introduction to Programming with Java *3:0:0:3*

This introductory course in computer programming and problem solving is for students in the Digital Media program. The course is taught in the Java programming language of Java's interactive multi- capabilities. Students learn the main components and features of Java, understand the elements of Object Oriented Programming and how they relate to Java, and write applications and applets that can be incorporated into HTML documents for the World Wide Web. Students also learn programming methodology, which involves thinking about the best way to plan the design using object-oriented design and appropriate features of Java. Also covered is methodical and efficient development of the implementation using step-wise refinement, incremental testing and debugging.

CS 2134 Data Structures and Algorithms *4:0:0:4*

This course covers abstract data types and the implementation and use of standard data structures. Topics: Fundamental algorithms and the basics of algorithm analysis. A grade of C- or better is required of undergraduate computer science and computer-engineering majors. *Prerequisites: CS 1124 (C- or better) and MA 1024. Co-requisite: MA 2312/2322.*

CS 2164 Introduction to Programming in C *3:1.5:0:4*

This course covers programming in C. Topics: The syntax, variables, expressions, working environment, printf and scanf. Function calls and returns. Branching and looping. Relational operators. Bit-wise operators. Boolean expressions. Recursion. Pointers. Data structures: Arrays, structs, lists, stacks, trees, queues. String processing. Low level memory management, dynamic memory allocation. The preprocessor. File processing : fprintf, fscanf, fseek, sscanf. Concurrency, fork, pipe, signal. Dynamic multidimensional arrays, OS APIs. Linux/UNIX integration. A laboratory meets weekly. *Prerequisites: EE major status and either CS 1133 or CS 1114. Co-requisite: CS 2164 Lab.*

CS 2204 Digital Logic and State Machine Design *3:3:0:4*

This course covers combinational and sequential digital circuits. Topics: Introduction to digital systems. Number systems and binary arithmetic. Switching algebra and logic design. Error detection and correction. Combinational integrated circuits, including adders. Timing hazards. Sequential circuits, flip-flops, state diagrams and synchronous machine synthesis. Programmable Logic Devices, PLA, PAL and FPGA. Finite-state machine design. Memory elements. Weekly laboratory experiments introduce digital system design on FPGAs. A grade of C- or better is required of undergraduate computer-engineering majors. *Prerequisite: CS 1114 (C- or better) or CS 1133 (C- or better).*

CS 2214 Computer Architecture and Organization *3:0:2:4*

This course covers is a top/down approach to computer design. Topics: Computer architecture, introduction to assembly language programming and machine language set design. Computer organization, logical modules; CPU, memory and I/O units. Instruction cycles, the datapath and control unit. Hardwiring and microprogramming. The memory subsystem and timing. I/O interface, interrupts, programmed I/O and DMA. Introduction to pipelining and memory hierarchies. Fundamentals of computer networks. Weekly recitations support lecture topics and study homework assignments. *Prerequisites: CS 2204 (C- or better) for computer engineering majors; CS 2134 (C- or better) and MA 2312/2322 for computer science majors.*

CS 3113 Game Programming *3:0:0:3*

A programming intensive introduction to the creation of computer games. Using mostly two-dimensional sprite-based programming, we examine and experiment with animation, physics, artificial intelligence and audio. In addition, the course explores the mathematics of transformations (both 2D and 3D) and the ways they may be represented. *Prerequisite: CS 2134 (C- or better).*

CS 3224 Operating Systems *4:0:0:4*

This course studies the fundamental concepts and principles of operating systems. Batch, spooling and multiprogramming systems are introduced. The parts of an operating system are described in terms of their functions, structure and implementation. Basic policies for allocating resources are discussed. *Prerequisites: CS 2214 and CS 2134 (C- or better).*

CS 3233 Game Development Studio I *3:0:0:3*

This class introduces the principles of 2D and 3D computer game design. Students learn about the range of game types and understand their conceptual building blocks. Students complete a structured sequence of assignments towards the design for a new game.

CS 3254 Introduction to Parallel and Distributed Systems *3:3:0:4*

This course offers a solid grounding in the basic issues and techniques of parallel and distributed computing. The material covers the spectrum from theoretical models of parallel and distributed systems to actual programming assignments. *Prerequisite: CS 2134.*

CS 3314 Design and Implementation of Programming Languages *4:0:0:4*

This course covers issues underlying the design of high-level programming languages, along with elements of the compiler technology used to translate those languages into executable code. Topics covered include formal description of language syntax, parsing, memory management, attributes of variables and their binding times, control and data-abstraction mechanisms and object-oriented language features. The focus is on imperative and object-oriented languages, with brief introduction to functional and logic-programming paradigms. Substantial programming projects are required. *Prerequisites: CS 2134 (C- or better) and MA 2312.*

CS 3413 Design and Analysis of Algorithms *3:0:0:3*

This course covers fundamental principles of the design and analysis of algorithms. Topics include asymptotic notation, recurrences, randomized algorithms, sorting and selection, balanced binary search trees, augmented data structures, advanced data structures, algorithms on strings, graph algorithms, geometric algorithms, greedy algorithms, dynamic programming and NP completeness. *Prerequisites: CS 2134 (C- or better) and MA 2312/2322.*

CS 3714 Secure Information Systems Engineering I *4:0:0:4*

This course develops an approach to secure information-systems engineering consistent with today's vulnerabilities, threats and risks. Grounding is established in the basic security technologies and strategies in use today. A concept of security engineering is constructed for whole elements of the critical infrastructure (e.g., utilities, government services, financial services, etc.) including legacy environments, the Internet, wireless and the coming evolution of ubiquitous computing. *Prerequisite: Junior status.*

CS 3734 Scientific and Engineering Computing I *4:0:0:4*

This course takes advantage of the programming skills learned in introductory-level, computer-science courses to exploit the broad power of modern computing related to science and engineering disciplines. Computational techniques are taught in parallel with programming and problem-solving methodologies. Students learn to recognize a good or bad formulation of a problem, select the proper algorithm to solve a given computational problem and interpret the results. In doing so, they learn to become intelligent users, rather than creators, of computational software. *Prerequisites: CS 1114, MA 1124, and MA 2012/2132.*

CS 3513 Software Engineering I *3:0:0:3*

This course is the first of a two-course sequence of a design project (DP I and DP II). Focusing on software engineering, the course introduces techniques to specify, design, test and document medium and large software systems. Design techniques include information engineering, object orientation and complexity measures. Also covered are testing methods, such as path testing, exhaustive test models and construction of test data. An introduction to software tools and project management techniques is presented. Student projects involve team software development and tracking. *Prerequisites: CS 2134 (C- or better), CS 3224 and senior status.*

CS 4523 Design Project II *1:6:0:3*

This is the second course in a two-course design-project sequence (DP I and DP II) Students or several students work with a faculty member and/or graduate students on a current topic in computer science. Each term, a project course with a particular theme is offered by the Department of Computer and Information Science. A faculty member assigns individual or group projects. The project course is highly structured and supervised closely by faculty. Students are expected to use the design and project-management skills they learned in CS 4513 Software Engineering. Alternatively, students may work with a faculty member on an individual project of mutual interest. A written report and oral presentation are required. *Prerequisite: CS 3513.*

CS 4724 Secure Information Systems Engineering II *4:0:0:4*

This second semester course comprises projects, labs and discussions in Applied Secure Information Systems Engineering. Specifically, students build a comprehensive platform for secure computing based on best of breed, Open Source components starting with OpenBSD or a similar one. This platform is then contrasted with Java Security and with the secure computing efforts of Microsoft and its associates. A "Student Hackathon" is conducted to test findings and assumptions. Finally, recommendations are made to support the future security-procurement needs for whole elements of the critical Infrastructure.

CS 4744 Scientific and Engineering Computing II *4:0:0:4*

Making use of the knowledge acquired in Part I of the course, the second semester focuses on well-recognized, major computational developments with the greatest influence on the development and practice of science and engineering in the last century. The course draws upon a variety of computational problems from the breadth of science and engineering to interest students and to establish the relevance of the computational problem-solving approach. Students undertake projects. *Prerequisite: CS 3734.*

GRADUATE PREPARATORY COURSES

The graduate courses listed in this section were formulated to accommodate the needs of students who wish to pursue graduate studies in computer science, but who lack sufficient undergraduate preparation. No credit is allowed for these courses toward graduate degrees in computer science, information-systems engineering or other graduate degree programs administered by the Department of Computer and Information Science. Submission of substantial computer programming assignments is required in all these courses.

CS 5303* Introduction to Programming and Problem Solving *3:0:0:3*

This course introduces discrete mathematics, computers and programming; Running C/C++ programs under Unix; algorithmic language; pseudo code; problem solving and program structure. Topics include constants, variable, data types, assignments, arithmetic expressions, input and output; object-oriented and top-down design and procedures, selection and loops; functions; enumerated; arrays, structs and searching and sorting. *Prerequisite: Graduate status. *Online version available.*

CS 5403* Data Structures and Algorithms *3:0:0:3*

This course introduces data structures. Topics include program specifications and design; abstract data types; stacks, queues; dynamic storage allocation; sequential and linked implementation of stacks and queues; searching methods, sequential and binary; binary trees and general trees; hashing; computational complexity; sorting algorithms: selection sort, heap sort, mergesort and quicksort; comparison of sorting techniques and analysis. *Prerequisite: Graduate status and CS 5303. *Online version available.*

GRADUATE COURSES

Graduate courses in computer science are regularly offered on each campus, either annually or in two- or-three year cycles.

CS 6003 Foundations of Computer Science *3:0:0:3*

This course covers logic, sets, functions, relations, asymptotic notation, proof techniques, induction, combinatorics, discrete probability, recurrences, graphs, trees, mathematical models of computation and undecidability. *Prerequisite: Graduate status. Co-requisite: CS 5303.*

CS 6005-6025 Variable Credit Project/ Course

For students needing .5, 1, 1.5, 2 and 2.5 credit hours to meet graduation requirements, a project or special course is available with faculty approval.

CS 6033 Design and Analysis of Algorithms I *3:0:0:3*

This course reviews basic data structures and mathematical tools. Topics: Data structures, priority queues, binary search trees, balanced search trees. Btrees. Algorithm design and analysis techniques illustrated in searching and sorting: heapsort, quicksort, sorting in linear time, medians and order statistics. Design and analysis techniques: dynamic programming, greedy algorithms. Graph algorithms: elementary graph algorithms (breadth first search, depth first search, topological sort, connected components, strongly connected components), minimum spanning tree, shortest path. String algorithms. Geometric algorithms. Linear programming. Brief introduction to NP completeness. *Prerequisites: Graduate status, CS 5403 and CS 6003.*

CS 6043 Design and Analysis of Algorithms II *3:0:0:3*

This course covers techniques in advanced design and analysis. Topics: Amortized analysis of algorithms. Advanced data structures: binomial heaps, Fibonacci heaps, data structures for disjoint sets, analysis of union by rank with path compression. Graph algorithms: elementary graph algorithms, maximum flow, matching algorithms. Randomized algorithms. Theory of NPcompleteness and approach to finding (approximate) solutions to NPcomplete problems. Selected additional topics that may vary. *Prerequisites: Graduate status and CS 6033.*

CS 6063 Software Engineering I *3:0:0:3*

The course emphasizes the full software-engineering approach with alternative approaches. Technical emphasis is on requirements, design, development and modeling. Management issues include software cost estimating and project management. Understanding the processes applicable to the software development/integration cycle and maintenance along with technology changes on quality and development activities is highlighted. *Prerequisites: Graduate status and CS 5403.*

CS 6073 Software Engineering II *3:0:0:3*

The course covers modern, advanced software-engineering approaches with theory and practice orientations. Important design and management issues are analyzed and evaluated. Technical and management tradeoffs in distributed software systems are emphasized. An extensive number of real world case studies are assessed. A class project is required. *Prerequisites: Graduate status and CS 6063.*

CS 6083 Principles of Database Systems *3:0:0:3*

This course broadly introduces database systems, including the relational data model, query languages, database design, index and file structures, query processing and optimization, concurrency and recovery, transaction management and database design. Students acquire hands-on experience in working with database systems and in building web-accessible database applications. *Prerequisites: Graduate status, CS 6003 or equivalent, familiarity with basic data structures and operating system principles.*

CS 6093 Advanced Database Systems *3:0:0:3*

Students in this advanced course on database systems and data management are assumed to have a solid background in databases. The course typically covers a selection from the following topics: (1) advanced relational query processing and optimization, (2) OLAP and data warehousing, (3) data mining, (4) stream databases and other emerging database architectures and applications, (5) advanced transaction processing, (6) databases and the Web: text, search and semistructured data, or (7) geographic information systems. Topics are taught based on a reading list of selected research papers. Students work on a course project and may have to present in class. *Prerequisites: Graduate status and CS 6083 or equivalent, including experience with a relational database system.*

CS 6133* Computer Architecture I *3:0:0:3*

This course provides students with an understanding of computer-hardware subsystems, digital design strategies and fundamental computer-performance and capacity-improvement techniques. Combinational and sequential circuits are developed for the essential building blocks of computers. Binary number systems are presented in both human and computer algorithms. A uniprocessor computer is built from the blocks developed. An assembly language and an instruction set are presented. Processor implementation with a data path and hardwired and microprogrammed control is introduced. Performance evaluation of computers is studied. Basic pipelining is introduced to improve system performance. Memory-hierarchy alternatives are introduced to improve the capacity of the computing system. *Prerequisite: Graduate status.*Online version available.*

CS 6143 Computer Architecture II *3:0:0:3*

This course covers high-speed computer design. Topics: Uni-processor computer architectures that exploit parallelism, advanced pipelining, superscalar, VLIW, vector processors. Parallel processing: Interconnection structures, MIMD and SIMD systems. Other selected parallel computing topics, such as parallel algorithms, PRAM machines and multicore processing. *Prerequisites: Graduate status and CS 6133.*

CS 6183 Fault-Tolerant Computers *3:0:0:3*

This course introduces a variety of hardware and software techniques to design and model fault-tolerant computers. Topics include coding techniques (Hamming, SECSED, SECDED, etc.); majority voting schemes (TMR); software redundancy (Nversion programming); software-recovery schemes; network reliability design and estimation. The course introduces probabilistic methods for reliability modeling. Other topics: Examples from space fault tolerant systems, networks, commercial nonstop systems (TANDEM and STRATUS). RAID memory systems. Fault-tolerant modeling tools such as HARP, SHURE and SHARPE. *Prerequisites: Graduate status and CS 6133.*

CS 6233 Introduction to Operating Systems *3:0:0:3*

This course introduces basic issues in operating systems. Topics: Threads, processes, concurrency, memory management, I/O Control and case studies. *Prerequisite: Graduate status.*

CS 6243 Operating Systems II *3:0:0:3*

This course surveys recent important commercial and research trends in operating systems. Topics may include virtualization, network server design and characterization, scheduling and resource optimization, file systems, memory management, advanced debugging techniques, data-center design and energy utilization. *Prerequisite: CS 6233.*

CS 6253 Distributed Operating Systems *3:0:0:3*

This course introduces distributed-networked computer systems. Topics: Distributed control and consensus. Notions of time in distributed systems. Client/Server communications protocols. Middleware. Distributed File Systems and Services. Fault tolerance, replication and transparency. Peer-to-peer systems. Case studies of modern commercial systems and research efforts.

CS 6273 Performance Evaluation of Computer Systems *3:0:0:3*

This course focuses on modeling and performance analysis of computer systems. It concentrates on testing and evaluation of three-tiered distributed client/server and WEB-based systems and generally on distributed networking systems. The course presents and evaluates various systems architectures from a macro and micro viewpoint. *Prerequisites: Graduate status and EL 5363 or MA 2212/2222 and instructor's permission.*

CS 6373 Programming Languages *3:0:0:3*

This course covers the structures, notations and semantics of programming languages. Topics: Issues of scope, type structure and parameter passing. Control structures, including support for exception handling and concurrency. Abstract data types and object oriented languages. Programming in the large. Implementation issues. Functional, logic programming languages. Examples from a variety of languages. *Prerequisites: Graduate status and CS 5403.*

CS 6413 Compiler Design and Construction *3:0:0:3*

This course covers compiler organization. Topics: Lexical analysis, syntax analysis, abstract syntax trees, symbol table organization, code generation. Introduction to code optimization techniques. *Prerequisites: CS 5403, CS 6133 and CS 6003.*

CS 6533 Interactive Computer Graphics *3:0:0:3*

This course introduces the fundamentals of computer graphics with hands-on graphics programming experiences. Topics include graphics software and hardware, 2D line segment-scan conversion, 2D and 3D transformations, viewing, clipping, polygon-scan conversion, hidden surface removal, illumination and shading, compositing, texture mapping, ray tracing, radiosity and scientific visualization. *Prerequisites: Graduate status and CS 5403 or equivalents and knowledge of C or C++ programming.*

CS 6573* Penetration Testing and Vulnerability Analysis *3:0:0:3*

This advanced course in computer and network security focuses on penetration testing and vulnerability analysis. It introduces methodologies, techniques and tools to analyze and identify vulnerabilities in standalone and networked applications. *Prerequisite: CS 6823. *Online version available.*

CS 6613 Artificial Intelligence I *3:0:0:3*

Artificial Intelligence (AI) is an important topic in computer science and offers many diversified applications. It addresses one of the ultimate puzzles humans are trying to solve: How is it possible for a slow, tiny brain, whether biological or electronic, to perceive, understand, predict and manipulate a world far larger and more complicated than itself? And how do people create a machine (or computer) with those properties? To that end, AI researchers try to understand how seeing, learning, remembering and reasoning can, or should, be done. This course introduces students to the many AI concepts and techniques. *Prerequisites: Graduate status and CS 5403.*

CS 6643 Computer Vision and Scene Analysis *3:0:0:3*

An important goal of artificial intelligence is to equip computers with the capability to interpret visual inputs. Computer vision and scene analysis is an AI area that deals with constructing explicit, meaningful descriptions of physical objects from images. It includes many techniques from image processing, pattern recognition, geometric modeling and cognitive processing. This course introduces the many techniques and applications of computer vision and scene analysis. *Prerequisites: Graduate status, CS 5403 and MA 2012, or equivalents, or instructor's permission.*

CS 6673 Neural Network Computing *3:0:0:3*

This course introduces neural network models and their applications. Topics: Discussion of organization and learning in neural network models including perceptrons, adalines, backpropagation networks, recurrent networks, adaptive resonance theory and the neocognitron. Implementations in general and special purpose hardware, both analog and digital. Application in various areas with comparisons to nonneural approaches. Decision systems, nonlinear control, speech processing and vision. *Prerequisites: Graduate status and CS 5403; some familiarity with matrix notation and partial derivatives is recommended.*

CS 6703 Computational Geometry *3:0:0:3*

This course introduces data structures and algorithms for geometric data. Topics include intersection, polygon triangulation, linear programming, orthogonal range searching, point location, Voronoi diagrams, Delaunay triangulations, arrangements and duality, geometric data structures, convex hulls, binary space partitions, robot motion planning, quadtrees, visibility graphs, simplex range searching. *Prerequisite: Graduate status.*

CS 6753 Theory of Computation *3:0:0:3*

This course introduces the theory of computation. Topics: Formal languages and automata theory. Deterministic and non-deterministic finite automata, regular expressions, regular languages, context-free languages. Pumping

theorems for regular and context-free languages. Turing machines, recognizable and decidable languages. Limits of computability: the Halting Problem, undecidable and unrecognizable languages, reductions to prove undecidability. Time complexity, P and NP, Cook-Levin theorem, NP completeness. *Prerequisites: Graduate status and CS 6003 or instructor's permission.*

CS 6803* Information Systems Security Engineering and Management *3:0:0:3*

This course presents a system and management view of information security: what it is, what drives the requirements for information security, how to integrate it into the systems-design process and life-cycle security management of information systems. A second goal is to cover basic federal policies on government information security and methodologies. Topics include information-security risk management, security policies, security in the systems-engineering process, laws related to information security and management of operational systems. *Prerequisites: Graduate status and CS 392 or equivalent. *Online version available.*

CS 6813* Information, Security and Privacy *3:0:0:3*

This course introduces Information Systems Security and covers cryptography, capability and access control mechanisms, authentication models, security models, operating systems security, malicious code, security-policy formation and enforcement, vulnerability analysis, evaluating secure systems. *Prerequisite: Graduate status. *Online version available.*

CS 6823* Network Security *3:0:0:3*

This course begins by covering attacks and threats in computer networks, including network mapping, port scanning, sniffing, DoS, DDoS, reflection attacks, attacks on DNS and leveraging P2P deployments for attacks. The course continues with cryptography topics most relevant to secure networking protocols. Topics covered are block ciphers, stream ciphers, public key cryptography, RSA, Diffie Hellman, certification authorities, digital signatures and message integrity. After surveying basic cryptographic techniques, the course examines several secure networking protocols, including PGP, SSL, IPsec and wireless security protocols. The course examines operational security, including firewalls and intrusion-detection systems. Students read recent research papers on network security and participate in an important lab component that includes packet sniffing, network mapping, firewalls, SSL and IPsec. *Prerequisites: Graduate status and EL 5363 or CS 6843. *Online version available.*

CS 6843 Computer Networking *3:0:0:3*

This course takes a top-down approach to computer networking. After an overview of computer networks and the Internet, the course covers the application layer, transport layer, network layer and link layers. Topics at the application layer include client-server architectures, P2P architectures, DNS and HTTP and Web applications. Topics at the transport layer include multiplexing, connectionless transport and UDP, principles or reliable data transfer, connection-oriented transport and TCP and TCP congestion control. Topics at the network layer include forwarding, router architecture, the IP protocol and routing protocols including OSPF and BGP. Topics at the link layer include multiple-access protocols, ALOHA, CSMA/CD, Ethernet, CSMA/CA, wireless 802.11 networks and linklayer switches. The course includes simple quantitative delay and throughput modeling, socket programming and network application development and Ethereal labs. *Prerequisites: Graduate status and CS 2134.*

CS 6873 Project in Telecommunication Networks *3:0:0:3*

In this course, students design, develop and test communication software. Students work in small groups under faculty direction. Students have access to network resources for their work. *Prerequisites: Graduate status and CS 6843 and instructor's permission.*

CS 6903 Modern Cryptography *3:0:0:3*

This course examines modern cryptography from a theoretical perspective, with an emphasis on "provable security." The course looks particularly at cryptographic primitives that are the building blocks of various cryptographic applications. The course studies notions of security for a given cryptographic primitive, its various constructions and respective security analysis based on the security notion. The cryptographic primitives covered include pseudo-random functions, symmetric encryption (block ciphers), hash functions and random oracles, message authentication code, asymmetric encryption and digital signatures. Time permitting, the course covers how to build secure cryptographic protocols for authenticated key exchange, using the primitives studied. Also covered: various number-theoretic assumptions upon which cryptography is based. *Prerequisite: Graduate status.*

CS 6913 Web Search Engines *3:0:0:3*

This course covers the basic technology underlying Web search engines and related tools. The main focus is on large-scale Web search engines (such as Google, Yahoo and MSN Search) and their underlying architectures and techniques. Students learn how search engines work and get hands-on experience in how to build search engines from the ground up. Topics are based on a reading list of recent research papers. Students must work on a course project and may have to present in class. *Prerequisites: Good programming skills and graduate status.*

CS 6923 Machine Learning *3:0:0:3*

This course introduces the field of machine learning and covers standard machine-learning techniques, such as decision trees, nearest neighbor, Bayesian methods, support vector machines and logistic regression. Topics: Basic concepts in computational learning theory including the PAC model and VC dimension. Methods for evaluating and comparing machine learning techniques. *Prerequisite: Graduate status.*

CS 6963* Digital Forensics *3:0:0:3*

This course introduces information-technology professionals to the application of forensic science principles and practices for collecting, preserving, examining, analyzing and presenting digital evidence. The course includes selected topics from the legal, forensic and information-technology domains and uses lecture, laboratory and written projects to illustrate these topics. *Prerequisite: Graduate status. *Online version available.*

CS 9013-9253 Selected Topics in Computer Science *3 credits each*

This course covers topics of current interest in computer science. Recent offerings include software specification and validation, parallel algorithms and architectures, client-server systems and advanced object-oriented design (Java). Advanced topics: Databases, performance analysis, computer simulation, Java programming, Unix programming, human and computer interaction, cryptography with financial applications and biometric identification. *Prerequisites: Graduate status; others specified when course is offered.*

CS 9093* Biometrics *3:0:0:3*

The course concentrates on the unique advantages that biometrics brings to computer security. The course also addresses such challenging issues as security strength, recognition rates and privacy, as well as alternatives of passwords and smart cards. Students gain knowledge in the building blocks of this field: image and signal processing, pattern recognition, security and privacy and secure system design. By the end of the course students are able to evaluate and design security systems that include biometrics. *Prerequisite: Graduate status. *Online version available.*

CS 9163* Application Security *3:0:0:3*

This course addresses the design and implementation of secure applications. Concentration is on writing software programs that make it difficult for intruders to exploit security holes. The course emphasizes writing secure distributed programs in Java. The security ramifications of class, field and method visibility are emphasized. *Prerequisite: Graduate status.*Online version available.*

CS 9413/CS 9423 Readings in Computer Science I/II *3 credits each*

This course is primarily for advanced graduate students who wish to study in a specialized area under faculty supervision. Permission of the graduate director is required, as are regular meetings with the adviser. An examination or term report is required. *Prerequisite: Graduate status.*

PROJECT AND THESIS
Students may register and receive credit for these courses more than once.

CS 9963 Advanced Project in Computer Science *3:0:0:3*

This course permits the student to perform research in computer science with a narrower scope than a master's thesis. Acceptance of a student by a faculty adviser is required before registration. A project report and an oral examination on it are required. *Prerequisite: Graduate status.*

CS 997X Thesis for Degree of Master of Science *Variable credits*

Exceptional students may elect to write a master's thesis for which no more than 6 credits may be earned toward the degree. Such research should demonstrate adequately the student's proficiency in the subject material. Also required: oral thesis defense before at least three professors, plus a formal, bound thesis volume. Thesis registration must be continuous. *Prerequisites: Graduate status and satisfactory grades in prescribed courses.*

CS 999X Dissertation for Degree of Doctor of Philosophy *Variable credits*

The dissertation is an original investigation of a computer-science problem. The dissertation must demonstrate creativity and include features of originality and utility worthy of publication in a recognized journal. Candidates must orally defend their dissertations successfully. Registration of 21 credits and continuous dissertation registration are required. *Prerequisites: Passing of qualifying examination and approval of the Department of Computer Science and Engineering.*

Typical Course of Study for the Bachelor of Science in Computer Science

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Class	Lab.	Rec.	Cr.
		Hours/Week			
CS 1114	Intro. To Prog. and Problem Solving[1]	3	3	0	4
EG 1001	Engineering and Technology Forum	1	0	0	1
EN 1013W	College Writing Workshop[2]	3	0	0	3
MA 1024	Calculus I[3]	4	0	0	4
EG 1003	Intro to Engineering Design	2	3	0	3
					15

Spring Semester

Course No.	Course Title	Class	Lab.	Rec.	Cr.
		Hours/Week			
CS 1124	Object Oriented Programming[1]	3	3	0	4
CS 1122	Introduction to Computer Science	2	0	0	2
MA 1124	Calculus II	4	0	0	4
HuSS 1023W	First Year Writing Seminar	3	0	0	3
	Science Elective[4]	3	0	0	3
					16

SOPHOMORE YEAR

Fall Semester

CS 2134	Data Structures and Algorithms[1]	4	0	0	4
MA 2312	Discrete Math. I (½ semester)	4	0	0	2
MA 2322	Discrete Math. II (½ semester)	4	0	0	2
PL 2143	Ethics and Technology	3	0	0	3
	Science Elective[4]	3	0	0	3
Humanities and Social Sciences Elective[6]		3	0	0	3
					17

Spring Semester

CS 2214	Computer Arch. and Organization	3	0	2	4
MA 2212	Data Analysis I (½ semester)	4	0	0	2
MA 2222	Data Analysis II (½ semester)	4	0	0	2
CS	Elective[5]	3	0	0	3
	Science Elective[4]	3	0	0	3
Humanities and Social Sciences Elective[6]		3	0	0	3
					17

JUNIOR YEAR

Fall Semester

CS 3224	Introduction to Operating Systems	4	0	0	4
CS 3513	Software Engineering	3	0	0	3
MA 2012	Linear Algebra I (½ semester)	2	0	0	2
CS	Elective[5]	3	0	0	3
	Elective[7]				3
	Elective[7]				3
					18

Spring Semester

CS 3413	Design and Analysis of Algorithms	3	0	0	3
CS	Elective[5]	3	0	0	3
	Elective[7]				3
	Elective[7]				3
Humanities and Social Sciences Elective[6]		3	0	0	3
					15

SENIOR YEAR

Fall Semester

CS 4523	Design Project	3	0	0	3
CS	Elective[5]	3	0	0	3
	Elective[7]				3
	Elective[7]				3
Humanities and Social Sciences Elective[6]		3	0	0	3
					15

Spring Semester

CS	Elective[5]	3	0	0	3
CS	Elective[5]	3	0	0	3
	Elective[7]				3
	Elective[7]				3
Humanities and Social Sciences Elective[6]		3	0	0	3
					15

Total credits required for graduation: 128

1. Grade of C- or better is required in CS 1114, CS 1124 , CS 2134, MA 1024 and MA 1124.
2. Students who are placed by examination or by an adviser into EN 1080W must subsquently register for EN 1033W, rather than EN 1013W.
3. Students who are placed by examination or by an adviser into MA 914 must defer registration for MA 1024.
4. The Science electives may be chosen from any natural sciences (Physics, Biology and Chemistry).
5. Computer Science students must choose a concentration area consisting of three related courses. In addition, at least one of the CS elective must be a project course. A list of concentration areas and project courses are be available from the CSE department.
6. At least one Humanities and Social Sciences elective must be a Writing-intensive course. Writing-intensive Humanities and Social Sciences courses are designated by "W." In addition, one Humanities and Social Sciences elective must be a 3xxx or 4xxx level. Approved Humanities and Social Sciences electives span three clusters: CAM, STS and SEG. Students are encouraged to take Humanities and Social Sciences electives across clusters and/or disciplines within a cluster.
7. At least 9 credits of electives must be chosen from Math, Science or Humanities and Social Sciences.
8. With approval of the CSE department, certain closely related courses in EE, Math or other related disciplines may be substituted for CS electives. A list of approved substitutions is be available in the CSE department.

CONSTRUCTION MANAGEMENT PROGRAM

Program Directors:
Fletcher H. (Bud) Griffs and
Lawrence Chiarelli

UNDERGRADUATE PROGRAM

The Bachelor of Science in Construction Management is an interdisciplinary program in the Department of Civil Engineering. The program prepares students for a challenging career in the construction industry—as future leaders in a dynamic and ever-changing environment. It concentrates on the skills and understanding necessary to excel as a construction management professional and to compete in the marketplace. Graduates are engaged by owners, developers, construction managers, contractors, architects and engineers, lenders and other construction industry participants.

The Bachelor of Science in Construction Management program covers a broad range of subjects in engineering and construction management, such as planning, cost estimating, scheduling, project management and construction administration. The program also exposes students to the latest applications in construction research and technology. The program teaches students the fundamentals of engineering and construction science, as well as business aspects of construction and the application of traditional and emerging construction methods and technologies. Students also study basic economics, accounting and management principles.

Courses and projects in the program's junior and senior years illustrate current project management principles and methods by using materials from, and site visits to, construction projects led by experienced mentors.

Beyond the classroom, real-world work experience is available through internships and summer and part-time employment and through professional organizations and associated student chapters, including the Construction Management Association of America (CMAA), the Associated Schools of Construction (ASC), the American Society of Civil Engineers (ASCE), the Society of American Military Engineers (SAME) and the New York Building Congress (NYBC). NYU-Poly's Career Management Center also supports these efforts.

GOALS AND OBJECTIVES

The objective of the Bachelor of Science in Construction Management is to provide the following for its students:

- A solid foundation of knowledge in mathematics and the basic sciences as applied to construction management.
- The knowledge and skills to excel at an entry-level position as a construction professional and/or continue graduate study in construction management or a related field.
- The necessary written and oral communications skills to enable graduates to pursue leadership opportunities.
- A thorough understanding of state-of-the-art techniques and tools in construction management involving three-dimensional computer modeling, building information modeling (BIM), integration of information technology and the application of innovative planning, design and construction administration methodologies.
- A broad education in preparation for lifelong learning and individual growth. Students are required to take courses in writing and the humanities. Electives allow students to further customize their education to enhance individual interests.

PEDAGOGY

Construction management courses use a variety of pedagogical models, including theory-led teaching, case-method education and project-based and team-based teaching.

Teaching based on exposition of theory is applied to engineering and construction science. Fundamentals in mathematics, chemistry and physics, statics, mechanics of materials, modeling and construction methods and materials are necessary prerequisites to developing and applying construction management skills.

Case-method teaching uses real-world business experiences to demonstrate the application of general principles and to apply them to specific problems posed during instruction. This pedagogy is used to teach construction contracts and administration, estimating, scheduling, planning, safety and construction law.

Project-based and team-based education are experiential; students learn by doing, much as they would in a natural sciences laboratory class. Project-based education also provides students an opportunity to learn how to assemble and coordinate necessary information, assert authority and delegate responsibility. This skill is particularly important in construction management, in which the essential tasks are managing people and information.

It is common in construction management courses to employ all pedagogical approaches. The construction management faculty brings together theory-based instruction and an intimate understanding of state-of-the-art construction management practices.

The City of New York provides a universe of projects that are readily available to students to serve as a virtual laboratory. Construction documents and other resources are available to students for classroom study and visiting project sites. Faculty members who are actively involved in construction projects discuss the unique and special problems encountered on such projects, as well as potential solutions. Visits to professional offices and project sites are an essential part of an NYU-Poly construction management education.

PROGRAM CONTENT

The construction management curriculum incorporates the following subject areas:

	Credits
General Education	24
Mathematics and the Sciences	22
Business and Management	19
Construction Science	24.5
Construction	26.5
Other	12
Total:	**128**

CURRICULUM

The Bachelor of Science in Construction Management program is advised by a Department Advisory Board, comprising leaders from the engineering and construction professions to help assess and update the program curriculum. The general requirements of the curriculum accommodate the continually expanding requirements of the profession, advancements in knowledge and the contributions of related disciplines. Its offerings are intended to exceed minimum requirements by subject area of the American Council for Construction Engineering (ACCE) Standards and Criteria for Accreditation.

Table 1 summarizes the Construction Management curriculum by subject category. A typical four-year schedule for the program is included at the end of this section of the catalog.

TABLE 1: CURRICULUM FOR THE BS (CONSTRUCTION MANAGEMENT)

Course No.	Course Title	Credits	Sem[1]
Required Courses in Mathematics			
MA 1024	Calculus I[2]	4.0	F1
MA	Mathematics Elective[3]	4.0	F2
MA 2054	Applied Business Data Analysis I; or	4.0	So2
MA 2212	Data Analysis I; and	2.0	So2
MA 2222	Data Analysis II	2.0	So2
Total Required Credits in Mathematics		**12.0**	
Required Courses in the Physical Sciences			
CM 1004	General Chemistry for Engineers	4.0	F1
PH 1013	Mechanics	3.0	F2
Total Required Credits in Physical Sciences		**7.0**	
Required Courses in Humanities and Social Sciences			
EN 1013W	College Writing Workshop[4]	3.0	F1
HuSS 1023W	First-Year Writing Seminar[4]	3.0	F2
	Humanities/Social Sciences Elective[5]	3.0	So1
	Humanities/Social Sciences Elective[5]	3.0	So2
	Humanities/Social Sciences Elective[5]	3.0	J1
	Humanities/Social Sciences Elective[5]	3.0	J2
	Humanities/Social Sciences Elective[5]	3.0	S1
	Humanities/Social Sciences Elective[5]	3.0	S2
Total Required Courses in Humanities and Social Sciences		**24.0**	
Required Courses in Business and Management			
MG 2204	Financial Accounting[6]; or	4.0	So1;
FIN 2103	Creating and Understanding Financial Statements[6]	3.0	So1
FIN 2003	Economic Foundations of Finance[6] or	3.0	So2
Level II Elective[6] in Economics		3.0	So2
MG/EC/FIN	Level II Elective[6]	3.0	J1
MG/EC/FIN	Level II Elective[6]	3.0	J2
MG/EC/FIN	Level III Elective[6]	3.0	S1
MG/EC/FIN	Level III Elective[6]	3.0	S2
Total Required Credits in Business and Management		**18.0[6]**	
Required Courses in Civil Engineering			
CE 2113	Statics	3.0	So1
CE 2123	Mechanics of Materials	3.0	So2
CE	Elective[7]	3.0	S1
Total Required Courses in Civil Engineering		**9.0**	
Required Courses in Construction Management			
CE 1502	Leadership and Foundations of Construction Management	2.0	F2
CE 2504	Construction Modeling and Data Structures I	4.0	So1
CE 2513	Construction Materials and Methods	3.0	So1
CE 2523	Contracts and Construction Documents	3.0	So2
CE 3503	Cost Estimating	3.0	J1
CE 3513	Construction Scheduling	3.0	J1
CE 3532	Construction Site Layout	2.0	J1
CE 3541	Surveying	1.0	J1
CE 3553	Non-Structural Building Systems	3.0	J2
CE 3563	Construction Modeling and Data Structures II	3.0	J2
CE 4503	Construction Engineering	3.0	S2
CE 4513	Construction Project Administration	3.0	S1
CE 4523	Structural Building Systems	3.0	S1
CE 4533	Construction Law[6]	3.0	S2
CE 4543	Construction Management Project	3.0	S2
Total Required Courses in Construction Management		**42.0**	
Other Required Courses			
EG 1001	Engineering and Technology Forum	1.0	F1
EG 1003	Introduction to Engineering and Design	3.0	F1
CS 1133	Engineering Problem Solving and Programming	3.0	F2
Liberal Arts and Sciences Elective[8]		3.0	J1
Liberal Arts and Sciences Elective[8]		3.0	J2
Free Elective		3.0	J2
Total Required Other Credits = 16.0			
Total Credits for Degree = 128.0			

Footnotes for Table 1

1. Sem=semester usually taken; F= Freshman, So=Sophomore, J=Junior, S=Senior, 1=Fall, 2=Spring;
2. Students may substitute MA 1324, which includes two additional contact hours, for MA 1024.
3. The department recommends that students take MA 1124 Calculus II (or MA 1424 Integrated Calculus II) as the MA Elective.
4. All students take a writing placement examination. Students for whom English is a second language may be placed in an ESL section, which includes additional hours of language education. Students also may be placed in a remedial section, based upon the exam results, which may or may not carry degree credit.
5. Student must complete 24 credits in Humanities and Social Sciences, including the freshman writing courses, in accordance with the Technology, Culture and Society Departmental requirements. At least one elective shall be in Philosophy (PL) and contain at least 1 credit of ethics. At least one elective must be a 3xxx/4xxx level course. At least one elective must be a writing-intensive course, labeled by "W."
6. Students are required to complete 18 credits from Business and Management courses, with at least 6 credits from level III or higher courses. (One business and management credit is attributed to CE 4533 Construction Law). A level II course has a 2xxx number, while a level III course has a 3xxx number. Level III electives generally have a prerequisite of a related level II elective. Since courses may be three or four credits, the number of courses necessary to complete this requirement may vary.
7. CE elective is any course with a CE prefix for which the student has the approved prerequisites.
8. Students must complete 60 credits in liberal arts and sciences.

UNDERGRADUATE MINOR IN CONSTRUCTION MANAGEMENT

Much of what is designed is intended to be built or constructed in some manner. The goals of the minor are to teach fundamental technical and leadership skills and promote a greater understanding of relationships among construction and the other professions to students from the various engineering disciplines and other majors who may in some way become involved in the planning, construction, maintenance or operation of built systems. For this reason, the minor is open to any courses (subject to the within described credit and course prerequisites) within the undergraduate Construction Management program, and it will allow students to select courses that best fit their interests and complement their curricula.

A basic understanding of construction is necessary to take full advantage of the courses in the Construction Management curriculum. CE 1502 Leadership and Foundations of Construction Management (formerly CE 1504) is the first major course in the Construction Management curriculum and serves as the introduction to major course for the program. CE 1502 is a prerequisite to all other undergraduate Construction Management courses, except CE 4533 Construction Law. This prerequisite can also be satisfied by an appropriate introduction to major course in another curriculum, such as CE 1002 Introduction to Civil Engineering. The determination as to whether any other course may satisfy this prerequisite is subject to the evaluation and approval of the Construction Management Program Director. In addition, students who have taken CE 1002 (or its predecessor course) or another acceptable prerequisite may take CE 1502 (or have taken its predecessor course) with the approval of the Construction Management Program Director in satisfaction of the minor requirement; however, students may not count more than one introduction to major course toward the required number of credits for graduation. All other prerequisites shall be as stated in the catalog.

The individual courses taken to fulfill the requirements of the minor each may be 1, 2, 3 or 4 credits. Students must earn a passing grade in not less than five courses and not less than 14 credits.

PART-TIME STUDENTS

Students may register as part-time students (fewer than 12 credits a semester). Such students must be advised, however, that the department no longer offers many undergraduate courses in the evening, and part-time students are required to take most courses in the day. Part-time students should maintain close contact with their academic advisers to plan an appropriate course sequence.

GRADUATE PROGRAMS

NYU-Poly offers a Master of Science degree program in Construction Management and two graduate certificate programs: one in executive construction management (Exec 21) and the other in construction management.

THE EXEC 21 PROGRAM: GRADUATE CERTIFICATE PROGRAM IN EXECUTIVE CONSTRUCTION MANAGEMENT

The Exec 21 Certificate Program in Executive Construction Management (Exec 21) is offered by the Department of Civil Engineering. It is directed toward individuals with significant professional experience in the construction industry and it is focused primarily on the construction industry.

Exec 21 is a leadership program for construction professionals who may not wish to commit to the full Master of Science program, but seek formal certification in construction management. This group may include students who hold a bachelor's degree and who wish to specialize in construction management or those who may have previously completed an advanced degree and seek additional skills.

Recognized throughout the construction industry as a vital and innovative educational experience (recipient of the CMAA Academic Achievement Award), Exec 21 courses are taught by eminently qualified construction industry professionals and faculty.

Students without significant work experience who may not wish to commit to the full Master of Science program, but seek formal certification in construction management may enroll in the Certificate Program in Construction Management, jointly offered by the Department of Civil Engineering and the Department of Technology Management. That program includes general management courses in addition to construction management courses and does not require any work experience for full participation.

Admission

Students seeking admission to the Exec 21 Certificate Program should have earned a bachelor's degree in a related discipline and should have a minimum of three to five years of related professional experience. Undergraduate backgrounds in engineering, mathematics, science, management and/or the liberal arts are appropriate with the requisite work experience for admission.

Curriculum

Students must complete 15 credits of course work to earn a certificate. A minimum of 9 credits must be selected from the Exec 21 Core Courses, and up to 6 credits may be selected from those courses that satisfy the Major Requirement for the Master of Science in Construction Management Program and are approved by a Construction Management Program Director.

Exec 21 Core Courses:

CE 8703	Managing and Leading in the 21st Century
CE 8713	Construction and the Law
CE 8723	How to Succeed in Construction
CE 8733	Infrastructure Financing: Structuring of a Deal
CE 875X	Employer-Focused Residency
CE 8763	Capital Program Management/ Program Development
CE 8773	Dispute Avoidance and Resolution
CE 8783	Construction Management and Planning
CE 8803	Infrastructure Planning for Public Works

Grade Requirements

Students must maintain a B (3.0) cumulative average in all graduate courses taken at NYU-Poly.

GRADUATE CERTIFICATE IN CONSTRUCTION MANAGEMENT

The Department of Civil Engineering, in conjunction with the Department of Technology Management, offers a graduate certificate to students completing 15 credits of course work in construction management. The certificate program provides engineers and other professionals in the construction industry with the knowledge to understand relevant managerial and physical technological developments and to apply such knowledge effectively in their professions.

Admission

Applicants for the Certificate in Construction Management must hold relevant bachelor's degrees. Compatible backgrounds include engineering, math, science, management, architecture, economics, law and the liberal arts. The undergraduate degree must be from an acceptable institution.

Curriculum

Students must complete at least five courses (15 credits) in accordance with the following requirements:

(i) Select at least three courses (9 credits) from those courses that satisfy the Major Requirement for the Master of Science in Construction Manage ment Program and are approved by a Construction Management Program Director; and

(ii) Select at least one (3 credits) graduate-level Management (MG) course approved by a Construction Management Program Director.

Grade Requirements

Students must achieve a B (3.0) cumulative average in all graduate courses taken at NYU-Poly.

MASTER OF SCIENCE IN CONSTRUCTION MANAGEMENT

The Master of Science in Construction Management program requires 30 credits of course work. Courses include those in the Exec 21 and Construction Management certificate programs, Master of Science in Civil Engineering program courses in construction management and elective courses from other NYU-Poly graduate programs.

Courses taken as part of the Exec 21 Certificate Program in Executive Construction Management and the Graduate Certificate Program in Construction Management may be applied toward the Master of Science in Construction Management and the Master of Science in Civil Engineering.

Objectives

The Master of Science in Construction Management program is intended to prepare students for leadership positions in the construction industry. Specifically, the program seeks to provide a thorough understanding of:

- Basic management principles as applied to the construction industry;
- Principles of leadership in the construction industry;
- Integration of modern technology in construction;
- Innovative management tools for the analysis and control of construction projects;
- Principles and methods of planning and financing construction projects; and
- Fundamental tools for communication with diverse employee, client-and public groups.

Admission

Students seeking admission to the Master of Science in Construction Management program must hold a bachelor's degree from an accredited undergraduate institution. Students should have a minimum undergraduate grade-point average of 3.0, although this requirement can be waived for candidates with sufficient professional experience in construction management. All candidates are expected to have sufficient background in college-level mathematics; this requirement will be evaluated by a Construction Management Program Director. Students whose academic and professional backgrounds are deemed to be deficient may be required to complete additional undergraduate courses as a pre- or co-requisite to admission to any Construction Management program.

Transfer Credits

The residency requirement for the Master of Science degree is 21 credits. This is the minimum number of graduate credits that students must take at NYU-Poly to be awarded a Master of Science degree.

Students may request the transfer of up to 9 credits of acceptable course work, as determined by a Construction Management Program Director, toward the Master of Science in Construction Management. Such course(s) must be relevant to the student's degree program

and be taken at an accredited institution, and the student must have earned a grade of B or better. No transfer credit is awarded for courses in which a grade less than B was earned. Pass/fail courses will not be considered for transfer unless accompanied by a detailed written evaluation by the course instructor.

All transfer credit requests must be accompanied by an official transcript from the transferring institution. Applications for transfer credits are not considered until the candidate has earned a minimum of 12 graduate credits at NYU-Poly.

Validation credits by examination cannot be used toward fulfillment of the requirements of any graduate program.

Curriculum
A minimum of 15 credits (5 courses) must be selected from the following courses:

CE 7983	Selected Topics in Construction I
CE 7993	Selected Topics in Construction II
CE 8243	Construction Modeling Techniques
CE 8253	Project Management for Construction
CE 8263	Construction Cost Estimating
CE 8273	Contracts and Specifications
CE 8283	Risk Analysis
CE 8293	Construction Operations Analysis
CE 8303	Information Systems in Project Management
CE 8313	Engineering for Construction I: Methods and Technologies
CE 8323	Engineering for Construction II: Design
CE 8333	Marketing for Construction Management and Engineering Services
CE 8343	Construction Site Safety
CE 8353	Construction Scheduling
CE 8363	Building Information Modeling Project Controls
CE 8373	Construction Accounting and Finance
MG 8203	Project Management
MG 6013	Organizational Behavior

The above list is subject to change as courses are added to, or deleted from the Program.

The Exec 21 Core Courses may be applied to the above Major Requirement by a student who is enrolled in or has completed the Exec 21 Program, or by any other student with the consent of a Construction Management Program Director.

All students must complete a minor concentration of study, which shall consist of a minimum of 6 credits (two courses) selected from courses in any single graduate academic program at NYU-Poly, or any other concentrated area of study approved by a Construction Management Program Director. The selection of the minor concentration of study shall be made with the advisement and consent of a Construction Management Program Director.

A student may complete an up to three (3)-credit independent project to satisfy the Major Requirement: CE 993X Project for the Master of Science in Construction Management.

The remaining courses needed to fulfill the 30-credit requirement shall be selected from the Civil Engineering or Construction Management Programs (bearing a CE xxxx or TR xxxx designation), unless otherwise authorized by a Construction Management Program Director. However, if the minor area of study is from the Civil Engineering Department, up to two of the remaining courses may be selected from any other electives at NYU-Poly.

Note that some electives include prerequisites that not all program enrollees may have completed. Students cannot register for a course for which they have not satisfied the stated prerequisites unless they have the written permission of both the course instructor and a Construction Management Program Director.

Grade Requirements
To earn a Master of Science in Construction Management, students must maintain a B (3.0) cumulative average) in all graduate courses taken at NYU-Poly.

Registration for Exec 21 Core Courses
Students not enrolled in the Exec 21 Program must obtain the prior approval of a Construction Management Program Director to register for Exec 21 Core Courses.

CAMPUS
Graduate courses may be offered at NYU-Poly's main campus in Brooklyn, as well as at its Westchester, Long Island or other satellite locations, including 2 Broadway in downtown Manhattan.

APPLICANTS FROM FOREIGN INSTITUTIONS
Applicants to any graduate program in Construction Management from universities outside the United States must achieve a minimum score of 700 on the quantitative section of the Graduate Record Examination (GRE) and a minimum score of 550 (PBT), 213 (CBT), or 80 (IBT) on the Test of English as a Foreign Language (TOEFL). A Construction Management Program Director may waive the GRE and/or TOEFL requirement in exceptional circumstances after examining an applicant's transcripts or an interview with the applicant.

Foreign applicants who meet all admission requirements, but who fail to satisfy the TOEFL requirement, may be required to take one or more remedial courses in English before or as a condition to admission.

UNDERGRADUATE COURSES

CE 1502 Leadership and Foundations of Construction Management *2:0:0:2*

This course introduces the student to the profession of construction management. It focuses on the role of the construction manager and the fundamental concepts and terminology employed in planning, developing and constructing projects. Leadership, professional development, ethics and safety are emphasized.

CE 2504 Construction Modeling and Data Structures I *3:3:0:4*

This course introduces architectural drafting and computer graphics. It capitalizes on state-of-the-art computer applications in managing construction. The course familiarizes the student with two-dimensional construction drawings that represent the current industry standard, and it propels the student towards the future by teaching the basics of three-dimensional (3-D) computer modeling. This course also introduces the use of the 3-D model with associated databases to manage construction.

CE 2513 Construction Materials and Methods *2.5:1.5:0:3*

This course covers the fundamental materials and methods used in constructing building and civil infrastructure projects. It also includes a laboratory that exposes students to commonly employed testing methods of construction materials.

CE 2523 Contracts and Construction Documents *3:0:0:3*

This course covers the documents used in design and construction, including design and construction agreements, drawings and specifications, general and special conditions and others used for procurement and construction administration. The course also examines the relationships among the owner, designers, contractors and suppliers. Students have the opportunity to discuss quality, safety and business and professional ethics. *Prerequisite: CE 1502 or CE 1002.*

CE 3503 Cost Estimating *3:0:0:3*

Students learn the classification of work, quantity surveying techniques and basic estimating principles applied to construction projects. Also addressed are contracts; specifications and other construction documents; and the identification and allocation of direct and indirect project costs, overhead and profit.

Students are introduced to computer-based estimating techniques and software. *Prerequisite: CE 1502 or CE 1002.*

CE 3513 Construction Scheduling *2:3:0:3*

Students learn to apply the Critical Path Method (CPM) to construction projects, using precedence diagram networks. The course covers sequencing, cost allocation, updating, cash flow, resource constraints and scheduling, manpower leveling and distribution, time-scale networks, lead and lag-time constraints, time-cost tradeoffs, overlap and other specific leading edge scheduling techniques. Students direct an entire project from planning through scheduling and control, both manually and through software. *Prerequisite: CE 1502 or CE 1002.*

CE 3532 Construction Site Layout *2:0:0:2*

This course studies the practical applications of surveying and its relationship to site planning and design. The first portion of the course concentrates on land surveying concepts, including mathematics, horizontal and vertical control and angle measurement. The second portion of the course applies surveying data to site layout using traverses, area computations, property surveys, topography, and construction surveys for highway and building applications. *Prerequisite: CE 1502 or CE 1002.*

CE 3541 Surveying *0:3:0:1*

This field laboratory introduces students to basic surveying practice, including the use of surveying equipment (wheels, tapes, levels and theodolites), measurement theory and computation, data accuracy and precision, and the field book to properly record data. *Prerequisite: CE 1502 or CE 1002.*

CE 3553 Non-Structural Building Systems *3:0:0:3*

This course introduces the students to mechanical, electrical and vertical transportation systems for buildings. It examines fundamental aspects of the design, procurement and construction of heating, ventilating and air conditioning (HVAC), supply and sanitary plumbing, fire detection and suppression, high- and low-voltage electrical, security, elevator and escalator and building management systems. *Prerequisite: CE 1502 or CE 1002.*

CE 3563 Construction Modeling and Data Structures II *2:3:0:3*

This course is the continuation of the student's exploration of construction management through building information modeling (BIM). The students will apply their understanding of construction assemblies, trade scheduling and estimating through studies of a larger project. Emphasis will be placed on the student's ability to model complex assemblies while coordinating and scheduling multiple trades. This progressive approach incorporates the 3D model and the associated databases in the management of construction by developing unit pricing, detailed scheduling and procurement attributes associated with a design. *Prerequisite: CE 2504.*

CE 4503 Construction Engineering *3:0:0:3*

This course covers engineering fundamentals and developing trends in the use of excavating and earth-moving equipment, trucks, pumps, drilling and blasting equipment and cranes. Also considered are shoring and bracing and other temporary site construction operations. *Prerequisites: CE 1502 or CE 1002, and junior standing.*

CE 4513 Construction Project Administration *3:0:0:3*

This course examines the roles of the project participants in executing a construction project, focusing on delegating administrative duties and responsibilities and managing and coordinating the physical work and administrative control of project information and records. Students use computer-based project administration techniques and software. *Prerequisites: CE 1502 or CE 1002, and junior standing.*

CE 4523 Structural Building Systems *3:0:0:3*

This course introduces the general principles of loads on buildings and the design and analysis of conventional structural building systems in steel, concrete, wood and masonry. It also addresses the construction of such systems. *Prerequisites: CN major, CE 2123 and junior standing.*

CE 4533 Construction Law *3:0:0:3*

The course introduces students to areas of the law that they are likely to encounter in construction. Following an introduction to the legal system and form of legal analysis, areas addressed include contracts, procurement, scope definition, delays and acceleration, site conditions, warranties, termination, tort claims, dispute resolution and ethics. *Prerequisite: Junior standing.*

CE 4543 Construction Management Project *3:0:0:3*

This course is the senior capstone experience in construction management which requires students to demonstrate the skills acquired through the undergraduate construction management curriculum. Students work individually or in groups as determined by the instructor and other participating industry advisers. Students attend regularly scheduled lectures and workshops, participate in interim and final presentations, and are responsible for periodic written submissions. *Prerequisites: Senior status or as otherwise determined by the Construction Management Program Director.*

GRADUATE COURSES

MASTER OF SCIENCE MAJOR REQUIREMENT

CE 7983/CE 7993 Selected Topics in Construction I/II *3:0:0:3*

This course covers topics of special interest in current areas of construction management. Topics are announced before each semester's offering.

CE 8203 Project Management *3:0:0:3*

This course covers management of technology-based projects ranging—from individual research and development to large-scale and complex technological systems. Topics covered include: feasibility and risk analyses; project selection and portfolio optimization; functional and administrative structures; coordination and scheduling of activities; personnel planning; negotiations and contracts; cost estimation; capital budgeting; cost controls; and effective matrix management. *Also listed under MG 8203.*

CE 8243 Construction Modeling Techniques *3:0:0:3*

This course deals with various construction-modeling techniques, including the development of two-dimensional (2D) and three-dimensional (3D) design documents. Students are introduced to the development of building information models (BIM) and their associated databases, using state-of-the-art design and management systems.

CE 8253 Project Management for Construction *3:0:0:3*

This course deals with topics specific to developing and coordinating large projects, including organizational structures, management functions, pricing and estimating project costs, bidding and contracting, risk allocation, scheduling, time and cost control, labor relations, quality management and project lifecycle activities. *Also listed under MG 8253.*

CE 8263 Construction Cost Estimating *3:0:0:3*

This course covers estimating and cost control from the viewpoint of contractors and construction engineers; details of estimating with emphasis on labor, materials, equipment and overhead. *Also listed under MG 8263.*

CE 8273 Contracts and Specifications *3:0:0:3*

This course covers principles of contract law as applied to the construction industry and legal problems in preparing and administering construction contracts. *Also listed under MG 8273.*

CE 8283 Risk Analysis *3:0:0:3*

In this course, students investigate the ever-rising importance of risk analysis in project management. Topics include: analysis of qualitative and quantitative risk; techniques in probability analysis, sensitivity analysis, simulation of risk and utility theory; and computational methods for calculating risk. Students are exposed to real-world problems through case investigations.

CE 8293 Construction Operations Analysis *3:0:0:3*

This course examines the evaluation and model development of productivity, safety, quality and materials handling in construction operations. Topics include the principal methods for analysis and pre-planning work activities, including the use of three-dimensional (3D) building information models (BIM), four-dimensional (4D) and fully integrated and automated project processes (FIAPP), logistics animation, Monte Carlo scheduling, stochastic simulation and queuing theory. Students are introduced to the use of financial models for task, activity, project and program analyses. *Prerequisite: CE 8243 or Construction Management Program Director's approval.*

CE 8303 Information Systems in Project Management *3:0:0:3*

The course examines the use of contemporary tools for managing the vast array of information over the life of a project. Information handling is reviewed from the perspectives of knowledge acquisition and presentation. The course focuses on applying three-dimensional (3D) building information models (BIM) and four-dimensional (4D) and fully integrated and automated-project processes (FIAPP) that integrate 3D computer models, simulation, cost estimating, scheduling, procurement and information technology (with emphasis on the implementation of 3D computer models and relational databases as information systems for project information handling and project automation). *Prerequisite: CE 8243 or Construction Management Program Director's approval*

CE 8313 Engineering for Construction I: Methods and Technologies *3:0:0:3*

This course covers planning, design and equipment for new construction and for infrastructure rehabilitation; engineering fundamentals of earth moving; soil stabilization and compaction; methods for tunneling through rock and earth and rock blasting; foundation grouting; piles and pile driving equipment; dewatering systems and pumping equipment; factors affecting the selection of construction equipment; review of conventional construction equipment; and trends in robotics.

CE 8323 Engineering for Construction II: Design *3:0:0:3*

This course covers planning, design and equipment for new construction and for infrastructure rehabilitation; engineering fundamentals of earth moving; soil stabilization and compaction; methods for tunneling through rock and earth and rock blasting; foundation grouting; piles and pile driving equipment; dewatering systems and pumping equipment; factors affecting the selection of construction equipment; review of conventional construction equipment; and trends in robotics.

CE 8333 Marketing for Construction Management and Engineering Services *3:0:0:3*

This course focuses on the process of procurement of construction management and engineering services. It incorporates a hands-on approach to current industry practices. The materials address the following: identifying leads; researching and evaluating competition through various sources; reviewing and critiquing requests for qualifications (RFQ) and requests for proposals (RFP) and responses; developing a marketing resume; developing project profiles; evaluating presentations; and selecting successful candidates. Students will prepare their own proposals and presentations.

CE 8343 Construction Site Safety *3:0:0:3*

This course is for individuals who are interested in construction safety and the realities of a construction project and for those seeking certification as a Site Safety Manager from the New York City (NYC) Department of Buildings (DOB). Students learn about the comprehensive Subchapter 19 of the New York City Building Code and the City's Rules and Regulations on construction site safety projects. The course curriculum includes the content approved by the NYC DOB to prepare students for the Site Safety Manager examination.

CE 8353 Construction Scheduling *3:0:0:3*

Students will be instructed in advanced Critical Path Method (CPM) construction scheduling techniques including the use of Primavera Project Planner v. 7.0. The course will cover Precedence Diagramming Method (PDM), project resources and resource leveling, schedule updating, schedule impacts of date constraints, project time and cost trade-offs, activity duration estimating, work breakdown structures, differing scheduling requirements on different types of construction projects and an overview of construction contract scheduling specifications. An introduction to other scheduling methodologies and the use of schedules in construction claims will also be addressed.

CE 8363 Building Information Modeling Project Controls *3:0:0:3*

The purpose of this course is to enable students to use Building Information Modeling (BIM) as part of the planning and measurement of performance on construction projects. Students will learn various earned value management techniques to measure the actual performance of work and the associated cost and schedule impacts as compared to baseline values. Emphasis will also be placed on the importance of managing and tracking changes, and mitigating their impacts on construction projects.

CE 8373 Construction Accounting and Finance *3:0:0:3*

This course introduces students to the uses of accounting and financial analysis in decision making in a construction and development environment. The course will demonstrate to students how the principles of accounting and financial management can be adapted for, and used in the management of construction companies and project management. Students will review accounting concepts, rules, regulations and reporting requirements as they apply to construction and development, and they will use and create accounting and financial models.

CE 9933 MS Project in Construction Management *3 credits*

This course is a capstone, individually advised project resulting in a substantial report in a specific area of construction management.

EXEC 21 CORE COURSES

CE 8703 Managing and Leading in the 21st Century *3:0:0:3*

Today's mega projects require the formation of large multidisciplinary teams including engineers, constructors and financial, legal and business experts. Success in this challenging environment requires up-to-date and proven leadership and management skills. This course covers the basic components of management planning, organizing, directing, controlling and decision-making. It defines the engineering and construction team and discusses leadership styles. This course also addresses the management of change, external factors that shape decisions, the development of personal leadership abilities and, ultimately, 21st century leadership requirements. *Prerequisite: Admission to the Exec 21 Program or permission of a Construction Management Program Director.*

CE 8713 Construction and the Law *3:0:0:3*

Construction industry executives need not be legal experts, but they must be aware of the legal issues affecting their industry and their bottom line. This course uses the case study method to lead students through the concepts of design and construction law. The course focuses on the interface of legal, business and technical issues and their resolution. It includes the design and organization of construction documents; the legal aspects of bidding, subcontracting, bonds, insurance, mechanic's liens, etc; and the implication of delays, changes and charged conditions. Alternative dispute resolution (ADR) methods are introduced. *Prerequisite: Admission to the Exec 21 Program or permission of a Construction Management Program Director.*

CE 8723 How to Succeed in Construction *3:0:0:3*

This course leads students through the how-to's of running a successful, large, complex construction company. It analyzes how the industry actually works, including contractual relationships with clients in all types of projects from design/build to privatization. It covers the business fundamentals of running a construction company, including issues such as surety and insurance: various types of construction organizations, domestic and international; and company culture - inner-workings of a business that can mean the differences between success and failure. *Prerequisite: Admission to the Exec 21 Program or permission of a Construction Management Program Director.*

CE 8733 Infrastructure Financing: Structuring of a Deal *3:0:0:3*

This course examines what it takes to structure a deal from a credit perspective, legally and financially, for domestic and international projects. In the domestic sector, the course focuses on transportation projects, examining the peculiarities and the uniqueness of the capital market. Examples are studied and recent changes are discussed in areas such as financing transportation projects and the dramatically changing nature of financing these projects. In the international sector, the course covers innovative financing techniques. *Prerequisite: Admission to the Exec 21 Program or permission of a Construction Management Program Director.*

CE 875X Employer Focused Residency *Up to 3 credits*

In this course, students define a proposal for a project, the subject of which may be related to their employment. Students work one-on-one with an adviser throughout the semester. There is no formal classroom work; however, students must update their adviser weekly. The project runs no longer than one semester. Students formally present their projects' findings to invited guests at the end of the semester. *Prerequisite: Admission to the Exec 21 Program or permission of a Construction Management Program Director.*

CE 8763 Capital Program Management / Program Development *3:0:0:3*

The course examines the process of capital program management and development. Depending upon the instructor and project used for illustration, the course analyses how either the public or private sector views a project and develops it and the internal workings of an organization in determining how a project is selected, funded and managed. The course examines various contracting strategies, as well as the concepts of risk allocation, funding and project finance. *Prerequisite: Admission to Exec 21 Program or permission of a Construction Management Program Director.*

CE8773 Dispute Avoidance and Resolution *3:0:0:3*

This course analyzes the basic causes for construction disputes and introduces methods for dispute avoidance by proper risk allocation, management and control, as well as other techniques, including partnering. It uses the case study method to address litigation and provides an understanding of the process of arbitration and other alternative dispute resolution (ADR) methods such as negotiation, mediation, mini trials and dispute review boards. *Prerequisite: Admission to the Exec 21 Program or permission of a Construction Management Program Director.*

CE 8783 Construction Management and Planning *3:0:0:3*

Strategic planning is indispensable to achieving superior management. This course in business planning provides practical advice for organizing the planning system, acquiring and using information and translating strategic plans into decisive action. This knowledge is an invaluable resource for top and middle-level executives. P*rerequisite: Admission to the Exec 21 Program or permission of a Construction Management Program Director.*

CE 8803 Infrastructure Planning for Public Works *3:0:0:3*

This course deals with the process whereby infrastructure projects are conceived, studied and implemented. The focus will be on the management and leadership roles of the key players in public works agencies. Lectures, reading assignments and classroom discussions will deal with both routine procedures and controversial issues. Students will research and report on important public works projects and on special topics in infrastructure planning. *Prerequisite: Admission to the Exec 21 Program or permission of a Construction Management Program Director.*

Typical Course of Study for the Bachelor of Science in Construction Management

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Hours/Week Class	Lab.	Rec.	Cr.
CM 1004	General Chemistry	3	2	1	4
EN 1013W	College Writing Workshop[4]	3	0	0	3
MA 1024	Calculus I[2]	4	0	0	4
EG 1001	Engineering and Technology Forum	1	0	0	1
EG 1003	Intro. to Engineering and Design	.5	2.5	2	3
					15

Spring Semester

Course No.	Course Title	Hours/Week Class	Lab.	Rec.	Cr.
PH 1013	Mechanics	3	0	1	3
CS 1133	Problem Solving and Programming	3	0	0	3
CE 1502	Leadership and Foundations of Construction Management	2	0	0	2
HuSS 1023W	First-Year Writing Seminar[5]	3	0	0	3
MA 1124	Calculus II[3]	4	0	0	4
					15

SOPHOMORE YEAR

Fall Semester

CE 2113	Statics	3	0	1	3
CE 2504	Construction Modeling and Data Structures I	3	3	0	4
CE 2513	Construction Materials and Methods	2	3	0	3
MG 2204 FIN 2103	Financial Accounting[6]; or Creat. and Und, Fin. State.	3/4	0	0	3/4
Humanities and Social Sciences Elective[5]		3	0	0	3
					16/17

Spring Semester

CE 2123	Mechanics of Materials	3	0	0	3
CE 2523	Contracts and Construction Documents	3	0	0	3
FIN 2003 EC	Economic Foundations of Finance[6]; or Level II Elective[6] in Economics	3/4	0	0	3/4
MA 2054	Applied Data Analysis	4	0	0	4
Humanities and Social Sciences Elective[5]		3	0	0	3
					16/17

JUNIOR YEAR

Fall Semester

CE 3503	Cost Estimating	3	0	0	3
CE 3513	Construction Scheduling	2	3	0	3
CE 3532	Construction Site Layout	2	0	0	2
CE 3541	Surveying	0	3	0	1
MG/EC/FIN	MG/EC/FIN Level II Elective[6]	3	0	0	3
Liberal Arts and Sciences Elective[8]		3	0	0	3
Humanities and Social Sciences Elective[5]		3	0	0	3
					18

Spring Semester

CE 2504	Construction Modeling and Data Structures II	2	3	0	3
CE 3553	Non-Structural Building Systems	3	0	0	3
	Liberal Arts and Sciences Elective[8]	3	0	0	3
	Free Elective	3	0	0	3
MG/EC/FIN	MG/EC/FIN Level II Elective[6]	3	0	0	3
Humanities and Social Sciences Elective[5]		3	0	0	3
					18

SENIOR YEAR

Fall Semester

CE 4513	Construction Project Administration	3	0	0	3
CE 4523	Structural Building Systems	3	0	0	3
CE	Civil Engineering Elective[7]	3	0	0	3
MG/EC/FIN	MG/EC/FIN Level III Elective[6]	3	0	0	3
Humanities and Social Sciences Elective[5]		3	0	0	3
					15

Spring Semester

CE 4503	Construction Engineering	3	0	0	3
CE 4533	Construction Law[6]	3	0	0	3
CE 4543	Construction Management Project	3	0	0	3
MG/EC/FIN	MG/EC/FIN Level III Elective[6]	3	0	0	3
Humanities and Social Sciences Elective[5]		3	0	0	3
					15

Total credits required for the degree: 128

1. The table lists courses in the semester usually taken.
2. All students, except those who have earned a grade of 4 or 5 on the Calculus AB or BC AP Exam, take a mathematics placement examination. Students may be placed in an alternative course, which may not carry degree credit, based up the results of such placement examination. Students also may be advance-placed based upon AP or college math credit earned in high school. Students may substitute MA 1324, which includes two additional contact hours, for MA 1024.
3. The department recommends that students take MA 1124 Calculus II (or MA 1424 Integrated Calculus II) as the MA Elective.
4. Students with an ESL background may be placed in an appropriate remedial course, which includes additional hours of language education. Students may also be placed in a remedial section, based upon placement exam results, which may not carry degree credit.
5. Student must complete 24 credits in Humanities and Social Sciences, including the freshman writing courses, in accordance with the Technology, Culture and Society Department requirements. At least one Humanities and Social Sciences elective shall be in Philosophy (PL) and containat least 1 credit of ethics. At least one Humanities and Social Sciences elective must be a 3xxx/4xxx level course. At least one Humanities and Social Sciences elective must be a writing-intensive course, labeled by "W."
6. Students must complete 18 credits from Business and Management courses, with at least 6 credits from level III or higher courses. One additional credit in Business and Management is contributed by CE 4533. A level II course has a 2xxx number, while a level III course has a 3xxx number. Level III electives generally have a prerequisite of a related level II elective. Since courses may be 3 or 4 credits, the number of courses necessary to complete this requirement may vary.
7. CE Elective is any course with a CE prefix for which the student has the approved prerequisites.
8. Students must complete 60 credits in liberal arts and sciences.

MASTER OF SCIENCE IN CYBER SECURITY

Program Director: Nasir Memon

The MS in Cyber Security Program at NYU-Poly provides students with the critical knowledge and skills to become experts in cyber security, the science of protecting vital computer networks and electronic infrastructures from attacks. The program responds to the growing demand for security specialists in industry and in government organizations.

The cyber-security field is expected to generate many new jobs over the next decade as companies across all industries continue to place top priority on safeguarding their data and information systems. Graduates are well prepared for careers as developers of security products and as security-application programmers, security analysts, penetration testers, vulnerability analysts and security architects. They also may pursue positions as security researchers or continue their studies at the PhD level.

MASTER'S DEGREE REQUIREMENTS

CORE ELECTIVES AND REQUIREMENTS

To satisfy the requirements for the Cyber-Security MS program, the student must complete 30 credits, as listed below, with an overall average of B. In addition, a B average is required across all the required core courses, as indicated below.*

Computer Science Core Courses

CS 6233 Operating Systems I
CS 6843 Computer Networking
CS 6033 Design and Analysis of Algorithms I

Security Core Courses**

CS 6813 Computer Security
CS 6823 Network Security
CS 6903 Modern Cryptography
CS 9163 Application Security

Electives (3 courses)

Students may choose security-related courses from NYU-Poly or from New York University, including courses in the psychology, law and sociology departments. Selected courses must be approved by the Program Committee. All of the following courses are preapproved; others must be approved by the Program Committee.

CS 6573 Penetration Testing and Vulnerability Analysis
CS 6803 Information System Security Engineering and Management
CS 9093 Biometrics
CS 6963 Digital Forensics
EL 6393 Advanced Network Security
CS 9963 Advanced Projects (in the area of cyber-security)
CS 6243 Operating Systems II
CS 6043 Design and Analysis of Algorithms II
CS 6133 Computer Architecture

* Any required Computer Science core courses may be replaced if the student has taken a similar class.
** Most of the required Security Core courses have a project component.

Research Project (Optional)

One goal of the MS in Cyber Security is to introduce students to exciting research in cyber security and to attract some of them to pursue a PhD degree. To this end, NYU-Poly offers a semester-long Advanced Project (CS 9963) in cyber security (as listed above), as an elective. Students selecting this option are guided by a research professor and gain invaluable research experience.

Master's Thesis (Optional)

In addition to the above semester-long, research experience for students, the program also offers research-oriented MS students the master's thesis option. With this option, a student takes 6 credits of CS 9973 (MS Thesis) working with a faculty adviser on a research problem in cybersecurity, in lieu of two out of the three required electives.

The research need not be original, but should demonstrate adequately the student's proficiency in the subject. An oral defense of the master's thesis before at least three professors is required. The 6 credits of master's thesis must span two consecutive semesters. Whenever relevant, 3 credits of CS 9963 may be used as 3 credits of CS 9973, subject to faculty-adviser approval.

SPECIAL PROVISIONS

TRANSFER OF COURSES

Students with a prior MS or an advanced degree from another institution may be allowed to transfer a maximum of two courses. The Cyber Security MS Program Committee determines the course equivalence of the transferred course work. For each course to be transferred, the student must provide a complete description, along with lecture and assignment materials. Courses are considered for transfer credit if they were completed less than three years ago.

Student Transfers from other Master's Programs at Polytechnic Institute of NYU

Qualified MS students registered in other NYU-Poly master's programs (e.g., the CS master's program), who can demonstrate adequate skills in cyber security, may be permitted to transfer to the MS in Cyber Security Program. The admission criteria and program requirements are detailed in previous sections.

MS Cyber-Security Transfers to the PhD Program in Computer Science

Qualified Cyber Security MS students may transfer into the PhD program in Computer Science. The MS Program Committee first must recommend the applicant to the PhD Admissions Committee.

NOTE: Any other programmatic issues are evaluated individually by the Cyber Security MS Program Committee.

REQUIREMENTS FOR MASTER OF SCIENCE IN CYBER SECURITY

Entrance Requirements

Students need a superior undergraduate record from an accredited institution. Preferably, students should have an undergraduate degree in computer science, mathematics, science or engineering. However, applicants with degrees in other fields are considered individually for admission. Additionally, students must satisfy the following:

1. Knowledge of mathematics through calculus.
2. At least one year of university-level science.
3. A working knowledge of a high-level, general-purpose programming language (preferably C++) and of data structures.

Students who do not satisfy requirement 3 may satisfy the requirements by taking one or two non-credit, preparatory bridge courses.

Students who have superior academic credentials but who lack insufficient background are admitted with conditional status, pending satisfactory completion of preparatory bridge courses. In some cases, such students are interviewed to determine the necessary preparatory courses they need. Successful completion of the preparatory courses with a B or better average grade is a necessary condition for transfer to regular status.

The demonstrated ability to communicate in written and spoken English is essential to success in graduate studies in computer science and information systems engineering and is required for regular status. Foreign students and others for whom English is a second language may be required to undertake preparatory work to improve their language skills before admission into the graduate program.

Admission with advanced standing is accepted in accordance with NYU-Poly regulations published in the catalog. A maximum of 9 credits may be applied to the MS degree from previous graduate work at an acceptable institution.

Statement of Purpose

Applicants also should submit a special purpose statement clearly stating their experience in cyber security, and their motivation for applying to the program.

ELECTRICAL ENGINEERING PROGRAM

Undergraduate Program Director:
Ivan Selesnick
Graduate Program Director:
Yao Wang

The Department of Electrical and Computer Engineering offers an Electrical Engineering Program for the degrees Bachelor of Science, Master of Science and Doctor of Philosophy.

THE PROFESSION

The rapidly growing profession of electrical engineering has evolved from its early beginnings in electric-power generation and distribution through the development of radio, television, control and materials to computers, telecommunications and health care. In the last century, electrical engineers have created advances in power distribution, computers and communications that have changed the world. Their inventions have made the world a smaller, safer place and allow for immediate reporting and images from distant places that make world events part of daily life.

While electrical engineering undergraduate and graduate students concentrate on areas of electrical science, graduates apply their training to diversified fields such as electronic design, bioengineering, city planning, astronautics, radio astronomy, system engineering, image processing, telemetry, the Internet, computer design, management and patent law. As students mature and realize their abilities, they may choose professional careers in engineering, government, sales or education.

The expertise of NYU-Poly's electrical engineering faculty covers a wide range of fields. Principal areas of teaching and research are computer engineering, telecommunications, wireless communications, signal processing, systems and control engineering, power systems and energy conversion, electro-optics and electroacoustics, microwave engineering, plasma science and engineering, and microelectronic devices and systems.

Additional information about electrical engineering careers can be found online at www.ieee.org/organizations/eab/studentcarees.htm.

UNDERGRADUATE PROGRAM

The BS program in Electrical Engineering gives student a broad-based background in electrical engineering, preparing them for immediate employment in industry or government or for graduate study.

GOALS AND OBJECTIVES

The objectives of the Electrical Engineering Program are that graduates are expected to:

- Be engaged and advancing in their professional careers in a profession that utilizes their NYU-Poly degree, in Electrical Engineering or other career path, that include industry, academia, and governmental or non-governmental organizations.
- Be seeking continuous professional development and life-long learning through graduate school studies, continuing education credits and/or professional registration.

The BS program includes analysis and design courses in major electrical engineering areas that build on fundamental mathematics and science courses. Many courses include hands-on laboratory components. Undergraduates can choose from a variety of electives to provide depth and specialization, many in commercially viable areas such as local area networks, wireless communication and deregulated power systems.

Since most current engineering design is computer-facilitated, the department includes computer-aided design (CAD) programs in many undergraduate courses to emphasize possibilities for large-scale design, corrections for unmodeled complexities, trade-offs among performance criteria, and real-time simulations. A senior design project challenges each student to integrate analytical and design concepts from earlier courses to design a device or system to meet specified performance requirements.

The program recognizes that communication and interpersonal skills, developed in design-course team projects, are essential to a successful career in any profession. Students also must take writing intensive courses and elective courses in humanities and social sciences.

Students are taught by faculty familiar with current issues through sponsored-research programs, such as those coordinated by NYU-Poly's Center for Advanced Technology in Telecommunications (CATT), a World Wide Web lab, and many research grants awarded to individuals or groups of professors.

The Electrical Engineering Program keeps abreast of market changes through the CATT Industrial Affiliates Program and by hiring professors and part-time adjunct teachers with industrial experience, initiating frequent alumni contacts, reviewing professional journals and encouraging faculty to work in industry part time or while on sabbatical. Where possible, classroom work challenges students to apply their knowledge to current design situations. Students also apply broad technical knowledge to practical problems through interdepartmental cooperation. The curriculum employs senior projects to reflect Industry's need for an engineering-system approach. Topics include control and robotics, advanced hardware design, imaging, wireless communications, power electronics and areas mentioned above. Engineering's economic aspects are addressed by allowing undergraduates to choose electives, such as macro/micro economics, psychology, ethics and management process. Cost evaluation is required in the design projects for EG 1003 Introduction to Engineering Design. Senior projects emphasize time management and planning.

Exceptional undergraduate students have the opportunity for advanced study in two programs: (1) the BS/MS Program (please refer to the "Undergraduate Academic Programs and Policies" section of the catalog), and (2) the summer junior-research internship program, in which undergraduates work on research projects with graduate students and their advisers. Up-to-date information about program requirements, course offerings, senior-project topics and research projects is available online from the Department of Electrical and Computer Engineering at www.poly.edu/academics/departments/electrical/.

UNDERGRADUATE DEGREE REQUIREMENTS

The undergraduate electrical engineering program prepares students broadly for a career in electrical engineering in any of its specializations and readies them for immediate employment in industry, business and government, entrepreneurial endeavors or for further graduate education. The program is accredited by the Accreditation Board for Engineering and Technology (ABET).

The table at the end of this section, outlining the Typical Course of Study for a BS, shows a typical semester-by-semester program for students entering as freshmen in fall 2009 or later. The notes are an essential part of the table. Students are responsible for making themselves aware of possible changes in this program after the publication of this catalog. Those changes are posted outside the department's advising offices and on the department's website. (Students who started their studies before fall 2009 should consult the previous edition of this catalog or the department's website for program and course requirements applicable to them.)

SENIOR DESIGN PROJECT

In the two-semester senior Design Project, students focus on one aspect of electrical engineering. In the first semester, students develop skills using specialized laboratory equipment and computer-design packages, are introduced to techniques for planning projects and making effective presentations and learn to balance such design requirements as performance, safety, reliability and cost effectiveness. In the final semester, students design, build or simulate and test a device or system to meet prescribed engineering specifications.

Informal and formal written and public oral presentations help prepare students for professional careers. Design project students frequently work in groups or pairs to develop interaction skills essential to good engineering.

GRADUATION REQUIREMENTS

The Institute requires a 2.0 GPA in all courses and specifies other general requirements in the section "Undergraduate Academic Programs and Policies." This section describes the core curriculum for all engineering majors, including placement procedures in writing, mathematics and programming, course credits by transfer and advanced placement and credit by examination.

To graduate, students must (1) have a C- grade or better in CS 1133, CS 2204, EE 2013, EE 2024 and EE 3054 and (2) have a technical GPA of 2.0 based on all courses prefixed EE, CS or EL. Seniors may elect graduate courses labeled EL 5XX3, but not CS 5XX3. To enroll in other graduate courses, seniors must have a 2.7 GPA or better in related courses and adviser approval; juniors must have a 3.0 GPA or better and adviser approval.

Students are expected to meet the degree requirements in place when they first enrolled in a NYU-Poly program. Those requirements apply as long as students remain in good standing and fewer than eight years have elapsed since they entered the program. The period for unchanged requirements is proportionately less for a transfer student. (Students who started their studies before fall 2009 should consult the department's website for applicable program and course requirements.)

GOOD STANDING, PROBATION AND DISQUALIFICATION

Students who fail to meet Institute GPA requirements or other conditions of adequate progress toward completing a degree are put on probation. (See the "Undergraduate Academic Programs and Policies" section of this catalog for more details.) Students on final probation may not register for courses until grades are available from their previous semester's courses, and they are limited to a reduced number of credits per semester. Students who improve their academic performance are removed from probation and returned to good standing. Continued poor academic performance can lead to final probation and, eventually, disqualification from the Institute.

To remain in good standing in the undergraduate Electrical Engineering Program, students must:

1. Maintain, term-by-term and cumulatively, a technical GPA (based on EE, EL and CS courses) and an Institute GPA of 2.0 or better;
2. Earn a C- or better in each of the four courses specified above; and
3. Fulfill all course pre- and co-requisites.

Students facing difficulties, educational or personal, should consult their instructor or a departmental adviser as soon as possible.

Students who do not meet program conditions are placed on departmental probation. Probation conditions may require students to:

1. Repeat courses, including courses in which they received transfer credit and courses in which they received a C grade or less at NYU-Poly;
2. Specify their credit load and permissible withdrawals; and
3. Take other remedial programs.

Students who fail to meet departmental probation requirements, fail three times to earn the required grade in any one course or do not conform to the Institute Student Code of Practice are subject to disqualification from working toward a bachelor's in electrical engineering or from taking further electrical engineering courses. Actions taken depend on individual cases. Disqualified students may appeal in writing. Students also may apply for readmission after two terms (fall, spring or summer) have passed if they can demonstrate an improved chance of success.

DUAL UNDERGRADUATE MAJORS

With departmental permission, students may earn a single bachelor's degree in electrical and computer engineering. This degree requires 142 credits rather than the usual 128 required for individual bachelor's degrees.

TRANSFER STUDENTS

Transfer credits for courses taken at other schools are based on evaluation of content and level. Students completing the same program at another school, but in different years, may receive a different number of transfer credits. Students should consult an electrical engineering undergraduate adviser for current information.

Transfer students must arrive and present their records for evaluation at least one week before the regular registration period of their first semester at NYU-Poly. Transfer credits are awarded only for courses completed with C grades or better.

Qualified students from two-year pre-engineering programs, such as those at liberal-arts and community colleges, may fulfill the requirements for the BS in Electrical Engineering in two additional years. Since pre-engineering programs vary, a prescribed program is not possible; consequently, students should consult with a NYU-Poly undergraduate adviser at the beginning of their pre-engineering program.

Technology-program graduates may be able to fulfill the requirements for the BS in Electrical Engineering in two to three and a half years, depending on the scope and level of their previous education. Consult with an undergraduate adviser for details.

SENIOR THESIS

Undergraduate electrical engineering students wishing to do a Senior Thesis (BS thesis) instead of Design Project (DP) need not register for DP I or DP II, but they must:

1. Complete 6 total credits of Senior Thesis (EE 397);
2. Complete EE 4001 ECE Professional Development;
3. Make a presentation to their thesis adviser that is open for other students and faculty to attend; and
4. Bind their thesis according to Institute guidelines for MS and PhD theses.

Before registering for Senior Thesis, the student must arrange for a faculty member to serve as thesis adviser. In addition, students must have a 3.0 GPA to register for Senior Thesis instead of Design Project.

Additional notes:

1. The Senior Thesis must be design-oriented.
2. The 6 credits of DP I and DP II are replaced by 6 credits of Senior Thesis (EE 397).
3. The department advises that the 6 credits of Senior Thesis not be all taken in a single semester.

MINOR IN ELECTRICAL ENGINEERING

Students may obtain a minor in electrical engineering by taking 15 credits of EE prefixed courses. The courses may be any EE courses subject only to the prerequisite requirements. A grade of C- or better is required in EE 2013 and EE2024 and a GPA of 2.0 or better in the entire minor is required.

A minimum of 8 credits in the minor must be taken at NYU-Poly. The Electrical Engineering minor is not open to Computer Engineering students.

SENIOR HONORS STUDENTS

Each spring, the Department of Electrical and Computer Engineering selects senior honors students from among current juniors with high GPAs who will complete their degree requirements in the following academic year. Such students are listed as honor students in that year's commencement program and are given special permission to substitute courses in their senior year. Most often these students substitute more advanced graduate courses in place of usual requirements in the same study area. Transfer students are eligible for this designation after they complete half of the credits needed to satisfy NYU-Poly degree requirements (e.g., 64 of 128 total credits).

GUIDANCE FOR UNDERGRADUATE STUDENTS

Instructors provide help for their students during hours posted on their doors or by appointment. Students taking project or thesis courses work closely with faculty project advisers. Electrical engineering advisers in the undergraduate ECE office are glad to advise on courses and program adjustments that result from academic needs or personal problems.

The Office of Special Services sponsors a peer-tutoring program. The Polytechnic Tutoring Center (PTC) provides drop-in tutoring in selected courses. Personalized career counseling is available at the Career Center.

EG 1001, Engineering and Technology Forum, and EE 1002, Introduction to Electrical Engineering, introduce students to technology in society and to the Institute's curriculum for electrical engineering. Fellow students can offer excellent advice on how to adjust to the Institute environment and the engineering program and its demands. Outside class, students are urged to meet others who can give experienced advice by joining clubs such as the student branch of the Institute for Electrical and Electronics Engineers (IEEE) professional society, and other technical, sports, religious and ethnic clubs.

Students are advised to study and to do homework with other students. Everyone benefits and gains a deeper understanding when they explain a concept or technique to someone else.

INFORMATION

Undergraduate advising information is available on the Department of Electrical and Computer Engineering's website, www.poly.edu/academics/departments/electrical/. Students should consult that site for details on honors, probation, approved electives, projects, elective concentrations, course offerings and senior project topics. Curriculum and prerequisite changes, new courses, special sections and other last-minute announcements are also posted on bulletin boards outside the undergraduate and graduate Office of Electrical and Computer Engineering Advising. All students are responsible to stay informed about the latest procedures and regulations.

Descriptions of undergraduate electrical engineering courses are found after graduate EE program descriptions.

GRADUATE PROGRAMS

The Department of Electrical and Computer Engineering offers a graduate Electrical Engineering Program leading to graduate certificates and Master of Science, Master of Engineering and Doctor of Philosophy degrees.

Requirements for graduate degrees in electrical engineering are general. Each student may follow a program in any one of many fields, including those described below. For up-to-date information, students should refer to the Department of Electrical and Computer Engineering Graduate Student Manual. This publication, revised annually, is available rom the department's graduate office and on-line at www.poly.edu/ece/graduate/menu.php.

Outstanding students should apply for financial aid, including research assistantships, teaching assistantships or partial tuition remission.

GOALS AND OBJECTIVES

The Master of Science program in Electrical Engineering prepares graduates for a professional career as an entrepreneur, a practicing engineer in industry, business or government at an advanced level or to pursue the PhD degree in electrical engineering. Three core courses, two one-year sequences and electives provide breadth and depth across a number of electrical engineering subdisciplines.

The Doctor of Philosophy program in Electrical Engineering prepares graduates for a research career in electrical engineering and university-level teaching. The program provides students with strong fundamental knowledge in several electrical engineering disciplines, skills for independent research in a subdiscipline and the ability to prepare and defend a dissertation representing an original and significant contribution for publication in a recognized scientific or engineering journal.

CONCENTRATIONS

WIRELESS COMMUNICATIONS

Wireless communication has exploded in growth since cellular telephones were introduced. This growth has popularized other services such as wireless local area networks (WiFi), wireless wide area networks (WiMAX), Bluetooth and HomeRF. Major paradigm shifts from exclusive reliance on wired networks to an era of tetherless communications, and from a fixed-computing to a mobile-computing environment are under way in the communications world. The merging of Internet and mobile communications is igniting unprecedented growth and an information-technologies revolution.

COMPUTER ENGINEERING

Computer Engineering deals with various systems, devices and chips for computing, control, security and communication purposes. Computer engineers design supercomputers, ubiquitous personal and portable computers, communication equipments security hardware, networking units, intelligent control modules and various embedded hardware-software devices.

TELECOMMUNICATIONS AND NETWORKING

Telecommunications and networking manages systems such as telephone, television, radio transmission, radar, space communications and networks, including data networks, local area networks and the Internet. Program interests range from the design of components, such as switches and routers, to system and network design, performance analysis, modeling and protocols.

SIGNAL PROCESSING

Signal Processing is the theory and application of filtering, coding, transmitting, estimating, detecting, analyzing, recognizing, synthesizing, recording and reproducing signals by digital or analog devices or techniques. The term "signal" includes audio, video, speech, image, communication, geophysical, sonar, radar, medical, musical and other signals. Applications include: analyzing EKG and other biomedical signals for health monitoring; improving the quality of noisy, low-contrast

X-ray images; digitally synthesizing the sound of musical instruments and creating new sounds; compressing music, images and video for faster transmission over the Internet and to make better use of limited memory in portable digital devices; detecting the position and velocity of objects in radar and sonar.

Image and Video Processing
This concentration focuses on the compression of image and video signals for efficient storage and transmission, and on basic image processing techniques such as contrast enhancement, deblurring, denoising and feature extraction. Applications include digital television, video streaming, medical imaging, digital library, and object recognition and tracking for surveillance.

SYSTEMS AND CONTROL
System engineers are concerned with modeling and predicting the behavior of large systems from knowledge of the component parts. Examples include air traffic control systems, health-care delivery systems, manufacturing systems, and systems to monitor and control pollution of the environment. Control engineers are concerned with all aspects of automatic regulation of system performance, which includes modeling of system behavior. Together with the system engineer, they are trained in the fields of automation and system theory. Typical examples of control systems are automatic guidance systems for aircraft and space vehicles, routing of packets in a telecommunication network, control of unmanned and robotic systems, electric motor control, and chemical process control.

ELECTRONICS AND VLSI
The discipline involves designing and implementing circuits used in microcomputers, telecommunications, signal processing and control systems. Students learn to design such circuits with state-of the-art computer facilities and design tools. These circuits are fabricated with modern technologies such as CMOS, bipolar and GaAs. This discipline also involves the emerging area of nanoscale electronics, circuits and architectures and associated design tools.

FIELDS AND WAVES
Field and wave studies include electromagnetic and acoustic wave radiation and propagation under a variety of conditions, including non-linear, anisotropic and periodic media. Such studies include microwave waveguides and antennas, optical fibers, and integrated optics diffraction and scattering effects. Applications include radar, microwave and optical communications and wireless technology.

PLASMA AND ATMOSPHERIC PHYSICS
This area centers on gas breakdown and ionization and the interaction of the resultant plasma with electromagnetic waves. These studies have applications in the propagation of high-power radio waves in the atmosphere and ionosphere.

POWER SYSTEMS AND ENERGY CONVERSION
Studies in power and energy include not only traditionally important generation, conversion and distribution of electrical power, but also modern topics such as power electronics, ion plasmas for the electrical energy generation and electromagnetic propulsion.

REQUIREMENTS FOR THE MASTER OF SCIENCE

Entrance Requirement:
Admission to the Master of Science in Electrical Engineering Program requires a bachelor's in electrical engineering from an accredited institution, with a superior undergraduate academic record and a GPA of 3.0 or above. Students who do not meet these requirements will be considered individually for admission and may be admitted upon completion of specific undergraduate courses to remove preparation deficiencies.

Applicants without a BS in Electrical Engineering—but who are otherwise sufficiently prepared for admission without undergraduate deficiencies—may be required to take specified undergraduate and introductory level graduate electrical engineering courses. Only graduate courses count toward the master's degree.

A student with a BS in a field other than electrical engineering also may consider the departmental master's programs in computer engineering, electrophysics, system engineering, telecommunication networks, or the Master of Engineering in Interdisciplinary Studies in Engineering program, described elsewhere in this catalog, or the several Graduate Certificate programs described here.

Degree Requirements
To obtain the MS in Electrical Engineering degree, students must complete a total of 30 credits of courses, as described below.

GROUP 1: Core Courses
Three courses (3 credits each) from the following:

EL 5373	Internet Architecture and Protocols
EL 5473	Introduction to VLSI System Design
EL 5613	Introduction to Electric Power Systems
EL 6113	Signals, Systems and Transforms
EL 6253	Linear Systems
EL 6303	Probability Theory
EL 6413	Analog and High Frequency Amplifier Design
EL 6713	Electromagnetic Theory and Applications

Total in Group 1 **9 Credits**

Core courses cover fundamental material and should be taken as early as possible in the course of study for the degree program. Students may take an advanced course subsequent to a core course in lieu of the core course, with approval from an ECE graduate adviser.

GROUP 2: Two sequences, each containing two courses, where one course in each sequence may be a core course in Group 1. One sequence must include EL-prefixed courses, and another sequence may contain either EL or CS-prefixed courses. Approved course sequences are listed in the ECE Graduate Student Manual.

Total in Group 2 **6-12 Credits**

GROUP 3: These are approved electives and may include up to 6 credits of graduate courses offered by any science, engineering or management department.

Minimum Total: **30 Credits**

Out-of-department Courses: At least 24 credits must be in EL prefixed courses. A 3-credit course in other science or engineering disciplines may be used to substitute an EL course upon approval by an ECE graduate adviser. Remaining credits can be from any graduate science, engineering or management courses.

Thesis, Project and Reading: A master's thesis (EL 997X, minimal 6 credits) or an MS project (EL 9953 or EL 9963, 3 credits each) or a reading course (EL 9933 or EL 9943, 3 credits each) may be included as part of the elective courses in group 3. Oral defense of the master's thesis before at least three professors is required. Total credits for thesis, projects and readings should not exceed 9 credits within the 30 credits required for the MS degree. At most 3 credits can be taken for reading.

GPA Requirements: An overall GPA of 3.0 in all NYU-Poly graduate courses is required. In addition, a 3.0 average is required in the combination of the five to seven courses taken to satisfy groups 1 and 2.

Transfer Credits: The nine transfer credits allowed by NYU-Poly regulations can be applied only toward electives. Transfer credits may not be used to satisfy core or sequence course requirements.

Repetition of Courses: A student may register no more than three times for the same course, including registration for which a W was earned. A course will not count for degree credit if taken in violation of this rule. Students should consult the Department of Electrical and Computer Engineering Graduate Student Manual for detailed rules

and procedures, including student status, recommended course sequences, recommended electives, current research areas, course repetition and disqualification for low grades. The manual announces degree-requirement changes, if adopted by the faculty after this catalog is published.

REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY

General: Graduate students who exhibit high scholastic proficiency and demonstrate an ability to conduct independent research may extend their goals toward the doctorate. The PhD is awarded to students who complete the studies and research program (described below) and prepare and defend a dissertation. The dissertation must represent an original, significant contribution, qualified for publication in a recognized scientific or engineering journal.

Admission to Programs: Entrance into the doctoral study and research program is contingent on a candidate's passing the departmental qualifying examination and forming a guidance committee (both described below). Students entering the doctoral program at the baccalaureate level must meet the entrance requirement detailed above for the master's program. Students entering at the master's level for the PhD in Electrical Engineering are expected to have a master's in electrical engineering. Students holding a NYU-Poly master's degree in computer or systems engineering, electrophysics or telecommunications networks also can enter the program. Applicants with BS or MS in other disciplines may be admitted depending on academic background and record.

Qualifying Examinations: PhD qualifying examinations are offered twice a year. These examinations are divided into two sections: (1) a written examination requiring preparation through first-year graduate level courses in several areas related to the student's principal interest and (2) an oral examination concentrating mainly on this principal area. Principal concentration areas are communications, signal processing, systems and control, electromagnetics, networks, computer and network architecture, and power electronics and systems.

Details on allowed subject areas, recommended background courses, sample examination questions and the precise format for the coming year are available in the department's Graduate Office.

Guidance Committee: Upon passing the qualifying examination, PhD students must find a faculty member in their major interest area to serve as dissertation adviser. Students work with their dissertation advisers to find an adviser for a minor area outside of electrical engineering and a guidance committee of at least three faculty members. The dissertation adviser usually acts as chairman. At least one other guidance committee member must be in the student's major research interest area; this member may be from outside of NYU-Poly.

The minor adviser may be a member of the guidance committee. Students must submit names of these guidance committee members to the Office of Graduate Programs for approval. The dissertation adviser approves the study program in the student's major and the minor adviser approves the program of courses in the minor.

When the requirements for minor or major are completed, students should have the relevant adviser certify the completion in writing to the Office of Graduate Affairs, with copies to the Department of Electrical and Computer Engineering's Graduate Office.

The guidance committee conducts the area examination and dissertation defense and approves the final dissertation.

Course and Thesis Requirements: A minimum of 75 credits of academic work beyond the bachelor's degree, including a minimum of 21 credits of NYU-Poly dissertation research, is required. A minimum of 42 credits in formal courses (as distinct from independent study credits such as reading, project or thesis) are required. A student entering with a MS from a reputable graduate program may transfer 30 credits. PhD students are required to take a minimum of 9 credits of courses in a minor area outside of electrical engineering. The minor must be taken in an area that is both distinct from and yet consonant with the student's major study area. Students work with thesis advisers to develop their major study program. The major program should constitute a coherent, in-depth study of the most advanced knowledge in the student's area of concentration.

Average GPA among all courses must be 3.5 or above.

Seminar Attendance: PhD students are required to register for a 0-credit Research Seminars course (EL9900) for at least 4 semesters. Satisfactory grade is given only if the student attends more than 2/3 of the seminars offered in a semester.

Area Examination: In the area examination, the student reviews the prior research in the chosen dissertation topic and presents preliminary research results and additional research plan. The guidance committee evaluates the student's performance and determines whether the student demonstrates the depth of knowledge and understanding necessary to carry out research in the chosen area. The examination should be taken early in the PhD program and may be in the form of an open seminar attended by other interested faculty and students.

Submission of the Dissertation and Final Examination: After completing the doctoral dissertation, candidates undergo oral-thesis defense. The guidance committee conducts the examination, but the defense is open to all faculty members and to invited persons. Dissertation copies should be made available to prospective examiners at a reasonable advance time. Students are advised to consult the Office of Research and PhD Programs regarding how to submit, reproduce and bind the final manuscript.

Publication Requirement: To be granted the PhD degree, a PhD candidate must have at least one accepted or submitted journal paper on the thesis-research subject.

GRADUATE CERTIFICATES

The Department of Electrical and Computer Engineering offers the following Graduate Certificates, each requiring four courses (12 credits). A GPA of 3.0 or higher is required in the four courses to receive the certificate.

- Computer Engineering
- Image Processing
- Telecommunication Network Management
- Wireless Communications
- Power Electronics and Systems
- Power Systems Management

GRADUATE CERTIFICATE IN COMPUTER ENGINEERING

Computer engineering is a rapidly growing profession. Computer engineers are working in exciting times with unlimited opportunities. For instance, computer engineers interact with and design large supercomputers and the ubiquitous personal and portable computers. Furthermore, computer engineers play key roles in networking computers with other computers and intelligent devices. They also concentrate on projects such as designing specialized computer hardware to reconstruct the human genome, monitoring and controlling industrial plants and the environment, computer graphics and robotics, and designing biomedical devices and computer networks. Finally, computer engineers design and develop hardware and embedded hardware-software systems. The graduate certificate in computer engineering is for working professionals who seek a more in-depth understanding of the field. The program consists of three required courses and one elective course.

Group 1: Choose three from the following

Course	Title	Credits
EL 5493	Advanced Hardware Design (VHDL)	3
EL 5363	Principles of Communication Networks	3
EL 5473	Introduction to VLSI Systems Design	3
CS 6133	Computer Architecture I	3

Group 2: Choose one from the following, or the unchosen one in Group 1:

EL 5483	Real-Time Embedded Systems	3
EL 6493	Digital VLSI System Testing	3
EL 6443	VLSI System Architectures	3
EL 6413	Analog and High Frequency Amplifier Design	3
EL 6433	Digital Integrated Circuit Design	3
CS 6143	Computer Architecture II	3
CS 6183	Fault-Tolerant Computers	3

Certificate Coordinator:
Professor Ramesh Karri, Tel: 718-260-3596, E-mail: rkarri@poly.edu.

GRADUATE CERTIFICATE IN IMAGE PROCESSING

Image processing covers the fundamental technology behind applications such as digital television; medical imaging and teleradiology; video streaming and conferencing over wireless and wireless networks, multimedia database and digital library. All applications use digital image enhancement, filtering, analysis and compression techniques. This certificate is for working professionals who seek an in-depth understanding of image processing and communication technology. The program consists of three required courses and one elective course.

Required Courses:

Course	Title	Credits
EL 5123	Image Processing	3
EL 6123	Video Processing	3
CS 6643	Computer Vision and Scene Analysis	3

Elective Courses: choose one from the following:

EL 5823	Medical Imaging I	3
EL 6183	Digital Signal Processing Lab	3
EL 6113	Signals, Systems and Transforms	3
EL 6303	Probability Theory	3
EL 6313	Stochastic Processes	3
EL 7133	Digital Signal Processing	3
EL 7163	Wavelet Transforms and Filter Banks	3
EL 9953	Advanced Project I	3

Certificate Coordinator:
Professor Yao Wang, Tel: 718-260-3469, E-mail: yao@poly.edu.

GRADUATE CERTIFICATE IN TELECOMMUNICATION NETWORK MANAGEMENT

The explosive growth of data networks has created the need for effective network management. The widespread deployment of standards-based solutions (e.g., SNMP) is only a first step in facing the complexity of network management. A thorough knowledge of network protocols and network management standards is necessary for any practitioner. The program consists of four required courses. This certificate can be finished completely online.

Course	Title	Credits
EL 5363	Principles of Communication Networks	3
EL 5373	Internet Architecture and Protocols	3
or		
CS 6843	Network Protocols I	3
EL 6373	Local and Metropolitan Area Networks	3
CS 6813	Computer Security	3
or		
CS 6823	Network Security	3

Certificate Coordinator:
Professor Yong Liu, Tel: 718-260-3959, E-mail: yongliu@poly.edu.

GRADUATE CERTIFICATE IN WIRELESS COMMUNICATIONS

Wireless communication has experienced remarkable growth since cellular telephones were introduced. With FCC licensing of spectrum for Personal Communication Services (PCS)—and services such as wireless LANs, wireless Internet and wireless Personal Area Networks—the growth rate is expected to accelerate. To give electrical engineers the specific knowledge needed to work in this expanding market, NYU-Poly has structured a series of four graduate level courses that cover the knowledge needed for successful industry competition. The program comprises one required course and three recommended elective courses. This certificate can be finished completely online.

Required Course:

Course	Title	Credits
EL 6303	Probability Theory	3

Recommended Elective Courses (choose 3):

EL 5013	Wireless Personal Communication Systems	3
EL 5023	Wireless Information Systems Lab I	3
EL 5033	Wireless Information Systems Lab II	3
EL 6013	Principles of Digital Communications: Modulation and Coding	3
EL 6023	Wireless Communications: Channel modeling and receiver design	3
EL 6033	Modern Wireless Communication Techniques and Systems	3
EL 6063	Information Theory	3
EL 6073	Error Control Coding	3
EL 6753	UHF Propagation for Wireless Systems	3
EL 7023	Space-Time Wireless Communications	3
EL 90X3	Selected Topics Courses in Wireless	3

Certificate Coordinator:
Professor Frank Cassara, Tel: 631-755-4360, E-mail: cassara@rama.poly.edu.

GRADUATE CERTIFICATE IN POWER ELECTRONIC AND SYSTEMS

The Certificate in Power Electronics and Systems prepares students for engineering careers in a broad range of companies: from small manufacturers of electronic power equipment and defense contractors to large electric utilities and multi-national power equipment companies. The power range of covered equipment and systems is from miliwatts to gigawatts. This certificate could be a part of MS EE degree at NYU-Poly. The EL5613 course is a core course in both programs.

Required Courses:

Course	Title	Credits
EL 5613	Introduction to Electric Power Systems	3
EL 5673	Electronic Power Supplies	3

Elective Courses: Choose two from the following:

EL 5663	Physics of Alternative Energy	3
EL 5683	Electric Drives Characteristics and Controls	3
EL 6603	Power Electronics	3
EL 6623	Power Systems Economic and Planning	3
EL 6633	Transients, Surges and Faults in Power Systems	3
EL 6643	Relay Fault Protection	3
EL 6653	Power System Stability	3
EL 6663	Distributed Generation Systems	3
EL 6683	Adjustable Speed Drives	3
EL 96X3	Selected Topics in Power Engineering	3

Certificate Coordinator: Professor Dariusz Czarkowski, Tel: 718-260-3256, E-mail: dcz@pl.poly.edu.

GRADUATE CERTIFICATES IN POWER SYSTEMS MANAGEMENT

This certificate is for engineers who seek to enhance their power-industry knowledge. Students learn to manage complex utility projects, offer inventive solutions to old and new problems, and provide understanding of the power-industry economics. The certificate is for students who work as power-industry professionals or those who seek to do so. The program is also for those who want to learn more about power-systems deployment and acquisition, specification and planning.

Required Courses:

Course	Title	Credits
EL5613	Introduction to Electric Power Systems	3
MG8203	Project Assessment and Management	3

Elective Courses: choose two from the following:

EL 6623	Power Systems Economics and Planning	3
MG 8273	Contracts and Specifications	3
EL 9653	Special topics in Power Engineering: Transmission and Distribution Systems	3

Certificate Coordinator: Professor Francisco De Leon, Tel: 718-260-3961, E-mail: fdeleon@poly.edu.

UNDERGRADUATE COURSES

Students should consult departmental adviser postings, handouts and the department's website for changes in required courses, course contents and prerequisites that go into effect after this catalog is published.

General prerequisites: students may not register for any junior- or senior-level courses until they complete all freshman and most sophomore requirements. For all EE courses, the Institute assumes knowledge of computer programming at the level of CS 1113 and of computational mathematics packages used in calculus courses.

Note: Elective courses whose identifiers have three numerical digits (e.g., EE 107) are listed after the courses having identifiers with four numerical digits. Courses with identifiers of the form EL XYZ, available as senior electives, are listed with graduate EE courses.

EE 1002 Introduction to Electrical Engineering *2:0:0:2*

This course introduces numerous Electrical Engineering subject areas, including power systems, power electronics, computer networking, computer processors, communications, feedback control, signal processing, and EM fields/waves. As appropriate for each area, the course introduces various devices, design and operational issues, design methodologies and algorithms. Also introduced are basic equations to model systems and algorithms to solve specific problems. Important technical developments and problems are discussed. Mathematical methods are introduced as needed. The course gives an overview of department courses. Faculty lecturers discuss research and industrial projects in which they have been involved. Assignments include computer simulations and investigations of different systems. Written reports based on articles from the IEEE Spectrum Magazine are assigned. The IEEE Code of Ethics and ethics-related readings from the IEEE literature are discussed. *Prerequisites: CS 1133 and MA 1024. ABET competencies: i, h.*

EE 1012 Introduction to Computer Engineering *2:0:0:2*

This course helps students to understand computer engineering as a balance among hardware, software, applications and theory, the notion of abstraction, computer layers and how they relate to various aspects of computer engineering, implementation of abstract and physical computer layers: Number systems, digital logic, basic processor structure, instruction set architecture, machine languages, assembly languages and high-level programming in C. Other computer concepts, including compilers, operating systems and algorithms, are presented, along with the simulator concept and its usage for understanding computer design, testing and analysis. Experts present special topics in the area. Also discussed are invention, innovation, entrepreneurship and ethics in these topics and in Computer Engineering. *Also listed under CS 1012. ABET competencies e, h, j.*

EE 2013 Fundamentals of Electric Circuits I *3:0:1:3*

This course covers Passive DC circuit elements, Kirchoff's laws, electric power calculations, analysis of DC circuits, Nodal and Loop analysis techniques, voltage and current division, Thevenin's and Norton's theorems, and source-free and forced responses of RL, RC and RLC circuits. A minimum of C- is required to take other EE courses. *Co-requisites: MA 2012, MA 2132 and PH 2023. ABET competencies a, c, e, k.*

EE 2024 Fundamentals of Electric Circuits II *3:1:1:4*

The course continues EE 2013 and focuses on sinusoidal steady-state response; complex voltage and current and the phasor concept; impedance and admittance; average, apparent and reactive power; polyphase circuits; node and mesh analysis for AC circuits; use of MATLAB for solving circuit equations; frequency response; parallel and series esonance; and operational amplifier circuits. A laboratory meets on alternate weeks. A minimum of C- is required to take other EE courses. *Prerequisite: EE 2013 with C or better grade. ABET competencies a, b, c, d, e, k.*

EE 2613: Fundamentals of Electric Power Engineering for Non EE Students *3:0:0:3*

Introduction to electricity: current, voltage and electrical power. Ohm's Law. Kirchhoff's Laws. Electrical materials. Electrical energy generation process. Principles of AC. Bulk electrical power generation: hydroelectricity and thermoelectricity. Alternative generation sources. Synchronous Generators. Induction Motors. Transmission and distribution systems. Substations and transformers. Low-voltage networks. Industrial, commercial and residential networks and loads. Short-circuit and protection equipment. Relays and circuit breakers. Power quality. Reliability and blackouts. Physiological effects of electric currents in the human body. Exposure to low-frequency magnetic fields. National Electric Code (NEC). ANSI-IEEE Standards. IEC standards. Certification of electrical products compliance. *Prerequisites: MA 1024 MA 1124, and PH 1013. Co-requisite: PH 2023. ABET competencies a, d, h i, j.*

EE 3054 Signals and Systems *3.5:1.5:1:4*

This course centers on linear system theory for analog and digital systems; linearity, causality and time invariance; impulse response, convolution and stability; the Laplace, z- transforms and applications to Linear Time Invariant (LTI) systems; frequency response, analog and digital filter design. Topics also include Fourier Series, Fourier Transforms and the sampling theorem. Weekly computer-laboratory projects use analysis- and design-computer packages. The course establishes foundations of linear systems theory needed in future courses; use of math packages to solve problems and simulate systems; and analog and digital filter design. *Prerequisites: EE 2024 (C- or better), MA 2012 and MA 2132. ABET competencies a, b, c, e, k.*

EE 3064 Feedback Control *3.5:1.5:0:4*

This course introduces analysis and design of linear feedback-control systems; modeling of physical systems, performance specifications, sensitivity and steady-state error; Routh-Hurwitz and Nyquist Stability tests; the use of Root Locus and frequency-response techniques to analyze system performance and design compensation (lead/lag and PID controllers) to meet performance specifications. Students analyze and design control systems using math packages in the alternate-week computer laboratory. The course establishes the foundation of feedback-control theory for use in more advanced courses; introduces control-systems design concepts and practices; and develops facility with computer-design packages for design and simulation. *Prerequisites: EE 3054 (C- or better) and PH 2023. ABET competencies: a, b, c, e, g, i, k.*

EE 3114 Fundamentals of Electronics I *3.5:1.5:1:4*

This course focuses on circuit models and amplifier frequency response, op-amps, difference amplifier, voltage-to-current converter, slew rate, full-power bandwidth, common-mode rejection, frequency response of closed-loop amplifier, gain-bandwidth product rule, diodes, limiters, clamps and semiconductor physics. Other topics include Bipolar Junction Transistors; small-signal models, cut-off, saturation and active regions; common emitter, common base and emitter-

follower amplifier configurations; Field-Effect Transistors (MOSFET and JFET); biasing; small-signal models; common-source and common gate amplifiers; and integrated circuit MOS amplifiers. The alternate-week laboratory experiments on OP-AMP applications, BJT biasing, large signal operation and FET characteristics. The course studies design and analysis of operational amplifiers; small-signal bipolar junction transistor and field-effect transistor amplifiers; diode circuits; differential pair amplifiers and semiconductor device- physics fundamentals. *Prerequisites: EE 2024 (C- or better) and PH 2023. ABET competencies a, b, c, e, k.*

EE 3124 Fundamentals of Electronics II *3.5:1.5:0:4*

The course concentrates on differential and multistage amplifier, current mirrors, current sources, active loads; frequency response of MOSFET, JFET and BJT amplifiers: Bode plots; feedback amplifiers, gain-bandwidth rule and feedback effect on frequency response; Class A, B and AB output stages; op-amp analog integrated circuits; piecewise-linear transient response; determination of state of transistors; wave-shaping circuits; MOS and bipolar digital design: noise margin, fan-out, propagation delay; CMOS, TTL, ECL; and an alternate week laboratory. The course studies design and analysis of analog integrated circuits, frequency response of amplifiers, feedback amplifiers, TTL and CMOS digital integrated circuits. *Prerequisite: EE 3114. ABET competencies a, c, e, g, k.*

EE 3193 Introduction to Very Large Scale Integrated Circuits *3:0:0:3*

The course offers an overview of integrated circuit-design process: planning, design, fabrication and testing; device physics: PN junction, MOSFET and Spice models; inverter static and dynamic behavior and power dissipation; interconnects: cross talk, variation and transistor sizing; logic gates and combinational logic networks; sequential machines and sequential system design; subsystem design: adders, multipliers, static memory (SRAM), dynamic memory (DRAM). Topics include floor planning, clock distribution, power distribution and signal integrity; Input/Output buffers, packaging and testing; IC design methodology and CAD tools; implementations: full custom, application-specific integrated circuit (ASIC), field programmable gate arrays (FPGA). The course provides foundations of VLSI design and custom VLSI design methodology and state-of-the-art CAD tools. *Prerequisites: CS 2204 (C- or better) and EE 3114. ABET competencies: a, c, e, k.*

EE 3363 Real-Time Embedded Controls and Instrumentation *3: 0: 0: 3*

Introduction to real-time embedded systems. Overview of utilization of embedded micro-controllers and micro-processor for real-time applications. Concepts of modeling and simulation of real-time systems and their hardware-in-the-loop realization. Overview of various sensors and actuators and the associated instrumentation. Electrical and communication standards for interfacing sensors and actuators in embedded systems. Sample micro-controllers and micro-processors and FPGAs in embedded applications. Operating environment in real-time processing systems and software implementations. Case studies of control systems. *Prerequisites: EE 2024 and CS 2204 and knowledge of C programming language.*

EE 3404 Fundamentals of Communication Theory *3.5:1.5:0:4*

The course covers bandpass signal representation and quadrature receivers; noise in communication systems; Digital Modulation Schemes, coherent and noncoherent receivers; coding fundamentals, block and convolutional codes; higher-order modulation schemes, QAM, M-PSK; intersymbol interference and equalization techniques; and carrier and symbol synchronization. Alternate-week computer laboratory projects analyze and design computer packages. The course teaches principles of various modulation and coding techniques and their relative effectiveness under transmission-environments constraints and uses math packages to analyze and simulate communication systems. *Prerequisite: EE 3054 (C- or better); computer engineering students may register with instructor's approval. Co-requisite: MA 3012. ABET competencies a, c, e, k.*

EE 3414 Multimedia Communication Systems I *4:0:0:4*

The course is Part I of an approved Institute Sequence in Multimedia Communications. Topics: speech and audio sampling and quantization; frequency domain characterization and processing of speech signals; speech and audio-coding standards; wired and wireless telephone systems; color perception and representation; basic image-processing tools; image-coding standards; basics of packet-switching networks and Internet technology. Requirements: one term project by a team of two or more students related to course content. Objectives: to understand basic techniques for speech, audio and image processing and principles of wired and wireless telephone systems and the Internet. *Prerequisites: CS 1114 or CS 1133 and MA 1024. ABET competencies: a, b, d, g, h, k.*

EE 3423 Light and Lightening *3:0:0:3*

The course explores physical concepts in conversion of electric energy into visible light. Nature of light. Visualization of light. Principles of operation and characteristics of modern light sources. Incandescent and tungsten halogen lamps. Fluorescent mercury lamps. Low-pressure sodium lamps. High intensity discharge (HID) lamps. Solid-state light sources. Latest trends in lighting technology. *Prerequisites: CM 1004 and PH 2033. Also listed under PH 3423.*

EE 3604 Electromagnetic Waves *3.5:1.5:0:4*

Electromagnetic wave propagation in free space and in dielectrics, starting from a consideration of distributed inductance and capacitance on transmission lines. Electromagnetic plane waves are obtained as a special case. Reflection and transmission at discontinuities are discussed for pulsed sources, while impedance transformation and matching are presented for harmonic time dependence. Snell's law and the reflection and transmission coefficients at dielectric interfaces are derived for obliquely propagation plane waves. Guiding of waves by dielectrics and by metal waveguides is demonstrated. Alternate-week laboratory. Objectives: Establish foundations of electromagnetic wave theory applicable to antennas, transmissions lines and materials; increase appreciation for properties of materials through physical experiments. *Prerequisites: EE 2024 (C- or better) and MA 3112. ABET competencies: a, b, c, e, k.*

EE 3824 Electric Energy Conversion Systems *3.5:1.5:0:4*

Introduction to electric-energy sources, energy-storage devices, energy economics, environmental issues and electrical hazards. Principles of electric power systems transmission and distribution. Basic electromechanical conversion systems pulse and distribution transformers, induction rotating machines. Principles of electric energy conversion, static power supplies, static controllers and electric-power quality. Fundamentals of power management heat-sinks and cooling systems. Alternate-week experiments with basic electrical machines. Objec-

tives: familiarization with energy sources, storage devices and their economical and environmental management; analysis and design of transmission and distribution systems, basic electrical machinery and power electronic converters. *Prerequisite: EE 2024 (C- or better). Co-requisite: EE 3604. ABET competencies: a, b, c, e, g, k.*

EE 4001 ECE Professional Development and Presentation *1:0:0:1*

This course provides electrical and computer engineering students with concepts, theory, principles and experience in project management and project presentation. Students learn how to apply skills learned in engineering coursework to team projects in a professional environment. *Prerequisites: Junior or senior status or permission of the instructor. Restricted to Electrical and Computer Engineering majors. ABET competencies: a, e, f, g.*

EE 4144 Introduction to Embedded Systems Design *3.5:1.5:0:4*

The course covers architecture and operation of embedded microprocessors; microprocessor assembly language programming; address decoding; interfacing to static and dynamic RAM; Serial I/O, Parallel I/O, analog I/O; interrupts and direct memory access; A/D and D/A converters; sensors; microcontrollers. Alternate-week laboratory. Objectives: to provide foundations of embedded systems design and analysis techniques; expose students to system level design; and teach integration of analog sensors with digital embedded microprocessors. *Prerequisites: CS 2204 (C- or better) and EE 2024 (C- or better). ABET competencies: a, c, d, e, g, j, k.*

EE 4414 Multimedia Communication Systems II *4:0:0:4*

This course is Part II of an approved Institute Sequence in Multimedia Communications. Topics: analog and digital video format, properties of human visual systems, multiplexing of separate color components, video-coding methods and standards, analog and digital TV systems. Policy and business issues in TV system development. Video conferencing systems, video streaming over the Internet, Internet protocols for real-time applications. Requires one-term project on a topic related to the course content by a team of two or more students. Objectives: to understand basic techniques for video processing and principles of television systems and real-time services over the Internet. *Prerequisites: EE 3414 or 3054, or sufficient knowledge of Fourier Transforms. ABET competencies: a, b, d, g, h, k.*

ELECTRICAL ENGINEERING DESIGN PROJECT I (EE DP I)

The required design project consists of two three-credit courses. The first course, EE DP I, is one of a number of specialty lab/project courses offered by the department in various subdisciplines such as electronics, machinery, robotics, imaging, communications, etc. (EE 4113-4183, below).

DP I provides significant background laboratory experience in the student's area of concentration. Students begin independent projects by finding an adviser and initiating the project work, and exercising oral presentation and written communication skills. *Prerequisite: completion of all junior-level technical courses. ABET competencies: a, b, c, e, f, g, k.*

EE 4113 EE DPI- Control and Robotics *0:6:1:3*
Additional prerequisite: EE 3064.

EE 4123 EE DPI- Electrical Power and Machinery *1:3:1:3*
Additional prerequisite: EE 3824.

EE 4133 EE DPI- Electromagnetic Waves and Applications *1:3:1:3*
Additional prerequisite: EE 3604.

EE 4143 EE DPI- Integrated Circuit Design *1:3:1:3*
Additional prerequisite: EE 3124.

EE 4153 EE DPI- Multimedia *(also listed under EL 5143)* *0:6:1:3*

EE 4163 EE DPI - Digital Signal Processing Lab *(also listed under EL 6183)* *1:3:1:3*

EE 4173 EE DPI- Telecommunication Networks *(also listed under EL 5373)* *1:3:1:3*
Additional prerequisite: EE 3404.
Additional co-requisite: EE 136.

EE 4183 EE DP I-Wireless Communication *(also listed as EL 5023)* *1:3:1:3*
Additional prerequisite: EE 3404.

EE 4223 Electrical Engineering Design Project II *0:6:1:3*

In this concluding phase of the Design Project, students and their advisers continue to work on the independent project begun in the previous semester. The final project builds upon analytical and laboratory skills developed in previous required and elective courses. The project may be an individual one, or may be carried out by a student team working with a faculty group adviser. The final Capstone Project also may be a multidisciplinary project carried out with students from other departments. *Prerequisite: EE 41X3. ABET competencies: a, b, c, d, e, f, g, h, i, j, k.*

EE 4313 Computer Engineering Design Project I *1:3:1:3*

Lectures and experiments introduce computer hardware organization, assembly language programming and interfacing computer hardware to physical devices. This course exercises the student's oral presentation and written communication skills, and provides background necessary for beginning independent project work. Students find an adviser and choose DP II course project. *Prerequisite: completion of all junior-level technical courses, including minimum grade requirements. ABET competencies: a, b, c, e, f, g, k.*

EE 4323 Computer Engineering Design Project II *0:6:1:3*

Students work with faculty advisers in this concluding phase of their Capstone Project. This project builds upon the analytical and laboratory skills developed in previous required and elective courses. The project may be an individual one, or carried out by a team of students working with a faculty group adviser. The project also may be multidisciplinary, carried out with students from other departments. Students are required to make oral and written presentations. *Prerequisites: EE 4313 or CS 4513. ABET competencies: a, b, c, d, e, f, g, h, i, j, k.*

EE 4823 Electric and Hybrid Vehicles *3:0:1:3*

Electric and hybrid vehicles mechanical fundamentals. DC, induction, and permanent magnet ac motors and drives. Regenerative breaking. Automotive power electronics. Fuel cells for electric vehicles. Electric Energy storage. The class meets four hours a week for lectures and recitation. *Prerequisites: EE 3824 and PH 2033. ABET competencies: a, c, h, k.*

EE 107 Control System Design *3:0:0:3*

The course covers design of linear feedback control systems, selected from the following: lag-lead compensators; pole placement controllers; state-variable feedback and observers; linear quadratic optimal control, stochastic systems, sampled-data-and computer-controlled systems; and phase-plane and describing function techniques for nonlinear systems. *Prerequisite: EE 3064. ABET competencies: a, b, c, e, k.*

EE 116 Communication Electronics *3:0:0:3*

The course centers on design and analysis of small-signal and large-signal tuned amplifiers, sine-wave oscillators, mixers, AM modulators and demodulators, FM modulators and demodulators, phase-locked loops. *Prerequisite: EE 3124. ABET competencies: a, c, e, k.*

EE 136 Communication Networks *3:0:0:3*

This course develops basic techniques used in communication networks. After protocol layering is introduced, algorithms and protocols are discussed for use in each of the five layers: physical, data link, network, transport and application. Specific protocols such as TCP/IP, ATM, SS7 are included. *Prerequisite: junior status in electrical engineering, computer engineering, or computer science. Corequisites: for EE majors: MA 3012 and MA 3112; for CompE/CS majors: MA 2212 and MA 2222. ABET competencies: a, c, e, j, k.*

EE 164 Electromagnetic Fields and Radiation *3:0:0:3*

Review and mathematical interpretation of Maxwell's Equations; basic antenna theory and radiation; antenna parameters and arrays; rectangular metal waveguides; dielectric waveguides; and applications at radio and optical frequencies are discussed. *Prerequisite: EE 3604. ABET competencies: a, c, e, k.*

EE 210 Summer Honors Research Laboratory *0:9:0:3*

An individual or small-group intensive, 11-week research-oriented project, often related to current faculty research projects. Offered in the summer following the junior year. Students may use this course to satisfy the Technical Elective requirement or the Design Project II. A limited number of students are selected for this program based on application forms submitted in the preceding spring. (See www.poly.edu/academics/departments/electrical/research). *ABET competencies: a, b, c, e, f, g, i, j, k.*

EE 371-6 Guided Studies in Electrical Engineering *1,2,3,4,5,6 credits, respectively.*

Guided study under the guidance of a faculty member of a topic related to Electrical Engineering. *Prerequisite: Adviser approval.*

EE 381-6 Guided Studies in Computer Engineering *1, 2, 3, 4, 5, 6 credits, respectively.*

Guided study under the guidance of a faculty member of a topic related to Computer Engineering. *Prerequisite: Adviser approval.*

EE 397 Senior Thesis *As arranged*

IIndependent design-oriented engineering project preformed under guidance of faculty adviser. Oral thesis defense and formal, bound thesis volume required. Registration of at least 6 credits required. *Prerequisites: Senior status and adviser approval. Credits: variable.*

GRADUATE COURSES

EL 5013 Wireless Personal Communication Systems *3:0:0:3*

The course introduces underlying principles of wireless communications and practical systems. Topics: Science and technology including radio signal propagation, interference-limited communications, multiple access, radio resources management and mobility management. Building blocks of wireless networks. Essential functions of cellular telephone systems and wireless local area networks. Details of the most important technologies including GSM, CDMA, wideband CDMA and WiFi (IEEE802.11). *Prerequisite: EE 3404 or equivalent.*

EL 5023 Wireless Information Systems Laboratory I *1.5:4.5:0:3*

This course includes hands-on experience with a combination of laboratory experiments, lectures and projects relating to spread spectrum code division multiple access (CDMA) wireless communication systems. Specific topics include pseudo-noise code generation, transmitters and receivers for direct sequence and frequency hopping systems, acquisition and tracking, CDMA wireless computer communications, UHF channel propagation characteristics including multipath time delay profiles and attenuation measurements, bit error rate measurements, phase locked loops and spectrum sharing with existing narrowband users. *Prerequisite: Graduate status or EE 3404. Also listed under EE 4183.*

EL 5033 Wireless Information Systems Laboratory II *1.5:4.5:0:3*

This course includes hands-on experience with a combination of laboratory experiments, lectures and projects relating to basic and advanced topics in wireless communications. Specific topics include mixers, IQ modulation, phase locked loops, receiver design, PN code acquisition, smart antennas and RFID. *Prerequisite: EL 5023.*

EL 5123 Image Processing *3:0:0:3*

The course focuses on image formation and perception; image acquisition, representation and display; image sampling and resizing; contrast enhancement; two-dimensional Fourier transform and other unitary transforms; frequency domain and spatial domain linear filtering; median and morphological filtering; image smoothing, sharpening and edge detection through linear and nonlinear filtering; color image representation and processing; lossless and lossy image coding techniques and standards, image debluring; imaging geometry, image registration and geometric transformation. Students also learn to implement selected imaging processing algorithms in MATLAB or C-language. *Prerequisites: Graduate student status or EE 3054 and MA 3012. Also listed under BE 6223.*

EL 5143 Multimedia Laboratory *1.5:4.5:0:3*

This course provides hands-on experience in processing and communication of speech, audio, image and video signals. Topics include sampling and quantization, sampling rate conversion, lossless and lossy compression, basic techniques in speech, audio, image and video coding, multimedia conferencing, video on-demand, video multicasting, multimedia document creation. Students are exposed to popular software and hardware for multimedia signal processing and document creation. Each week includes a lecture and a lab. *Prerequisites: Graduate status or EE 3054 or equivalent. Also listed under EE 4153.*

EL 5213 Introduction to Systems Engineering *3:0:0:3*

This course introduces fundamentals of systems engineering process. Topics: Multidisciplinary systems methodology, design and analysis of complex systems. Brief history of systems engineering. Mathematical models. Objective functions and constraints. Optimization tools. Topics to be covered include identification, problem definition, synthesis, analysis and evaluation activities during conceptual and preliminary system design phases. Decision analysis and utility theory. Information flow analysis in organizations. Elements of systems management, including decision styles, human information processing, organizational decision processes and infor-

mation system design for planning and decision support. Basic economic modeling and analysis. Requirements development, life-cycle costing, scheduling and risk analysis. Application of computer-aided systems engineering (CASE) tools. *Prerequisite: Graduate status.*

EL 5223 Sensor Based Robotics *3:0:0:3*

The course covers robot mechanisms, robot arm kinematics (direct and inverse kinematics), robot arm dynamics (EulerLagrange, Newton-Euler and Hamiltonian Formulations), six degree-of-freedom rigid body kinematics and dynamics, quaternion, nonholonomic systems, trajectory planning, various sensors and actuators for robotic applications, end-effector mechanisms, force and moment analysis, introduction to control of robotic manipulators. *Prerequisite: Graduate status. Pre/co-requisite: EE 3064. Co-requisite: EE 3064. Also listed under ME 6613.*

EL 5253 Applied Matrix Theory *3:0:0:3*

The course focuses on in-depth introduction to theory and application of linear operators and matrices in finite-dimensional vector space. Topics: determinants, eigenvalues and eigenvectors. Theory of linear equations. Canonical forms and Jordan canonical form. Matrix analysis of differential and difference equations. Singular value decomposition. Variational principles and perturbation theory. Numerical methods. *Prerequisites: Graduate status, MA 2012, MA 2132, MA 2112 and MA 2122.*

EL 5363* Principles of Communication Networks *3:0:0:3*

This course covers all fundamental aspects of communications networks. Topics are: protocol architecture, data transmission and signal encoding, multiplexing, spread spectrum, data link control, local area networks, wireless LAN, circuit switching, packet switching, routing, traffic control, Internet protocol, transport layer protocol, application design and the basics of network security. *Prerequisite: MA 3012 or instructor's permission. *Online version available.*

EL 5373* Internet Architecture and Protocols *3:0:0:3*

This course introduces basic local area networking technologies and protocols in a set of lectures and laboratory experiments. Topics: link level protocols. Local area networks: CSMA/CD, Token Ring, IEEE standards and protocols. The Internet protocol suite: IP, ARP, RARP, ICMP, UDP and TCP. LAN Interconnection: bridges, routers and gateways. Application protocols: SNMP, FTP, SMTP and NFS. *Prerequisite: EL 5363 or EE 136. *Online version available. Also listed under EE 4173.*

EL 5463* Introduction to RF/Microwave Integrated Circuits *3:0:0:3*

The course topics include: review of transmission lines and smith chart. Introduction of signal graphs technique. Noise in microwave circuits. Introduction to active devices for RF and microwave circuits. S-parameter modeling. Design of amplifiers, stability analysis and examples. Oscillators and mixers. Transistor and dielectric resonator oscillators. Design considerations and examples. Introduction to microwave systems. *Prerequisite: EE 3604. *Online version available.*

EL 5473* Introduction to VLSI System Design *3:0:0:3*

This course covers CMOS processing technology, MOS transistor theory, static/dynamic circuit and logic design techniques, circuit performance estimation, standard cells and gate arrays, clocking strategies, input/output structures, datapath, memory and control logic design. Advanced VLSI CAD tools are used for schematic capture, layout, timing analysis and simulations for functionality and performance. *Prerequisites: Senior or graduate status, CS 2204 and EE 3114 or equivalent. *Online version available.*

EL 5483 Real Time Embedded Systems *3:0:0:3*

This course provides an overview of the unique concepts and techniques needed to design and implement computer systems having real-time response requirements in an embedded environment. It contrasts the concepts and techniques of real time and embedded systems with those of more traditional computer systems. Topics include: Basic concepts of real time and embedded systems, hardware features, programming languages, real time operating systems, synchronization techniques, performance optimization and current trends in real time and embedded systems such as incorporating internet connectivity. *Prerequisite: Knowledge of C, Pascal or other programming language and a basic understanding of computer architecture.*

EL 5493 Advanced Hardware Design *3:0:0:3*

This course shows how a hardware-description language (for example, VHDL) can be used for computer hardware modeling, logic synthesis, register-level synthesis and simulation. The resulting design with hundreds or thousands of gates is then ready to be downloaded to form FPGA chips or silicon cells. Programs used: QuickVHDL, modeling and simulation tools from Mentor Graphics or similar large-scale programs. A design project is required and students make a written and oral presentation. *Prerequisite: Graduate status.*

EL 5513 Electro-Optics I *3:0:0:3*

This course describes the phenomena of and introduces the analyzing techniques for wave propagation in optical systems. Topics include: Review of Maxwell equations; propagation of plane waves: polarization, reflection, refraction, interfaces and multilayers; Fourier optics and diffraction; Ray and Gaussian beams; Optical cavities; Guided optical beams, optical fibers and guiding layers; Dispersion and mode distortion in fibers. *Prerequisites: Graduate status, EE 3604 or equivalent.*

EL 5523 Electro-Optics II *3:0:0:3*

This course focuses on active optical systems. Topics include: resonant optical cavities; laser oscillation and amplification; general characteristics of lasers, laser excitation; semiconductor lasers; detection of optical radiation. *Prerequisite: EL 5513.*

EL 5533 Physics of Nanoelectronics *3:0:0:3*

The course covers limits to the ongoing miniaturization (Moore's Law) of the successful silicon device technology imposed by physical limitations of energy dissipation, quantum tunneling and discrete quantum electron states. Topics: quantum physical concepts and elementary Schrodinger theory. Conductance quantum and magnetic flux quantum. Alternative physical concepts for devices of size scales of 1 to 10 nanometers, emphasizing role of power dissipation. Tunnel diode, resonant tunnel diode, electron wave transistor; spin valve, tunnel valve, magnetic disk and random access memory; single electron transistor, molecular crossbar latch, quantum cellular automata including molecular and magnetic realizations. Josephson junction and rapid single flux quantum' computation. Photo- and x-ray lithographic patterning, electron beam patterning, scanning probe microscopes for observation and for fabrication; cantilever array as dense memory, use of carbon nanotubes and of DNA and related biological elements as building blocks and in self-assembly strategies. *Prerequisite: PH 2033. Also listed under PH 5493.*

EL 5553 Physics of Quantum Computing *3:0:0:3*

The course focuses on limits to the performance of binary computers, traveling salesman and factorization problems, security of encryption. Topics: the concept of the quantum computer based on linear superposition of basis states. The information content of the qubit. Algorithmic improvements enabled in the hypothetical quantum computer. Isolated two-level quantum systems, the principle of linear superposition as well established. Coherence as a limit on quantum computer realization. Introduction of concepts underlying present approaches to realizing qubits (singly and in interaction) based on physical systems. The systems under consideration are based on light photons in fiber optic systems; electron charges in double well potentials, analogous to the hydrogen molecular ion; nuclear spins manipulated via the electron nuclear spin interaction and systems of ions such as Be and Cd which are trapped in linear arrays using methods of ultra-high vacuum, radiofrequency trapping and laser-based cooling and manipulation of atomic states. Included: summary and comparison of the several approaches. *Prerequisite: PH 2033. Also listed under PH 5553.*

EL 5613 Introduction to Electric Power Systems *3:0:0:3*

The course focuses on basic concepts in electric power systems. Topics: single-and-three-phase circuits, power triangle; transmission lines parameters: resistance, inductance, capacitance, transformers and generators; lumped-component piequivalent circuit representation; perunit normalization; symmetrical phase components; load-flow program. *Prerequisite: EE 2024 or equivalent.*

EL5623 Finite Elements for Electrical Engineering *3:0:0:3*

This course introduces the finite elements method for solving electrical engineering problems. Topics: a refresher of basic concepts of electromagnetism. Introduction to the solution methods of partial differential equations. Comparative summary of the solution methods for Maxwell equations. Finite elements, Garlekin and least squares approaches. Description of some commercial software packages. In this hands-on course, students do assignments and final projects using the finite elements software COMSOL Multiphysics. *Prerequisite: Graduate status or EE 3604 and EE 3824.*

EL 5663 Physics of Alternative Energy *3:0:0:3*

This course concentrates on non-petroleum sources of energy include photovoltaic cells, photocatalytic generators of hydrogen from water and nuclear fusion reactors. Topics: advanced physics of these emerging technical areas are introduced in this course. Semiconductor junctions, optical absorption in semiconductors, photovoltaic effect. Energy conversion efficiency of the silicon solar cell. Single crystal, polycrystal and thin film types of solar cells. Excitons in bulk and in confined geometries. Excitons in energy transport within an absorbing structure. Methods of making photocatalytic surfaces and structures for water splitting. Conditions for nuclear fusion. Plasmas and plasma compression. The toroidal chamber with magnetic coils as it appears in recent designs. Nuclear fusion by laser compression (inertial fusion). Small-scale exploratory approaches to fusion based on liquid compression and electric field ionization of deuterium gas. *Prerequisite: PH 2033. Also listed under PH 5633.*

EL 5673* Electronic Power Supplies *3:0:0:3*

This course covers following topics: Review of power relationships. Power semiconductor switching devices. Rectifiers. Basic PWM dc-dc switching cells. Non-isolated and isolated PWM dc-dc converters. Control of PWM converters. Resonant and softswitching converters. Low drop-out (LDO) voltage regulators. Switched capacitor charge pumps. PWM inverters. Applications to computer equipment, portable units, distributed power systems, uninterruptible power supplies and electric drives. Power quality and EMI issues. American and International power-supply standards. *Prerequisite: EE 3824 or equivalent. *Online version available.*

EL 5683 Electric Drives Characteristics and Controls *3:0:0:3*

The course centers on conversion of load (resistive) torque, inertia, mass and force to a rotating shaft; acceleration and deceleration times; motor power-rating selection; thermal consideration at different duty cycles; load diagram construction; four-quadrant speed control operation for DC and AC motors; Worked examples. *Prerequisite: EE 3824 or equivalent.*

EL 5713 Microwave Engineering Laboratory/Project *1.5:4.5:0:3*

The course covers design, fabrication, testing of passive circuits (couplers and filters), active circuits (amplifier and oscillator) and antennas using printed circuits. Topics: design and stimulation using microwave CAD tools (ADS, HFSS, PCAAMT), HP-8510 automated network analyzer measurement, frequency and time domain measurement, printed circuit layout and photo etching. *Prerequisite: EE 3604. Co-requisite: EL 5733 or EL 6713.*

EL 5733 RF and Microwave Systems Engineering *3:0:0:3*

The course covers following topics: Review of electromagnetic theory and transmission lines. Printed transmission lines. S, Z, Y, ABCD parameters, network theory, signal flow graphs, CAD methods. Excitation of waveguides. Single and multisection impedance transformer, power divider, directional coupler, hybrid circuits. Microwave resonator: series, parallel resonators, stubs and cavities. Filter theory and designs, coupled-line filters, Kuroda identities, Chebychev and maximally flat filters. *Prerequisite: Graduate status or EE 3604.*

EL 5753 Introduction to Plasma Engineering *3:0:0:3*

The course focuses on basic plasma concepts and applications; parameters describing the plasma; motion of charged particles in electromagnetic fields; effect of particle collisions on plasma transport: diffusion and mobilities. Plasmas as dielectric media; plasma dielectric response functions for collective plasma oscillations and for electromagnetic wave propagation in plasma. Plasmas for practical applications. *Prerequisite: Graduate status or EE 3604.*

EL 5813 Biomedical Instrumentation *3:0:0:3*

This course gives an overview on the theory, design and application of biomedical instrumentation used for diagnosis, monitoring, treatment and scientific study of physiological systems. The objective of this course is to enable students to design, build and test useful circuits, and to interface them with a computer using a data acquisition system for further signal analysis and processing. *Prerequisites: A course in circuits including Op-Amps (eg. EE 2024) and programming experience.*

EL 5823 Medical Imaging I *3:0:0:3*

This course introduces the physics, instrumentation and signal processing methods used in X-ray imaging (projection radiography), X-ray computed tomography, nuclear medicine (SPECT/PET), ultrasound imaging and magnetic resonance imaging. *Prerequisites: Undergraduate-level courses in multivariable calculus, physics, and probability. Co-requisite: EE 3054 preferred but not required. Also listed under BE 6203.*

EL 6013* Principles of Digital Communications: Modulation and Coding *3:0:0:3*

The course covers following topics: Principles of M-ary communication: signal space methods, optimum detection. Fundamental parameters of digital communication systems, various modulation techniques and their performance in terms of bandwidth efficiency and error probability. Efficient signaling with coded waveforms. Block coding and convolutional coding. Joint modulation and coding. Equalization for communication over bandlimited channels. Brief overview of digital communications over fading multipath channels. *Prerequisites: EE 3404 and EL 6303. *Online version available.*

EL 6023* Wireless Communications: Channel Modeling and Receiver Design *3:0:0:3*

The course focuses on wireless communication channel models and practical techniques for mitigating transmission impairments. Topics: Channel Modeling Parameters: Path loss; Fading: long-term vs. short-term fading, flat vs. frequency selective fading and slow vs. fast fading; Multipath spread parameters: delay spread, angular spread and Doppler spread, Matrix Channel Modeling for Multiple Input and Multiple Output (MIMO) Systems. Channel Parameter Estimation: training sequence and blind approaches. Mitigation: Mitigation of path loss and fading: Diversity, handoff and power control; Mitigation of intersymbol interference: rake receiver and equalizer; Mitigation of time variation: pilot symbols and dynamic tracking. Processing Techniques: LS, zero forcing, MMSE, LMS, etc. *Prerequisites: Graduate status or EE 3404, MA 3012. *Online version available.*

EL 6033* Modern Wireless Communication Techniques and Systems *3:0:0:3*

The course covers Multiple Access and Multiplexing Techniques; Spread spectrum and Code division multiple access (CDMA) techniques: Direct sequence, Frequency hopping; Multicarrier Techniques: Orthogonal frequency division (OFDM) and Multicarrier CDMA (MC-CDMA); New Wireless Communication Systems: Ultra Wideband communications, Wireless Fidelity (Wi-Fi), Radio Frequency Identification (RFID), Bluetooth, etc. *Prerequisites: EE 3404 and EL 6303. *Online version available.*

EL 6063 Information Theory *3:0:0:3*

Mathematical information measures: entropy, relative entropy and mutual information. Assymptotic equipartition property, entropy rates of stochastic processes. Lossless source encoding theorems and source coding techniques. Channel capacity, differential entropy and the Gaussian channel. Lossy source coding rate distortion theory. Brief overview of network information theory. *Prerequisites: Graduate status and EL 6303.*

EL 6073 Error Control Coding *3:0:0:3*

The course covers the following topics: The general theory of linear codes. Galois fields. Coding and error correction methods. Linear block codes. Convolutional codes. Parallel and serial concatenated codes. Iterative decoding algorithms. Low density parity check codes. *Prerequisite: EL 6303.*

EL 6113* Signals, Systems and Transforms *3:0:0:3*

The course covers following topics: Continuous and discrete linear systems, system function. Fourier transforms. Periodic functions. Z transforms. Discrete Fourier series. Fast Fourier transforms. Magnitude Characteristics of LTI systems. All-pass Systems and Properties. Analog and digital filters. Finite order system functions. Digital processing of analog signals. Sampling theorems. *Prerequisite: Graduate status. Also listed under BE 6403. *Online version available.*

EL 6123 Video Processing *3:0:0:3*

This course covers Fourier analysis of video signals, properties of the human visual system, video signal sampling and sampling rate conversion, motion modeling and estimation, video compression techniques and standards, stereo video processing and compression, error control in networked video applications, analog and digital video systems. Students will learn to implement selected algorithms in MATLAB or C-language. A course-project is required. *Prerequisites: EL 5123 or EL 5143 and EL 6303.*

EL 6183 Digital Signal Processing Laboratory *1.5:4.5:0:3*

This course includes hands-on experience with a set of laboratory experiments, lectures and projects relating to real-time digital signal processing (DSP) using a DSP microprocessor. Students gain experience in the implementation of common algorithms used in a variety of applications and learn tools and functions important for the design of DSP-based systems. Students are required to complete a project and give an oral presentation. This course is suitable for students interested in DSP and Embedded Systems. *Prerequisites: EL 6113 or equivalent, C/C++. Also listed under BE 6483.*

EL 6213 System Modeling, Analysis and Design *3:0:0:3*

Introduction of basic system concepts such as system state, inputs, outputs and disturbances. Modeling methods and Computer Aided Systems Engineering (CASE) formal structures. CASE tools for solving practical systems-related problems. Quantitative techniques including linear programming, network flow analysis, integer and nonlinear programming, Petri nets, basic probabilistic and stochastic tools, Markov processes, queueing theory and Monte Carlo techniques for simulation. Fundamentals of decision and risk analysis. *Prerequisite: EL 5213. Co-requisite: EL 6303 recommended.*

EL 6223 Nonlinear and Sampled-Data Control Systems *3:0:0:3*

Introduction of nonlinear systems. Phase plane analysis, nonlinearities, linearization, limit cycles and averaging. Stability techniques: describing function, Lyapunov functions, Popov locus ad circle criterion. Analysis and design of sampled-data systems by Z-transforms and state variable methods. Semiglobal and global stabilization of nonlinear sampled-data systems. *Prerequisites: Graduate status and EL 6253.*

EL 6233 System Optimization Method *3:0:0:3*

Formulations of system optimization problems. Elements of functional analysis applied to system optimization. Local and global system

optimization with and without constraints. Variational methods, calculus of variations, and linear, nonlinear and dynamic programming iterative methods. Examples and applications. Newton and Lagrange multiplier algorithms, convergence analysis. *Prerequisites: Graduate status and EL 5253 or EL 6253.*

EL 6243 System Theory and Feedback Control *3:0:0:3*

Design of single-input-output and multivariable systems in frequency domain. Stability of interconnected systems from component transfer functions. Parameterization of stabilizing controllers. Introduction to optimization (Wiener-Hopf design). *Prerequisites: Graduate status and EE 3064.*

EL 6253 Linear Systems *3:0:0:3*

Basic system concepts. Equations describing continuous and discrete-time linear systems. Time domain analysis, state variables, transition matrix and impulsive response. Transform methods. Time-variable systems. Controllability, observability and stability. SISO pole placement, observer design. Sampled data systems. *Prerequisites: Graduate status and EE 3054 or EL 5253.*

EL 6303* Probability Theory *3:0:0:3*

The axiomatic definition of experiment and probability. Conditional Probability. Bayes' Theorem, Notion of independence. Repeated trials. Bernoulli trials and their limiting forms. The concept of a random variable. Probability distribution and density functions. Probability mass functions. Examples of random variables: Normal(Gaussian), Poisson, Gamma, Exponential, Laplace, Cauchy, Rayleigh, etc. Bayes' Theorem revisited. Functions of one random variable and their density functions. Expected value of a random variable: Mean, Variance, Moments and Characteristic functions. Two random variables: Joint distribution and joint density functions of two random variables, Independence. One function of two random variables. Two functions of two random variables. Order statistics. Joint moments, Uncorrelatedness, Orthogonality, Joint characteristic function. Jointly Gaussian random variables. Conditional distribution and conditional expected values. The central limit theorem. The principle of maximum likelihood. Elements of parameter estimation. Maximum likelihood estimation for unknown parameters. Unbiased estimators and their variances. *Prerequisites: Graduate status and MA 3012. Also listed under BE 6453. *Online version available.*

EL 6313 Stochastic Processes *3:0:0:3*

Random Variables, Random vectors and Random processes; Second order characterization of stochastic processes, autocorrelation and covariance functions, special processes: Poisson process, Wiener process and White noise process. Stationary processes, types of stationarity: Strict sense stationary and Wide sense stationary processes, Gaussian processes, memory-less processes. Linear Systems with random inputs, Input-output Autocorrelation relations, Input-output Stationarity properties. Ergodicity and related results. Wide sense stationary processes, Autocorrelation function and power spectra. Spectral theory for linear systems. Rational spectra, Hilbert transforms, shot noise, thermal noise. Discrete time processes, Spectral factorization, Matched filters. Integral equations and series representation of stochastic processes: Karhunen Loeve (KL) expansion. Modulation, Band limited processes and sampling theory. Mean square estimation and the orthogonality principle. Linear Prediction and its Geometric interpretation. Levinson Recursion for one step predictors. Mean square estimation and normality. Mean square error for one and multi-step predictors. Smoothing and prediction as applications of orthogonality principle. *Prerequisite: EL 6303.*

EL 6333 Detection and Estimation Theory *3:0:0:3*

Detection Theory: Binary Hypothesis Testing; Bayes' Criteria; Likelihood Ratio Test; minmax test; Neyman-Pearson Tests; Receiver Operating Characteristics. Parameter Estimation Theory: Random parameter Estimation; Bayes' Procedure; Minimum Mean Square Error (MMSE) Estimator; Maximum A-Posteriori (MAP) Estimator. Nonrandom Parameter Estimation: MAP Estimator; Unbiased Estimators and Cramer-Rao(C-R) Bound; Higher Order Bhattacharya Bounds.Uniformly Minimum Variance Unbiased Estimators (UMVUE); Sufficient Statistic; Factorization Theorem; Rao-Blackwell Theorem. Multi-Parameter Estimation; Fisher Information Matrix. Composite Hypothesis Testing; Series Representation of Stochastic Processes with Rational spectra; Detection of distinct signals in white noise and colored noise; Mary Detection and Estimation of signals in white noise and colored noise. Blind Channel Identification. Elements of signal design for white Gaussian noise. M-ary waveform design for two-dimensional signals. *Prerequisites: Graduate status and EL 6303.*

EL 6373* Local and Metropolitan Area Networks *3:0:0:3*

This course introduces students to fundamental design issues in wireless and wired local and metropolitan area networks, explains the state-of-the-art solutions proposed and deployed in the field by using latest standards and protocols as examples, and discusses trends in the wireless/wired LAN/MANs. Example wireless technologies covered include the IEEE 802 family of protocols, e.g., WiFi, WiMax and Bluetooth. Example wireline technologies include those associated with Ethernet and MAN technologies such as Resilient Packet Ring. *Prerequisites: EL 5363 or EE 136 or instructor's permission. *Online version available.*

EL 6383* High-Speed Networks *3:0:0:3*

This course covers the basics, architectures, protocols and technologies for high-speed networks. Topics: synchronous optical network (SONET), asynchronous transfer mode (ATM), ATM adaptation layer (AAL), 10/100/1000/10G Ethernet, Ethernet over SONET (EOS), quality of service control, packet scheduling, network processor, buffer management, flow and congestion control, TCP, high-speed TCP and XCP, Routing and IP fast rerouting, WDM networks, MPLS and GMPLS. Each student is required to complete a project that can be reading, software design or hardware design. *Prerequisites: Graduate status, EL 5363 or EE 136 or equivalent. *Online version available.*

EL 6393* Advanced Network Security *3:0:0:3*

While the recent proliferation of broadband wireline and wireless networking technologies have substantially increased the available network capacity and enabled a wide-range of feature-rich high-speed communication services, security remains a major concern. Network attacks have become common recurring events that increasingly threaten the proper functioning and continual success of the communication infrastructure and services. One way to mitigate such threats is to develop new security/defense architectures, systems, methodologies and algorithms that can scale together with the communications infrastructure in terms of operating speed, operational simplicity and manageability. This course aims to understand the theoretical, architectural, system and implementation issues related to all aspects of security in high-speed networks and study various proposed solutions. Students are required to read research papers and complete a term project with either simulation programs to evaluate

the proposed schemes, or architecture/VHDL designs for the schemes. *Prerequisite: CS 6823 or adviser approval. *Online version available.*

EL 6413* Analog and High Frequency Amplifier Design *3:0:0:3*

Basic semiconductor physics, small-signal low frequency models for bipolar junction transistors, biasing and temperature compensation techniques. Physics, models and biasing of field effect transistors. High frequency models. Single and multistage broadband small signal amplifiers. Harmonic distortion analysis of amplifiers. Emitter follower analysis at high frequencies. Complete design and analysis of operational amplifiers (Op-Amp) analog integrated circuits. Nonlinear Op-Amp applications. Circuit design techniques to increase Op-Amp slew rate. *Prerequisites: Graduate student status or EE 3114 and EE 3124. *Online version available.*

EL 6423 RF Electronics for Wireless Applications *3:0:0:3*

Tuned circuits and impedance transformers, narrowband nonlinear amplifiers. Tuned circuit sine wave oscillators, mixers, AM modulators and demodulators, FM modulators and demodulators and the phase-locked loop. *Prerequisite: EL 6413.*

EL 6433* Digital Integrated Circuit Design *3:0:0:3*

Analysis and design of digital integrated circuits. Circuit analysis of piecewise linear single energy storage element networks. Rules for determining states of diodes and transistors. Bipolar junction and field effect transistors as switches. Basic digital logic gates. Integrated circuit logic and building blocks (TTL, MOS, CMOS, ECL, integrated injection logic). Sweep circuits (constant current, Miller, bootstrap), monostable, astable and bistable (Schmitt Trigger) switching circuits. Applications (pulse width modulator, triangle wave generator, FM function generator design). *Prerequisite: EL 6413. *Online version available.*

EL 6443 VLSI System and Architecture Design *3:0:0:3*

This course continues from EL 5473 and covers top-down VLSI design using VHDL including structural design, modeling, algorithmic and register level design, synthesis, prototyping and implementation using FPGAs and methods to design for test (DFT). This course provides a solid background and hands-on experiences with the CMOS VLSI design process in which custom design techniques (covered in EL 5473) are married with HDL synthesis to produce complex systems. Students complete a project covering design partitioning, placement and routing, automated synthesis and standard cell design and use. The course explores how these techniques are used in designing ASICs, System-on-Chips (SoC) and advanced microprocessors. *Prerequisite: EL 5473.*

EL 6553 Quantum Mechanics I *3:0:0:3*

Quantum mechanics with applications to atomic systems. The use of Schrodinger's equations. Angular momentum and spin. Semi-classical theory of field-matter interaction. *Prerequisites: MA 2122 and PH 3234 or equivalents. Also listed under PH 6673.*

EL 6583 Fiber Optic Communications *3:0:0:3*

This course deals with the operating principles of optical communications systems and fiber-optic communication technology. The main elements of systems are presented in block diagrams and discussed individually. The advantages and disadvantages and the applications of Fiber Optic Communications Systems are discussed. Topics include: overview of optical communication systems, review of optics, review of analog and digital communications, the characteristics of optical fibers, optical waveguides, optical sources and transmitters, optical detectors and receivers, optical amplifiers, noise and detection, impairment in optical communication systems and optical network design issues. Upon completion of this course, students are familiar with the principles and technology of optical communication systems, and are able to design a simple point-to-point optical communications link, including bandwidth, loss, signal to noise ratio (S/N) and bit error rate considerations. *Prerequisite: Graduate status or EE 3604.*

EL 6603 Power Electronics *3:0:0:3*

The course centers on principles of thyristor devices, GTOs, MOSFETs, IGBTs; dynamic characteristics of DC/DC converters; forced commutation circuits; switched-mode power supplies; full- wave and half-wave rectifiers; phase controlled converters; effect of the load characteristics; pulse-width modulated inverters. *Prerequisites: Graduate status and EE 3824 or equivalent.*

EL 6623 Power Systems Economics and Planning *3:0:0:3*

Power-system economics: revenue requirements, load duration and reserve requirements. Load forecasting: econometric methods. Optimal expansion planning and methodologies: optimal generation expansion computer modeling. Decision analysis techniques. Deregulation of electric power industry. *Prerequisites: Graduate status and EL 5613 or equivalent.*

EL 6633 Transients, Surges and Faults in Power Systems *3:0:0:3*

Analysis of lumped-circuit, normal and abnormal transients in power equipment and systems. Short-circuit fault analysis and transient recovery of three-phase circuits. Analysis of traveling-wave surges on transmission lines, windings and integrated systems. *Prerequisites: Graduate status and EL 5613 or equivalent.*

EL 6643 Relay Fault Protection *3:0:0:3*

Protective relay functions and classification. Electromechanical relay types, operating principles and basic characteristics. Communication channels for relaying. Current and voltage transformers, transducers. Protection of busses, transformers, generators, motors and other station equipment by the zone protection method. Distribution and transmission line relaying systems. Relay setting calculations. Primary and backup protection, application and philosophy with applied relay engineering examples. *Prerequisites: Graduate status and EL 5613 or equivalent.*

EL 6653 Power System Stability *3:0:0:3*

The course introduces power-system dynamics: mathematical modeling of prime movers, power plants, synchronous machines, field exciters transmission lines, relay loads and stabilizers. *Prerequisites: Graduate status, EE 3824 and EL 5613.*

EL 6663 Distributed Generation Systems *3:0:0:3*

Benefits and limitations and classification of small generating systems; principles of operation and electrical equivalent circuits of fuel cells, solar cells, micro-turbines, reciprocating engines, wind turbines and gas turbines; fault conditions; reactive power support; power quality issues. *Prerequisites: EE 3824 and EL 5613 or equivalent.*

EL 6683 Adjustable Speed Drives *3:0:0:3*

Engineers universally recognize that electric drives offer enormous potential for energy conservation. Factory automation, transportation (all-electric and hybrid-electric vehicles) and a trend to replace hydraulic drives by electric ones has driven interest among

employers and students for education based on solid theoretical foundations. The course requires only a basic undergraduate preparation in circuits, electromagnetics and energy. Advanced topics of special electric machinery and control methods are introduced on in-time basis. This course complements EL 5683, which covers electromechanical aspects of electric drives, and EL 6603, which covers on AC-DC and DC-AC conversion for drives and utility applications. *Prerequisites: Graduate status and EE 3824 or equivalent.*

EL 6713 Electromagnetic Theory and Applications *3:0:0:3*

This course introduces Maxwell's equations, wave equation, vector potentials, boundary conditions and Poynting vector. Time-harmonic fields and phasor approach are introduced. The properties of freely propagating plane waves in uniform and layered media are derived, as well as waves guided by structures, including various transmission lines, hollow waveguides and dielectric waveguides. A unified treatment of wave propagation is given with general theorems and examples drawn from microwaves, integrated circuits and optics. *Prerequisites: Graduate status and EE 3604.*

EL 6723 Electromagnetic Radiation and Antennas *3:0:0:3*

The electromagnetic fields radiated by current elements are derived from Maxwell's equations. From these results, the fields radiated by many types of antennas are derived, including various types of dipoles, arrays, aperture, and frequency independent and traveling wave antennas. Concepts introduced include radiation resistance and pattern, directivity, gain, effective area, reciprocity, bandwidth, noise temperature, mutual coupling and array scanning impedance. *Prerequisites: Graduate status and EL 6713, or EL 3604 with grade B or better.*

EL 6753* UHF Propagation for Wireless Systems *3:0:0:3*

The course examines UHF radio applications for cellular mobile radio telephones, wireless local area networks and personal communications networks, propagation and reflection of plane waves and spherical waves; antennas for transmitting and receiving; path loss and link budgets; Huygens' principle; Fresnel zone and diffraction of plane and spherical waves; mathematical models of UHF propagation over a flat earth, around buildings in cities and within buildings; influence of propagation on capacity of cellular systems. *Prerequisites: Graduate status and undergraduate electromagnetics course. *Online version available.*

EL 6823 Medical Imaging II *3:0:0:3*

This course introduces mechanisms and concepts related to image acquisition, subsequent image processing and image formation in various biomedical imaging modalities. Building on material covered in EL 5823/BE6203-Medical Imaging I, this course focuses on advanced topics such as functional magnetic resonance imaging (MRI), ultrasound imaging, biomagnetic imaging and optical tomographic imaging. *Prerequisites: EL 5823/BE 6203. Also listed under BE 6213.*

EL 7023 Space-Time Wireless Communications *3:0:0:3*

The course provides an introduction to Multiple-Input Multiple-Output (MIMO) wireless communication systems. MIMO system capacity, MIMO system design criteria. Space-time block and trellis codes. Spatial multiplexing and receiver design. Applications to MIMO OFDM systems. *Prerequisites: EL 6303. Co-requisites: EL 6013 or EL 6023.*

EL 7133* Digital Signal Processing *3:0:0:3*

Properties and applications of the discrete Fourier transform and FFT. Frequency measurement. Properties and design of linear-phase FIR digital filters by windowing, least-squares and minimax criterion. Spectral factorization and design of minimum-phase FIR filters. Design of recursive digital filters. Short-time Fourier transform. Finite precision effects. Multirate systems. Basic spectral estimation. Basic adaptive filtering (LMS algorithm). Computer-based exercises are given regularly. *Prerequisite: EL 6113 or equivalent.*Online version available.*

EL 7153 Array Signal Processing *3:0:0:3*

General sonar and radar array processing concepts. Array performance considerations. Narrowband and broadband signal processors. Classical and high resolution techniques for source direction finding. Eigenstructure-based techniques and spatial smoothing techniques. Performance analysis of eigenstructure-based techniques. Asymptotic distribution of eigenparameters associated with smoothed sample covariance matrices in uncorrelated and coherent scenes. Wiener solution and adaptive algorithms. Least Mean Square (LMS), accelerated gradient search and gradient algorithms with constraints. Direct implementation by inversion of the sample covariance matrix and transient response considerations. Smart antenna design concepts for Rayleigh fading cellular communication channels. Space Time Adaptive Processing (STAP) for ground and air moving target detection. *Prerequisites: Graduate status, EL 6113 and EL 6313.*

EL 7163 Wavelet Transforms and Filter Banks *3:0:0:3*

Orthogonal and biorthogonal wavelet bases on the real line. Scaling functions and the dilation equation. Construction of Daubechies wavelet bases. Mallat's algorithm. Digital filter banks and the discrete wavelet transform. Two-dimensional wavelet transform and applications to image processing. Wavelet-based noise reduction. Lattice and lifting structures for implementation of filter banks. Expansive (over-complete) transforms. Additional applications. Students are required to complete a project and give an oral presentation. Regular computer-based exercises are given. *Prerequisite: EL 7133.*

EL 7253 State Space Design for Linear Control Systems *3:0:0:3*

Topics covered in this course include canonical forms; control system design objectives; feedback system design by MIMO pole placement; MIMO linear observers; the separation principle; linear quadratic optimum control; random processes; Kalman filters as optimum observers; the separation theorem; LQG; Sampled-data systems; microprocessor-based digital control; robust control and the servocompensator problem. *Prerequisites: Graduate status and EL 6253.*

EL 7353* Communication Networks I: Analysis, Modeling and Performance *3:0:0:3*

The course introduces the analytical techniques used in the design and performance analysis of networks. Building on their knowledge of networking technology and applied mathematics, especially probability, students learn basic queuing theory, to be applied to performance analysis of multiplexers, switches and multiple access networks. Newer techniques such as the network calculus, the study of non-Poissonian long range dependent traffic sources and applications to TCP, admission control, advanced packet switches and IEEE 802.11 networks are introduced. *Prerequisites: EL 5363 and EL 6303.*Online version available.*

EL 7363 Communications Networks II: Design and Algorithms *3:0:0:3*

The course covers network design, which consists of topology design and traffic routing taking into account dynamics in network states, such as link/node failures and traffic demand variations. Efficient design models and optimization methods are crucial to simultaneously achieve good network user performance and high savings in network deployment and maintenance. This course introduces mathematical models, design problems and optimization algorithms that can be used to guide network design practice. Subjects include: Network Design Problem Modeling, Optimization Methods, Multi- Commodity Flow Routing, Location and Topological Design, Fair Networks, Resilient Network Design, Robust Network Design, Multi-Layer Networks. *Prerequisite: Graduate status, EL 5363 or equivalent.*

EL 7373* High Performance Switches and Routers *3:0:0:3*

This course addresses the basics, the theory, architectures and technologies to implement high-performance high-speed large-scale routers and switches. The fundamental concepts and technologies of packet forwarding, classification and switching learned in the class are useful and practical when designing IP routers, Ethernet switches and optical switches. Topics: IP Route Lookup, Packet Classification, Packet Scheduling, Buffer Management, Basics of Packet Switching, Output-buffered Switches, Shared-memory Switches, Crosspoint-buffered Switches, Input-buffered Switches, Clos-network Switches, Multi-Stage Buffered Switches, Two-Stage Load-Balanced Switches, Optical Packet Switches and ASIC for IP Routers. *Prerequisite: EL 5363 or adviser approval. *Online version available.*

EL 8223 Applied Nonlinear Control *3:0:0:3*

Stability and stabilization for nonlinear systems; Lyapunov stability and functions, input-output stability and control Lyapunov functions. Differential geometric approaches for analysis and control of nonlinear systems: controllability, observability, feedback linearization, normal form, inverse dynamics, stabilization, tracking and disturbance attenuation. Analytical approaches: recursive back stepping, input-to-state stability, nonlinear small-gain methods and passivity. Output feedback designs. Various application examples for nonlinear systems including robotic and communication systems. *Prerequisites: Graduate status and EL 6253 or EL 7253.*

EL 8233 Optimal Control Theory *3:0:0:3*

This course focuses on optimal control problem for deterministic systems with various constraints. Topics: solution for both continuous and discrete-time systems using the maximum principle and dynamic programming. Singular arcs. Neighboring-optimal solutions. Fuel and time optimal control problems. Computational methods. *Prerequisites: Graduate status, EL 6233 and EL 6253.*

EL 8253 Large-Scale Systems and Decentralized Control *3:0:0:3*

This course introduces analysis and synthesis of large-scale systems. Topics: system-order reduction algorithms, interconnected system stability, series expansion and singular perturbation. Lyapunov designs. Applications to traffic networks, power systems and transportation networks. Decentralized control: decentralized fixed-mode, LQR, frequency-shaped cost functionals and overlapping decompositions. Stability of interconnected systems and Vector Lyapunov analysis. *Prerequisites: Graduate status and EL 7253 or instructor's permission.*

EL 90X3 Selected Topics in Wireless Communication (X=1, 2, 9) *3:0:0:3*

This course covers selected topics of current interest in wireless communications. (See department for detailed description of each particular offering.) *Prerequisites: Specified when offered.*

EL 91X3 Selected Topics in Signal Processing (X=1, 2,...9) *3:0:0:3*

The course centers on selected topics of current interest in signals and systems. (See departmental mailing for detailed description of each particular offering.) *Prerequisites: Specified when offered.*

EL 92X3 Selected Topics in Control Systems (X=1, 2,...9) *3:0:0:3*

The course discusses topics of current interest to feedback and control-system engineers. (See department mailing for detailed description of each particular offering.) *Prerequisites: Specified when offered.*

EL 93X3 Selected Topics in Telecommunications and Networking (X=1, 2,...9) *3:0:0:3*

The course covers selected topics of current interest in telecommunications and networking. (See departmental mailing for detailed description of each particular offering.) *Prerequisites: Specified when offered.*

EL 94X3 Selected Topics in Computer Electronic Devices and Systems (X=1, 2,...9) *3:0:0:3*

This course examines special topics of current interest in the field of electronic devices, circuits and systems. (See departmental mailing for detailed description of each particular offering.) *Prerequisites: Specified when offered.*

EL 95X3 Selected Topics in Electro-Optics, Quantum Electronics and Material Science (X=1, 2,...9) *3:0:0:3*

The course covers topics of current interest dealing with the interaction of matter with electromagnetic fields. (See department mailing for detailed description of each particular offering.) *Prerequisites: Specified when offered.*

EL 96X3 Selected Topics in Power Engineering (X=1, 2,...9) *3:0:0:3*

The course looks at topics of current interest in electric power engineering. (See departmental mailing for detailed description of each particular offering. Prerequisites: Specified when offered.

EL 97X3 Selected Topics in Electrodynamics, Wave Phenomena and Plasmas (X=1, 2,...9) *3:0:0:3*

The course discusses topics of current interests in plasmas, electromagnetic and acoustic wave propagation, diffraction and radiation, including wave interactions with plasmas, materials and special mathematical and numerical techniques. (See departmental mailing for detailed description of each particular offering.) *Prerequisites: Specified when offered.*

EL 9900 Seminar in Electrical and Computer Engineering *0:0:0:0*

This course consists of seminar presentations on recent developments in electrical and computer engineering by speakers from industry, research and education institutions. To receive a satisfactory grade, a

student must attend at least two thirds of the seminars during the semester registered. A PhD student must register and obtain satisfactory grade for at least four semesters.

EL 9920 Summer Graduate Internship *0:0:0:0*

This course provides graduate students majoring in electrical engineering, computer engineering, electrophysics, systems engineering, telecommunication networks or wireless innovation the opportunity to gain practical training off campus. Such training will enhance and strengthen the students overall educational experience by obtaining practical experience in currently active areas in industry. *Adviser approval is required*.

EL 9933 Readings in Electrical and Computer Engineering I *3:0:0:3*

This course requires a student to read advanced literature in a research field relevant to electrical and computer engineering, under guidance of a faculty member who is expert in the field. Oral presentation and a written report is required. Not more than 3 credits may be taken toward the master's degree. A student must secure a project adviser before registration. *Prerequisite: Degree status.*

EL 9943 Readings in Electrical and Computer Engineering II *3:0:0:3*

This course requires a student to read advanced literature in a research field relevant to electrical and computer engineering, under guidance of a faculty member who is expert in the field. Oral presentation and a written report are required. No more than 3 credits may be taken toward the master's degree. A student must secure a project adviser before registration. *Prerequisite: Degree status.*

EL 9953 Advanced Projects I *3:0:0:3*

This course requires a student to conduct a theoretical and/or experimental project in a research area in electrical and computer engineering. The project is chosen based on the student's specialized interest and preparation and is guided by a faculty member who is expert in the chosen subject. Oral presentation or a written report is required at the adviser's discretion. A student must secure a project adviser before registration. *Prerequisite: Degree status.*

EL 9963 Advanced Projects II *3:0:0:3*

This course requires a student to conduct a theoretical and/or experimental project in a research area in electrical and computer engineering. The project is chosen based on the student's specialized interest and preparation and is guided by a faculty member who is expert in the chosen subject. Oral presentation or a written report is required at the adviser's discretion. A student must secure a project adviser before registration. *Prerequisite: Degree status.*

EL 997x Thesis for Degree of Master of Science in Electrical Engineering, Computer Engineering, Electrophysics, System Engineering, or Telecommunication Networks *Variable Credits*

The student is required to conduct a theoretical and/or experimental project in a research area in electrical engineering, computer engineering, electrophysics, system engineering, or telecommunication networks. The project is chosen based on the student's specialized interest and preparation and is guided by a faculty member who is expert in the chosen subject. Oral-thesis defense and formal, bounded thesis are required. Registration of at least 6 credits over continuous semesters is required. A student must secure a thesis adviser before registration. *Prerequisite: Degree status.*

EL 999x Dissertation for Degree of Doctor of Philosophy in Electrical Engineering *Variable Credits*

The dissertation is an original investigation of an electrical-engineering problem. The work must demonstrate creativity and include features of originality and utility worthy of publication in a recognized journal. Candidates must successfully defend their dissertations orally and submit a bounded thesis. Registration of at least 21 credits over continuous semesters is required. *Prerequisite: Passing PhD qualifying examination.*

Typical Course of Study for the Bachelor of Science in Electrical Engineering

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Hours/Week Class	Lab.	Rec.	Cr.
MA 1024	Calculus I	4	0	0	4
CS 1133	Engineering Problem Solving and Programming[4]	2	0	3	3
EG 1003	Introduction to Engineering and Design	.5	2.5	2	3
EG 1001	Engineering and Technology Forum	1	0	0	1
EN 1013W	College Writing Workshop	3	0	0	3
					14

Spring Semester

Course No.	Course Title	Hours/Week Class	Lab.	Rec.	Cr.
MA 1124	Calculus II	4	0	0	4
PH 1013	Mechanics	3	0	1	3
CM 1004	General Chemistry for Engineers	3	2	1	4
EE 1002	Introduction to Electrical Engineering	2	0	0	2
HuSS 1023W	First-Year Writing Seminar	3	0	0	3
					16

SOPHOMORE YEAR

Fall Semester

MA 2012	Elements of Linear Algebra I	4	0	0	2
MA 2132	Ordinary Differential Equations	4	0	0	2
PH 2023	Electricity, Magnetism and Fluids	3	0	1	3
PH 2021	Introductory Physics Lab I	0	1.5	0	.5
EE 2013	Fund. of Electric Circuits I[4]	3	0	1	3
CS 2204	Digital Logic and State Machine Design[4]	3	3	0	4
Humanities and Social Sciences Course[2]				3	
					17.5

Spring Semester

MA 2112	Multivariable Calculus A	4	0	0	2
MA 2122	Multivariable Calculus B	4	0	0	2
PH 2033	Waves, Optics and Thermodynamics	3	0	1	3
PH 2031	Introductory Physics Lab II	0	1.5	0	.5
EE 2024	Fundamentals of Electric Circuits II[4]	3	1	1	4
CS 2164	Introduction to Programming in C	3	1.5	0	4
					15.5

JUNIOR YEAR

Fall Semester

MA 3112	Complex Variables I	4	0	0	2
MA 3012	Introduction to Probability I	4	0	0	2
EE 3054	Signals and Systems[4]	3.5	1.5	1	4
EE 3114	Fundamentals of Electronics I	3.5	1.5	1	4
Humanities and Social Sciences Course[2]					3
					15

Spring Semester

EE 3604	Electromagnetic Waves	3.5	1.5	0	4
EE	Restricted Elective[3]				4
EE	Restricted Elective[3]				4
Humanities and Social Sciences Course[2]					3
					15

SENIOR YEAR

Fall Semester

EE 4XX3	Design Project I				3
EE 4001	ECE Professional Development	1	0	0	1
EE	Restricted Elective[3]				4
EE/EL	Elective[5]				3
Humanities and Social Sciences Course[2]					3
Humanities and Social Sciences Course[2]					3
					17

Spring Semester

EE 4XX3	Design Project II				3
EE/EL	Elective[5]				3
EE/EL	Elective[5]				3
EE/CS/EL	Elective				3
EE/CS/EL	Elective				3
Humanities and Social Sciences Course[2]					3
					18

Total credits required for the degree: 128

Notes

1. For transfer students and students changing major, EE 1002 is not required.
2. Choice of Humanities and Social Sciences courses must conform to university requirements.
3. The Restricted Electives must be 3 of 4 courses:
   EE 3124 Electronics II
   EE 3824 Electric Energy Conversion Systems
   EE 3404 Communication Theory
   EE 3064 Feedback Control
4. A grade of at least C- is required in CS 1133, CS 2204, EE 2013, EE 2024, and EE 3054.
5. One of the following courses can be used in place of an EE/EL elective:
   MG 2204 Financial Accounting
   FIN 2103 Creating and Understanding Financial Statements
   EC 2524 Managerial Microeconomics (May not be used for Humanities and Social Sciences elective)
6. Three 4-credit electives may be used in place of four 3-credit electives.
7. The EE/EL and EE/EL/CS elective courses must contain at least one two-course sequence.

ELECTROPHYSICS PROGRAM

Program Director: Nirod Das

NYU-Poly offers a program leading to a Master of Science in Electrophysics. Students entering the program typically have an undergraduate background in electrical engineering or physics, a strong interest in physical phenomena and/or applied mathematics and a desire to conduct research.

The Department of Electrical and Computer Engineering administers the Electrophysics Program.

The program comprises basic courses in wave propagation, electromagnetic theory, microwave circuits and electro-optics. Traditional areas of active research include propagation modeling for wireless communications, propagation and scattering of waves, electromagnetic theory, antennas, microwave circuits, plasmas and solid-state devices. Areas of modern optics covered include lasers and optical communications. Additional areas covered are nonlinear wave propagation, ultrasonic waves in solids and waves in the earth's ionosphere. NYU-Poly's electrophysics faculty has significantly contributed to each area cited above. Students are exposed to some of the most current technical developments in each area and can be guided in research at the forefront of these areas.

GOALS AND OBJECTIVES

The Master of Science program in Electrophysics prepares students to work at the interface between electrical engineering and physics, where new engineering applications of various physical phenomena are developed. Emphasis is on wave propagation, microwave circuits, electroptics and plasmas. Students entering the program with an undergraduate degree in physics receive a view of engineering applications and requirement, as well as an advanced view of the physical processes of interest. Students interested in furthering their understanding of these topics may do so by continuing in the PhD program in Electrical Engineering.

Students in this program will gain a deep understanding of the basic physical principles in one or more of the following areas: (a) electromagnetic wave propagation, (b) microwave devices and circuits, (c) antennas and radiation and (d) lasers and electro-optics for communications. Students learn the engineering applications and performance measures of the physical principles in the different areas and are able to apply their knowledge to device and system design problems. For those interested in PhD-level studies, the MS in Electrophysics prepares them for independent research that advances the knowledge of engineering applications of physical principles.

REQUIREMENTS FOR THE MASTER OF SCIENCE

The entrance requirements for a Master of Science in Electrophysics are a bachelor's degree in engineering or science from an accredited institution, with a superior undergraduate record, including undergraduate courses in differential equations, electromagnetic theory, quantum and solid-state physics and linear systems. Students with deficiencies in these areas may be admitted if they take appropriate introductory courses to remedy these deficiencies. Outstanding students are advised to apply for financial aid in the form of research fellowships, teaching fellowships or partial tuition remission.

To satisfy the requirements for an MS in Electrophysics, students must complete 30 credits, as described below, and maintain a GPA equal to or greater than 3.0 in all graduate courses. In addition, a GPA of 3.0 is required in courses in Group 1 and Group 2, as indicated below.

GROUP 1: Core Courses

Three courses (3 credits each) from the following:

EL 5513	Electro-Optics I
EL 5733	RF and Microwave Systems Engineering
EL 5753	Introduction to Plasma Engineering
EL 6113	Signals, Systems, and Transforms
EL 6583	Fiber Optic Communications
EL 6713	Electromagnetic Theory and Applications

Total in Group 1 9 Credits

GROUP 2:

Two sequences each containing two courses; one course in each sequence may be a core course in Group 1. Both of these sequences must be in electrical engineering. Approved course sequences for the program are detailed in the ECE Graduate Student Manual.

Total in Group 2 6-12 Credits

GROUP 3:

Approved electives, which may include up to 6 credits of courses offered by any science or engineering program.

Total in Group 3 9-15 Credits

Minimum Total: 30 Credits

OUT-OF-DEPARTMENT COURSES:

At least 24 credits must be in EL prefixed courses. A 3-credit course in other science or engineering disciplines may substitute for an EL course with approval by an ECE graduate adviser. Remaining credits can be from any graduate courses in science or engineering.

THESIS, PROJECT, AND READING

A master's thesis (EL997x, 6 credits) or an MS project (EL9953 or EL9963, 3 credits each) or a reading course (EL9933 or EL9943, 3 credits each) may be included as part of the elective courses in Group 3. Oral defense of the master's thesis with at least three professors in attendance is required. The total credits for thesis, projects and readings should not exceed 9 credits within the 30 credits required for the MS degree. At most 3 credits can be taken for reading.

A complete course of study, including the choice of the course sequences, should be arranged in consultation with an adviser. An overall GPA of 3.0 in all graduate courses is required. In addition, a 3.0 average is required in the combination of five to seven courses offered to satisfy Groups 1 and 2 above. Students should consult the Department of Electrical and Computer Engineering's Graduate Student Manual (www.poly.edu/academics/departments/electrical/graduate-resources) for detailed rules and procedures, including student status, transfer credits, recommended electives, two-course sequences, current areas of research and disqualification for low grades. Descriptions of graduate courses used in the Electrophysics Program are located in the Electrical Engineering Program section of this catalog.

ENVIRONMENT-BEHAVIOR STUDIES PROGRAM

Academic Adviser: Richard E. Wener

The Department of Technology, Culture and Society offers a Master of Science degree (30 credits) and a Certificate in Environment-Behavior Studies (12 credits).

This field applies behavioral-science methods and knowledge to understand the relationship between people and the built or natural environment. This program trains students to address socio-technical problems in a variety of research and applied settings. Students with training and expertise in design, technical or scientific areas are encouraged to apply.

GOALS AND OBJECTIVES

The Master of Science program in Environment-Behavior Studies provides courses for design and planning professionals that address human needs in built and natural settings. Students plan individualized programs in consultation with faculty advisers, based on core courses (9 credits), program electives (15 credits) and master's thesis (6 credits).

To apply, please contact Prof. Richard E. Wener (rwener@poly.edu) for further information.

REQUIREMENTS FOR THE MASTER OF SCIENCE

The master's degree requires 30 credits. To qualify for a degree, a thesis based on relevant and substantive research is required. Thesis acceptance involves an oral presentation and defense.

CORE COURSES (9 CREDITS)
PS 9083 Research Methods
PS 9263 Environmental Psychology
Statistics (MA 651 or equivalent)

THESIS (UP TO 6 CREDITS):
SS 997 Master's Thesis (can be repeated once)

ELECTIVES (15 CREDITS):
Students take three PS graduate elective courses and two from any department, chosen in consultation with their adviser.

REQUIREMENTS FOR ADVANCED CERTIFICATE

Students may take a four-course sequence for a Certificate in Environment-Behavior Studies. The program is available as a minor for students in other programs or for students applying directly for the certificate.

ADMISSION CRITERIA

Students are required to have a bachelor's degree from an accredited institution. Background in psychology (introductory and advanced courses) is useful but not required.

GRADUATE COURSES

PS 9053 Psychology: Applied *3:0:0:3*

This course demonstrates how various problems, particularly in work, can be solved through the judicious use of psychological principles. Phenomena addressed include human-machine interaction and other engineering-behavior interactions, smoking, study habits, memory, creative thinking, group interaction, raising children, influencing people, self control and specific problems brought up in class by students. Students learn to employ behavioral analysis to understand various problems. Students select a problem, perform behavioral analysis and modify it as a class project.

PS 9063 Human Cognition and Information Processing *3:0:0:3*

This course covers human cognitive capabilities, including natural language and information processing. Topics: Memory, internal representation of knowledge, concept information, symbol manipulation, language acquisition, reasoning and problem solving. Artificial intelligence approaches to natural language learning and acquisition of cognitive skills.

PS 9073 Human-Computer Interaction *3:0:0:3*

This course introduces students to human behavioral issues in designing and using interfaces for information systems. Basic issues of behavioral research and evaluation methods are discussed. Sensory systems and memory and learning theory relevant to human factors systems are reviewed and related to specific interface issues, such as interaction devices, dialogue design and reference material. The focus is on understanding the issues involved in creating systems amenable to human use.

PS 9083 Research Methods *3:0:0:3*

This course examines theory and methods of sensory-functions measurement in human and animal subjects. Topics: Examination of the concept of the threshold and problems of its measurement. Investigation of learning—motor and verbal, simple and complex—including problem solving and creative thinking. Students perform a series of experiments with human and animal subjects.

PS 9093 Experimental Psychology *3:0:0:3*

The course explores experimental and descriptive methods, including quasi-experimental design and large-scale survey techniques used by social, environmental and developmental psychologists to assess human behaviors in laboratory and natural settings. The course focuses on laboratory and observational methods used to assess environmental effects, attitude measurement, social impact assessment and theory and psychometric bases of normal personality development and assessment. *Prerequisite: PS 9083 or consent of adviser.*

PS 9103 Theories of Learning *3:0:0:3*

The course looks at programmed learning, behavior therapy, attitude function and social interaction. All students are required to perform one experiment on learning under instructor guidance. Available to undergraduate majors in social science.

PS 9113 Psychology of Language and Communication *3:0:0:3*

The course deals with methodological problems in analysis of language, verbal behavior in animals, anatomical and physiological aspects of speech apparatus, operant and respondent conditioning of verbal behavior, semantics, statistical approaches and mathematical models, contextual factors and pathology of speech. All students are required to perform one experiment under guidance of instructor.

PS 9123 Sensation and Perception *3:0:0:3*

This course reviews different sensory systems: vision, audition, taste, smell, touch, temperature sensitivity, vestibular and kinesthetic senses and their relations to nonsensory controlling stimuli such as states of the organism, learning and social psychological variables. Topics: Techniques for obtaining psychophysical data on each sensory system and relations of these techniques to theories of discrimination. Available to undergraduate majors in social science.

PS 9133 Physiological Psychology *3:0:0:3*

The course covers physiological and anatomical bases of behavior. Topics: Memory, motivation, emotion, sleep reward mechanisms, psychosurgery and higher cortical functions.

PS 9153 Behavioral and Societal Aspects of Transportation *3:0:0:3*

This course explores behavioral analyses of transportation decision-making and travel characteristics. Topics: User needs in design of transportation systems: crowding, social isolation, crime, comfort and convenience. Social impact of transport systems on communities.

PS 9203 Seminar in Psychology *3:0:0:3*

This seminar discusses major areas of psychology required of all MS candidates. Topics: History and systems, sensation and perception, learning, developmental and abnormal.

PS 9253 Social Impact Assessment *3:0:0:3*

This seminar discusses major areas of psychology required of all MS candidates. Topics: History and systems, sensation and perception, learning, developmental and abnormal.

PS 9263 Environmental Psychology *3:0:0:3*

The course covers theory and methods of measuring sensory functions in human and animal subjects. Topics: Examination of the concept of the threshold and problems of its measurement. Investigation of learning—motor and verbal, simple and complex—including problem solving and creative thinking. Students perform a series of experiments with human and animal subjects.

PS 9283 Advanced Topics in Environmental Psychology *3:0:0:3*

This course varies from year to year depending on the needs and interests of students and instructors. Potential subjects include social impact of transportation systems; stress and the environment; aversive environmental factors; laboratory assessment of environmental effects on animal learning; effects of pollution; human factors of software design; assessing the built environment, including the office; and applied behavioral analysis. The course may be repeated for total of up to nine credits.

PS 997x Thesis for Degree of Master of Science

This course is an independent research project that demonstrates scientific competence and that is performed under the guidance of advisers. The course may be repeated for total up to 6 credits. Prerequisite: consent of adviser.

NYU POLY

ENVIRONMENTAL ENGINEERING AND SCIENCE PROGRAM

Academic Adviser: Mohammad Karamouz

The Department of Civil Engineering offers graduate programs in environmental engineering and environmental science leading to the following degrees:

- Master of Science in Environmental Engineering
- Master of Science in Environmental Science

The department also offers the following graduate programs with a concentration in environmental and water resource engineering:

- Master of Science in Civil Engineering
- Doctor of Philosophy in Civil Engineering

Programs in environmental engineering and environmental science are described below. Programs in civil engineering with a concentration in environmental and water resource engineering are described in the Civil Engineering Program section of this catalog.

Master of Science programs are practice-oriented with a strong foundation in underlying principles and methods. The PhD is intended for students with a strong research interest and a desire to advance the state of the art with their research.

Environmental science and environmental engineering are multidimensional professions dealing with preserving, protecting and remedying air, water and soil environments. The program prepares graduates to be employed immediately to meet the challenges of this century or to proceed directly to advanced graduate studies.

GENERAL REQUIREMENTS FOR ENVIRONMENTAL PROGRAMS

ADMISSION REQUIREMENTS

Applicants for the Master of Science in Environmental Engineering should hold an undergraduate or graduate degree in environmental or civil engineering or equivalent from an accredited institution. Students may be accepted with other related backgrounds, but should, as a minimum, have one year of chemistry and physics and basic courses in calculus and differential equations. Such students may be asked to take up to 15 credits of undergraduate courses to complete their preparation. Applicants for the Master of Science in Environmental Science typically have undergraduate or graduate degrees in the physical, chemical or biological sciences. The adviser may require or recommend undergraduate courses to make up for academic preparation deficiencies.

Admission to the PhD program requires a suitable MS degree from an acceptable institution. A minimum GPA of 3.5 in master's level work is generally required for admission. For more information about the PhD in Civil Engineering, consult the Civil Engineering Program section of this catalog.

GRADE REQUIREMENTS

To earn graduate degrees, Polytechnic requires that students have a 3.0 GPA or better in all graduate courses and in all guided studies (readings, projects, theses, dissertations). Averages are computed separately for courses and guided studies. Transfer credits from other institutions are not included in this average.

ANALYTIC BACKGROUND

All applicants for MS in environmental programs must show evidence of quantitative analytic ability, generally including a minimum of two years of college mathematics and a college-level course in statistics.

PhD applicants are expected to have a superior quantitative analytic background. In addition, they are advised to take at least one course in graduate level statistics, regression analysis or design of experiments as part of their studies.

ADVISING

Each graduate student is assigned a faculty academic adviser. Students must maintain frequent contact with their advisers throughout their studies. Students must meet with their academic advisers before each registration and at any other time they need advice or consultation.

Students must have a detailed program of study formally approved by their advisers before registration. Advisers also handle requests for waiver of certain degree requirements. Such waivers must be approved in writing and placed in the student's departmental file.

Where specific courses are waived, instructor permission is also required. When waivers are granted, students may be required to take other specific courses in their place or to select additional electives.

Students who register for any guided studies (readings, projects, theses, dissertation) are supervised by a project adviser for each activity. A project adviser may or may not be the same as a student's academic adviser, depending upon the selected subject matter. To register for any guided study activity, students must submit written proposals to a project adviser before registration. To register, students must obtain written approval from their project and academic advisers. Doctoral students may not register for dissertation credits until they have passed the PhD qualifying examination.

In addition to academic and project advisers, students studying under research or teaching fellowships are assigned fellowship advisers. Normally, these would be either the principal investigator of the research effort funding the fellowship or the director of the academic area in which the teaching fellowship is awarded.

While academic advisers consult and advise students, the student is responsible for ensuring that all degree requirements are fulfilled and all necessary forms and applications are submitted.

TRANSFER CREDITS

Students must take a minimum of 24 credits at Polytechnic in order to be awarded an MS degree. Students may transfer up to 6 credits of acceptable courses toward a MS degree, subject to the academic adviser's approval. To be transferred, the course(s) must be relevant to the program and from an acceptable institution. A grade of B or better is required for any transfer credit.

Courses graded on a pass/fail basis are not considered for transfer unless accompanied by a detailed written evaluation by the course instructor. All transfer requests must be accompanied by an official transcript from the transferring institution. Application for transfer credits is accepted only after the student has earned 12 credits at Polytechnic.

MASTER OF SCIENCE IN ENVIRONMENTAL ENGINEERING

GOALS AND OBJECTIVES

The MS in Environmental Engineering prepares graduates to plan, functionally design, control, operate and manage municipal and industrial pollution-prevention systems. Students are exposed to a learning atmosphere that provides a mix of theoretical and practical approaches. Courses include a mix of presentations, project exercises and practical problem solutions.

Specific program objectives are to provide the skills necessary to:

- fundamentally understand the science and engineering of natural and man-made environmental systems;
- functionally design air, water and waste treatment systems and components;
- control and operate environmental facilities;
- understand the modeling and simulation of environmental systems; and
- participate actively in multidisciplinary teams to solve environmental problems.

PROGRAM REQUIREMENTS

Core Courses (12 Credits)

Course No.	Course Title	Credits
CE 7373	Environmental Chemistry and Microbiology	3
CE 7423	Water and Wastewater Treatment	3

and select 2 of the following 4 courses:

CE 7223	Hydrology	3
CE 7233	Ground Water Hydrology and Pollution	3
CE 7753	Environmental Systems Management	3
CE 7673	Env. Impact Assessment	3

Major Courses (9 Credits)

Select 3 of the following 5 courses:

CE 7393	Adv. Env. Chemistry and Microbiology	3
CE 7433	Adv. Water and Wastewater Treatment	3
CE 7473	Analysis of Stream and Estuary Pollution	3
CE 8493	Environmental Geotechnology	3
CE 7703	Solid Waste Management	3

Master Project or Theses (3-6 credits)

CE 9996	Project	3
CE 9997	Master's Thesis	6

Electives (3-6 credits)

3-6 credits of approved engineering and science electives

Total 30 credits

MASTER OF SCIENCE IN ENVIRONMENTAL SCIENCE

GOALS AND OBJECTIVES

The primary goal of the MS in Environmental Science is to prepare professionals to:

- fundamentally understand the science and applied engineering of natural and man-made environmental systems;
- evaluate the interactions between man and the environment and control adverse impacts of pollution on ecological systems;
- understand the monitoring and laboratory analysis of environmental systems; and
- participate actively in a multidisciplinary team of professionals to solve environmental problems.

PROGRAM REQUIREMENTS (TOTAL 30 CREDITS)

1. Core Courses (9 credits)

Course No.	Course Title	Credits
CE 7373	Environmental Chemistry and Microbiology	3
CE 7423	Water and Wastewater Treatment	3
CE 7223	Hydrology	3

2. Twelve credits of approved courses in Environmental Engineering, Chemical and Biological Engineering at NYU-Poly, and NYU Environmental Health Science, including up to 6 approved transfer credits.

Suggested Courses:		Credits
BIOL-GA 1004	Environmental Health (NYU CAS)	3
EHSC-GA1010	Weather, Air pollution and Health (NYU CAS)	3
EHSC-GA.1006	Toxicology (NYU CAS)	3
CE 7233	Ground Water Hydrology and Pollution	3
CE 7393	Advanced Environmental Chemistry and Microbiology	3
CE 7433	Advanced Water and Wastewater Treatment	3
CE 7473	Analysis of Stream and Estuary Pollution	3
CE 7673	Environmental Impact Assessment	3
CE 7703	Solid Waste Management	3
CE 7753	Environmental Systems Management	3
CE 7523	Air Pollution	3
CE 7553	Environmental Toxicology	3
CE 9963	Project for the Master of Science	3
CE 9973	Thesis for the Master of Science	6

3. Nine credits of approved elective courses

Total 30 credits

DOCTOR OF PHILOSOPHY IN CIVIL ENGINEERING

Students wishing to pursue a doctoral degree in environmental engineering and environmental science may do so under the PhD in civil engineering and environmental science. For detailed information, please consult the Civil Engineering Program section of this catalog.

GRADUATE COURSES

For the list of graduate courses, please consult the Environmental and Water Resources Engineering section of the Civil Engineering program in this catalog.

FINANCIAL ENGINEERING PROGRAM

Program Director: Charles Tapiero
Program Co-Director: Barry Blecherman

MASTER'S IN FINANCIAL ENGINEERING

Financial engineering seeks to bridge theoretical finance and its practice. This concept underpins the NYU-Poly MS program in financial engineering. The goals and objectives of the program are to train and prepare our students for fast-moving and highly rewarding careers that create value enabled by finance, technology, computational finance and engineering risk finance. Careers and employment opportunities include trading, investments, financial risk management, pricing as well as corporate financial positions in a broad array of firms such as financial services, insurance, industrial and business firms.

To these ends, the Department of Finance and Risk Engineering offers in its MS in Financial Engineering Program a wide range of graduate-level courses including: Quantitative Finance, Economics, Financial Markets and Corporate Finance, Financial Econometrics, Behavioral Finance, Credit Risk and Credit Derivatives, Financial Insurance, High Frequency Trading, Agent-Based Modeling, Financial Technology, Risk Management, Risk Analysis and Assessment in Financial Services, Financial Regulation, Oprisk, Stochastic Finance Calculus and Stochastic Financial Modeling. Both financial and economic theories are then applied to the complex problems financial engineers confront including: Fixed Income, Derivatives, Credit Risk and Credit Derivatives and Securitization. In addition, the department offers a wide range of financial labs and Bloomberg assisted classes, topical and advanced courses including: Personal Finance, Financial Management, Algorithmic Trading, Environmental and Infrastructure Finance, Rare Events and Uncommon Risks Finance, Data Mining and Intelligent Finance.

These courses form a major portion of the course work for an advanced degree in financial engineering and bridge the gap between theoretical and applied finance. A limited number of courses may also be taken by students in other departments and at NYU (subject to approval by the Finance and Risk Engineering Department) to satisfy elective requirements.

The department has a Research Institute that emphasizes specialized research areas and provides research opportunities to students. These include:

- Research on personal finance and investments, the finance of rare and uncommon risks, financial regulation, real finance and business policy, alternatives finance as well as topical projects pursued by students and faculty.
- Research that emphasizes trading platforms and software development and the management of financial technology as well as related topics. The Institute is a research hub and laboratory for generating new industry ideas and tools. It also undertakes collaborative research projects to provide ideas, methods and tools with scholarly and practical applications.

REQUIREMENTS FOR THE MASTER OF SCIENCE

A Bachelor's degree is required for admission to this program. It is expected that students will have superior mathematical talent. Students with degrees in other fields may be admitted, possibly with undergraduate deficiencies, at the discretion of departmental advisers. Before beginning graduate studies, conditionally approved students must demonstrate proficiency in basic statistics, probability and mathematics. The Department makes available refresher courses for this purpose and to serve the population of students who have been out of academia prior to matriculating into this program. Prerequisites: GRE exam scores (GMAT may be substituted, but GRE is strongly preferred), Calculus (MA 1124 or equivalent) Probability and Statistics (MA 2212 and MA 2222 or equivalent), and Linear Algebra (MA 2012 or equivalent).

Master's in Financial Engineering: 33 credits

All tracks include in their program:

- 5 core courses, each 3 credits
- Track required courses totaling 7.5 credits
- 1 required applied lab, worth 1.5 credits
- 4 elective courses, each 1.5 credits
- 1 Capstone Experience of 3 credits

All MS Financial Engineering students must also complete the Bloomberg Essentials Online Training Program to be qualified for graduation. The Department of Finance and Risk Engineering supports students' efforts in this area by providing many Bloomberg terminals and laboratory assistants to answer student questions. This is a zero-credit requirement that is listed here as FRE 5500.

Core Courses (Required):		**credits**
*FRE 6003	Financial Accounting	3
FRE 6023	Economic Foundations in Finance	3
FRE 6103	Corporate Finance	3
FRE 6123	Financial Risk Management and Asset Pricing	3
*FRE 6083	Quantitative Methods in Finance	3

** For Risk Finance the 6 credits comprising FRE 6003 and FRE 6083 are replaced by FRE 6021, FRE 6051, and FRE 6223.*

All tracks: Core courses = 15 credits.

Incoming MS students of Financial Engineering have four track options. Each track has required courses totaling 7.5 credits (except Risk Finance which requires 10.5 credits).

- Financial Markets and Corporate Finance
- Computational Finance
- Technology and Algorithmic Finance
- Risk Finance (Credit Risk, Financial Management and Insurance)

Financial Markets and Corporate Finance Track

FRE 6041	Risk Management in the Real World	1.5

and four of the following five courses:

FRE 6091	Financial Econometrics	1.5
FRE 6291	Applied Derivative Contracts	1.5
FRE 6411	Fixed Income Securities and Interest Rate Derivatives	1.5
FRE 6711	Portfolio Theory and Applications	1.5
FRE 6271	Valuation of Equity Securities and Financial Statement Analysis	1.5

Computational Finance Track

FRE 6041	Risk Management in the Real World	1.5

and four of the following five courses:

FRE 6231	Stochastic Calculus and Financial Modeling	1.5
FRE 6251	Numerical and Simulation Techniques in Finance	1.5
FRE 6311	Dynamic Assets and Options Pricing	1.5
FRE 6331	Financial Risk Management and Optimization	1.5
FRE 6351	Advanced Financial Econometrics	

Technology and Algorithmic Finance Track

FRE6151	Foundations of Financial Technology	1.5

and four of the following:

FRE 6041	Risk Management in the Real World	1.5
FRE 6131	Clearing and Settlement and Operational Risk	1.5
FRE 6251	Numerical and Simulation Techniques in Finance	1.5
FRE 6451	Behavioral Finance and Trading Strategies	1.5
FRE 6511	Derivatives Algorithms	1.5
FRE 7211	Forensic Financial Technology and Regulatory Systems	1.5
FRE 7221	Databases and Financial Information Technology	1.5
FRE 7241	Algorithmic Portfolio Management	1.5
FRE 7251	Algorithmic Trading and High-Frequency Finance	1.5
FRE 7261	News Analytics and Strategies, Credits	1.5

Risk Finance

Note: this track has 10.5 credits of required course work, no lab requirement and fewer elective credits. Further, for this track only, the 6 credits of core courses FRE 6003 and FRE 6083 are replaced by FRE 6021, FRE 6051 and FRE 6223.

Core:

FRE 6021	Insurance and Financial Credit Derivatives	1.5
FRE 6023	Economic Foundations in Finance	3
FRE 6051	Insurance Finance and Actuarial Science	1.5
FRE 6103	Corporate Finance	3
FRE 6123	Financial Risk Management and Asset Pricing	3
FRE 6223	Actuarial Models	3

Track Required:

FRE 6143	Life Contingencies I	
FRE 6231	Stochastic Calculus and Financial Modeling	1.5
FRE 6251	Numerical and Simulation Techniques in Finance	1.5
FRE 6351	Advanced Financial Econometrics	1.5

Required Labs per Track: 1.5 credits

Students from all tracks except Risk Finance must choose one of the following labs for 1.5 credits:

FRE 6811	Financial Software Laboratory
FRE 6821	Financial Econometrics Laboratory
FRE 6831	Computational Finance Laboratory
FRE 6861	Technology and Algorithmic Finance Laboratory

Required Certification: 0 credits

All students must complete the following certification:

FRE 5500	Bloomberg Certification

Capstone Options: 3 credits

There are four different capstone options:

* FRE 7003 Financial Engineering Capstone: Thesis (required for potential PhD candidates)
* FRE 7023 Financial Engineering Capstone: Internship (200 hours at least, two reports to the faculty are required).
* FRE 7043 Financial Engineering Capstone for all tracks: Project, under faculty supervision.
* Two special topics courses at 1.5 credits each, with a capstone paper submitted to the faculty.

Credit Allocation for Financial Markets and Corporate Finance, Computational Finance, and Financial Information Services and Technology tracks:

Core Courses:	15
Required Courses:	7.5
Elective Credits:	6
Lab:	1.5
Capstone:	3
Total Credits:	**33**

Credit Allocation for Risk Finance track:

Core Courses:	15
Required Courses:	10.5
Elective Credits:	4.5
Capstone:	3
Total Credits:	**33**

All these options require a review by faculty advisers and certification of satisfactory work.

GRADUATE CERTIFICATE PROGRAMS

The Graduate Certificate programs have the same application requirements and prerequisites as the Master of Science degree.

Graduate Certificate Program in Financial Engineering Program Prerequisites

Ease of use of the following material:

Calculus	MA 1124 or equivalent
Probability/Statistics	MA 2212 and 2222, or equivalent

Knowledge of spreadsheets expected and some exposure to computer-programming languages is required. A GRE score must be submitted for an application to be considered; a GMAT may be substituted but the GRE is strongly preferred.

Financial Engineering Certificate Credits

FRE 6083	Quantitative Finance	3
FRE 6103	Corporate Finance	3
FRE 6411	Fixed Income Securities and Interest Rate Derivatives	1.5
FRE 6291	Options and Derivatives	1.5
FRE 6511	Intermediate Derivatives Valuation and Applications	1.5
FRE 6711	Portfolio Theory and Applications	1.5
	Free elective	1.5
	Lab	1.5

To satisfy the 1.5 credits of lab required, students choose one of the following labs:

FRE 6811	Financial Software Laboratory
FRE 6821	Financial Econometrics Laboratory
FRE 6831	Computational Finance Laboratory
FRE 6861	Technology and Algorithmic Finance Laboratory

Total Credits: 15

Graduate Certificate Program in Financial Risk Management Program Prerequisites

Calculus	MA 1124 or equivalent
Probability/Statistics	MA 2212 and 2222, or equivalent
Linear Algebra	MA 2012 or equivalent

Knowledge of spreadsheets is expected and some exposure to computer-programming languages is required. A GRE score must be submitted for an application to be considered; a GMAT may be substituted but the GRE is strongly preferred.

Risk Management Certificate Credits

FRE 6123	Financial Risk Management and Asset Pricing	3
FRE 6271	Valuation of Equity Securities and Financial Statement Analysis	1.5
FRE 6411	Fixed Income Securities and Interest Rate Derivatives	1.5
FRE 6291	Options and Derivatives	1.5
FRE 6511	Intermediate Derivatives Valuation and Applications	1.5
FRE 6711	Portfolio Theory and Applications	1.5
FRE 6731	Basel 2 and Value at Risk	1.5
FRE 6751	Credit Risk Measurement and Management	1.5
FRE 6791	Operational Risk Measurement and Management	1.5
	Free elective	1.5
	Lab	1.5

To satisfy the 1.5 credits of lab required, students choose one of the following labs:

FRE 6811	Financial Software Laboratory
FRE 6821	Financial Econometrics Laboratory
FRE 6831	Computational Finance Laboratory
FRE 6861	Technology and Algorithmic Finance Laboratory

Total Credits: 18

Graduate Certificate Program in Financial Technology Management Program Prerequisites

Financial Accounting:	FRE 6003 or equivalent
Economics:	FIN 2003 or equivalent
Probability/Statistics:	MA 2212 and 2222, or equivalent

Knowledge of spreadsheets is expected and some exposure to computer-programming languages is required. A GRE score must be submitted for an application to be considered; a GMAT may be substituted but the GRE is strongly preferred.

Financial Technology Management Certificate Credits

FRE 6123	Financial Risk Management and Asset Pricing	3
FRE 6151	Foundations of Financial Technology	1.5
FRE 6861	Technology and Algorithmic Finance Laboratory	1.5

and 6 of the following courses:

FRE 6041	Risk Management in the Real World	1.5
FRE 6131	Clearing and Settlement and Operational Risk	1.5
FRE 6251	Numerical and Simulation Techniques in Finance	1.5
FRE 6451	Behavioral Finance and Trading Strategies	1.5
FRE 6511	Derivatives Algorithms	1.5
FRE 7211	Forensic Financial Technology and Regulatory Systems	1.5
FRE 7221	Databases and Financial Information Technology	1.5
FRE 7241	Algorithmic Portfolio Management	1.5
FRE 7251	Algorithmic Trading and High-Frequency Finance	1.5
FRE 7261	News Analytics and Strategies, Credits	1.5

Total Credits: 15

UNDERGRADUATE MINOR IN FINANCE

The Department of Finance and Risk Engineering offers an undergraduate minor in finance to NYU-Poly engineering, mathematics, computer science and natural science students. To complete this minor, students must pass 15 credits of courses designated "FIN". Included in this total must be FIN 2003, FIN 2103 and FIN 2203. The remaining credits can be chosen from courses in FIN at the 3000-level or 4000-level. The residency requirement for this minor is 9 credits; no more than 6 credits of study towards the minor may be transferred from another institution.

UNDERGRADUATES IN GRADUATE FRE COURSES

The Department of Finance and Risk Engineering does not permit undergraduates to take courses with the prefix "FRE"; these are graduate courses reserved for graduate students. Exceptions are made only for sub-matriculated undergraduates; undergraduates who have applied to and been accepted to the MS FE program at NYU-Poly in their senior year of undergraduate studies. No other exceptions are made.

UNDERGRADUATE COURSES

FIN 2003 Economic Foundations of Finance *3:0:0:3*

This course focuses on the fundamental economic concepts underpinning modern financial theory. Material includes consumer behavior; utility theory; analysis of production and costs; competitive markets; monopolistic and monopsonistic markets; time value of money; game theoretic analysis of oligopoly; asymmetric information in markets; externalities; market efficiency and more. The calculus is used to develop these concepts. *Prerequisites: HuSS 1023W and 8 credits of calculus.*

FIN 2103 Creating and Understanding Financial Statements *3:0:0:3*

This course provides a solid understanding of the creation and interpretation of modern financial statements. Topics include the compelling reasons for financial statements, Sarbanes-Oxley, U.S. accounting principles and how they differ abroad, quality of financial information, financial ratios and their uses, cash-flow analysis, measurement of corporate performance, credit analysis and introduction to managing financial risk. *Prerequisite: HuSS 1023W.*

FIN 2203 Corporate Finance and Financial Markets *3:0:0:3*

This course covers the fundamentals of corporate finance, valuation, risk, capital budgeting and market efficiency. Students who complete this class acquire a solid foundation needed for intermediate and advanced topics in finance. This class is a prerequisite for all FIN classes at the 3000 level. *Prerequisites: HuSS 1023W and 8 credits of calculus. Co-requisites: MA 2054 or MA 2212 or MA 3012.*

FIN 3213 Financial Management and Risk Engineering *3:0:0:3*

The course introduces the elements and techniques of risk engineering spanning the following: Probabilities and their distributions and data analysis and statistics as well as Monte Carlo simulation. Throughout, these techniques are demonstrated through special problems and cases providing the necessary tools and concepts for dealing with major problems in risk engineering, decision-making under uncertainty, and financial management and pricing. The course is based on multiple sessions in a Financial Laboratory environment, using computational-risk software, statistical and financial econometric software, and simulation programs and software. *Prerequisite: FIN 2203. Co-requisites: FIN 2003 and FIN 2103.*

FIN 3233 Derivatives and the Options Market *3:0:0:3*

This course builds on mathematical models of bond and stock prices and covers two major areas of mathematical finance with significant impact on operating-model financial markets, namely, Black-Scholes arbitrage pricing of options, and other derivative securities and interest rates together with their term structure. The course makes significant use of probability and calculus, covering the material in a mathematically rigorous and complete manner. *Prerequisite: FIN 2203. Co-requisites: FIN 2003 and FIN 2103.*

FIN 3403 Entrepreneurship and Financial Management *3:0:0:3*

This course introduces the finance of entrepreneurship and venture capital. It considers the perspectives of the start-up firm and the venture capitalist and develops a framework for understanding the laws, contracts and issues involved in reaching mutually profitable contracts. *Prerequisite: FIN 2203.*

FIN 3503 Operational Risk Modeling and Analytics *3:0:0:3*

This course focuses on how to optimize business strategies, qualitatively and quantitatively with respect to operational risk. The course is organized around the principle that operational risk analysis consists, in part, of data collection and the building of mathematical models to describe the risk of failures in human resources, processes and technology. Beginning with a foundation for operational risk modeling and a focus on the modeling process, the course discusses probabilistic tools for operational risk modeling and statistical methods to calibrate models of operational risk. The quantitative assessment of operational risk uses the tools of probability, statistics and actuarial science. *Prerequisite: FIN 2203. Co-requisites: FIN 2003 and FIN 2103.*

FIN 3593 Probabilistic Risk Assessment *3:0:0:3*

This undergraduate course in probabilistic risk assessment (PRA) introduces students to a deep, comprehensive methodology for risk evaluation associated with complex engineered technological designs. Four fundamental questions are addressed: what can go wrong, what are the indications of potential failure, what is the potential magnitude of the failure, and with what probability will failure occur. We will also explore human reliability analysis and common-cause-failure analysis. This course can be applied towards the requirements for NYU-Poly's minor in Nuclear Science and Engineering but not towards the minor in Finance. *Prerequisite: MA 2054 or MA 2212 or MA 3012.*

FIN 4903 Special Topics in Finance and Risk Engineering *3:0:0:3*

The course considers unique topics of interest in Finance and Risk Engineering. It may feature a detailed look at a single topic or a series of focused topical presentations. *Prerequisite: Permission of Department or Instructor.*

REQUIRED GRADUATE COURSES

MS IN FINANCIAL ENGNEERING/ ALL TRACKS

FRE 5500 Bloomberg Certification *0:0:0:0*

The required Bloomberg certification is a self-taught, self-paced process available on any Bloomberg terminal. Upon completion and receipt of the certification, the student's requirement in this area will be deemed complete. This requirement can be completed at any time prior to the end of the financial lab course, even before beginning the Master's in Financial Engineering program if a student so chooses, but no later than the last class of the semester in which the lab course is taken.

FRE 6003 Financial Accounting *3:0:0:3*

This course provides a solid foundation in the construction and interpretation of financial statements. Topics include accounting terminology; financial statement preparation and analysis; liquidity and credit risk ratios; depreciation calculations; revenue recognition; and accrued liabilities and asset valuation. Also covered are the effects of equity transactions; cash flows; and various accounting methods on financial statements.

FRE 6023 Economic Foundations in Finance *3:0:0:3*

This course studies the interactions between money, the financial system and the economy. Topics include supply and demand; consumer theory; theory of the firm; production costs and other subject areas such as interest rates and asset returns. This course summarizes key insights from financial economics as the methodological and conceptual basis of financial engineering.

FRE 6083 Quantitative Methods in Finance *3:0:0:3*

This course focuses on quantitative methods and financial modeling. Probability theory, stochastic processes and optimization are studied and applied to a broad variety of financial problems and their derivatives. Topics include probability spaces; conditional probability; densities; distributions; density estimators; multivariate probability; moment-generating functions; random walks; Markov processes; Poisson processes; and the Brownian-motion process. *Prerequisite: Students are expected to know calculus and elementary probability.*

FRE 6103 Corporate Finance *3:0:0:3*

The modern corporation, as issuer of financial securities and end-user of financial risk-management products, is a major participant in financial markets and the economic counterpart to investors and financial intermediaries. The mechanism of financial markets and the valuation of instruments are studied in further detail in other courses. However, this course applies the tools of the trade of financial economics and corporate finance to the financial decision-making process of firms. Upon successful completion of this course, students know how to contribute to optimal financial decisions in a corporation: valuation; capital budgeting; risk; capital structure; dividend policy; long-term financing; risk management; and mergers and acquisitions. Increasingly important international factors that affect corporate finance are stressed throughout.

FRE 6123 Financial Risk Management and Asset Pricing *3:0:0:3*

This course introduces the techniques and problems of Financial Risk Management and Asset Pricing. It emphasizes risk finance and attitudes; Value at Risk; risk measurement principles; valuation and expected utility and their relevance in the valuation and the pricing of financial investments; insurance; management of derivatives; and risk management. Throughout, risk-management application problems are explored. The course introduces and focuses on the fundamental principles of the Arrow-Debreu state preference theory used to price derivatives and other assets in complete markets. Risk neutral-Binomial models in option pricing; essential elements of Ito calculus; and the Black-Scholes model for pricing options are introduced and applied to practical financial decision making and risk management problems.

REQUIRED COURSES IN TRACKS

TRACK: FINANCIAL MARKETS AND CORPORATE FINANCE

FRE 6041 Risk Management in the Real World *1.5:0:0:1.5*

The course covers failures of financial theory in risk management, deriving from fundamental definitions and assumptions in modeling, including pricing formulae; convexity; stochasticity and volatility; "fat tails"; and risk. Other topics: Portfolio robustness and extreme markets and moral hazard; data-mining biases and decision error; and decision-making with incomplete information.

FRE 6091 Financial Econometrics *1.5:0:0:1.5*

This course focuses on the art and science of statistical modeling of processes applied to business, finance and economics. These may include models of aggregate economic activity, economic behavior of firm or behavior of financial assets. Topics include statistical inference; maximum likelihood estimation; method of moments; Bayesian estimation; least-squares estimation; robust estimation; kernel estimation; copula estimation; analysis of variance; linear regression models; multiple regression; logistic regression; quantile regression; time series estimation; unit root tests; bootstrapping. *Prerequisite: FRE 6083. Students are expected to know basic statistics.*

FRE 6271 Valuation of Equity Securities and Financial Statement Analysis *1.5:0:0:1.5*

This course examines in detail the tools and techniques for analyzing financial statements for purposes of credit evaluation, forecasting, identifying merger candidates, enhancing the efficiency of decision making and diagnosing problem areas in the firm before crises develop. Students learn to use financial ratios to conduct duPont (i.e., decomposition) analysis, a methodology to discover sources of poor performance through interrelationships among a firm's financial ratios. *Prerequisites: FRE 6003 and FRE 6103.*

FRE 6291 Options and Derivatives *1.5:0:0:1.5*

This course covers derivative contracts, including futures, forward contracts, option and swap contracts. The course focuses on the use of these instruments by financial institutions. Basic valuation concepts and the use of derivatives for speculative purposes, hedging

purposes and arbitrage are discussed, as are the specifics of the contracts and the markets in which they trade. Also discussed are financial derivatives, such as interest rate, currency and equity contracts, and commodity contracts and specialty contracts, such as insurance derivatives and credit derivatives. *Prerequisites: FRE 6003, FRE 6023 and FRE 6103.*

FRE 6411 Fixed Income Securities and Interest Rate Derivatives *1.5:0:0:1.5*

This course examines the body of analytical tools and measures that constitute modern fixed-income markets. The valuation of interest-rate sensitive cash flows is the unifying theme. Major topics include theories of term structure, institutional aspects of fixed-income markets and analytical techniques for managing interest-rate risk. Bond refunding, defeasance, corporate bonds, forwards, futures, options and interest-rate swaps are discussed. The course gives an overview of the major classes of fixed-income securities and the markets in which they trade. Among the major classes of fixed-income instruments discussed are Treasury and agency securities, mortgage-backed securities (including CMOs and Strips), asset-backed securities, municipals, floating and inverse floating rate securities. *Prerequisites: FRE 6023, FRE 6083 and FRE 6103.*

FRE 6711 Investment Theory and Applications *1.5:0:0:1.5*

This course examines modern portfolio theory and investment selection. It considers portfolio analysis, single-period risk and return measures and the process of optimal portfolio selection. The basic portfolio model is extended to consider alternative risk concepts and multi-period portfolio horizons. Single-factor and multi-factor models are also discussed. Optimization techniques are applied. The basic portfolio model is extended to explain hedging theory and to build firm-wide risk management models. *Prerequisite: FRE 6411.*

TRACK: COMPUTATIONAL FINANCE

FRE 6231 Stochastic Calculus and Financial Modeling *1.5:0:0:1.5*

This course extends the core course FE6083 to Stochastic Calculus in Finance, emphasizing the modeling approach and resolution of important problems in derivatives finance, in pricing assets and complex financial products. In addition, cases highlighting the impact of theoretical finance on market trading, investment and portfolio management and related problems are emphasized. Some of the techniques used include Markov chains, random walks, stochastic differential equations and Ito Calculus, optimal stochastic control and stochastic dynamic programming as well as Monte Carlo simulation. These techniques are applied to selected financial engineering models to assess and simulate (using MATLAB and other software) essential derivative and related problems of practical importance in finance. *Prerequisite: FRE 6083.*

FRE 6251 Numerical and Simulation Techniques in Finance *1.5:0:0:1.5*

The course presents advanced numerical techniques to solve ordinary, partial and stochastic differential equations. These techniques are analyzed mathematically and use computer-aided software that allows for the solution and the handling of such problems. In addition, the course introduces techniques for Monte Carlo simulation techniques and their use to deal with theoretically complex financial products in a tractable and practical manner. Both self-writing of software as well as using outstanding computer programs routinely employed in financial and insurance industries will be used. *Prerequisite: FRE 6083.*

FRE 6311 Dynamic Assets and Options Pricing *1.5:0:0:1.5*

The course focuses on inter-temporal assets pricing in discrete and continuous time. The course explores problems in complete and incomplete markets of both theoretical and practical interest that require an appreciation of financial economic theories and computational techniques. Financial-engineering techniques are introduced including Martingales, stochastic calculus and jump processes; these are applied to engineering problems in finance. Problems and cases are presented that span Stocks and Derivatives (options of various sorts), Bonds and Implied Risk-Neutral Pricing. *Prerequisites: FRE 6083 and FRE 6123.*

FRE 6331 Financial Risk Management and Optimization *1.5:0:0:1.5*

This course provides solutions to the inter-temporal problems in financial management including management of portfolios, credit risks and market making. Dynamic and stochastic dynamic programming techniques as well as optimal control and stochastic control principles of optimality are presented, and their financial contexts emphasized. Both theoretical and practical facets of inter-temporal management of financial risks and risk pricing are also stressed. The course uses financial and optimization software to solve problems practically. *Prerequisites: FRE 6083, FRE 6091 and FRE 6123.*

FRE 6351 Advanced Financial Econometrics *1.5:0:0:1.5*

Financial econometrics has matured into a necessary and essential part of financial engineering that provides opportunities to deal with real and practical problems in finance. For example, techniques such as ARCH and GARCH and their subsequent development are used to estimate the volatility of underlying financial processes; the analysis of intra-day trading data that requires particular models and techniques; memory-based and fractal stochastic processes to study complex markets behaviors and copulas applied routinely to model- and estimate-dependent risks. These financial and risk problems require the application of advanced financial-econometric techniques, which the course provides from both theoretical and empirical-applied viewpoints. Selected cases provide a real-world sense of financial engineering when it is faced with financial-market reality and complexity. *Prerequisite: FRE 6083.*

TRACK: TECHNOLOGY AND ALGORITHMIC FINANCE

FRE 6131 Clearing and Settlement and Operational Risk *1.5:0:0:1.5*

This course focuses on issues involved in processing financial transactions—from order execution to final settlement of transactions—and operational risk in general. The course examines the procedures and market conventions for processing, verifying, and confirming completed transactions; resolving conflicts; decisions involved in developing clearing operations or purchasing clearing services; the role played by clearing houses; and numerous issues associated with cross-border transactions. The course also examines the effects of transaction processing, liquidity management, organizational structure, and personnel and compliance on the nature of operational risk. Qualitative and quantitative measures of operational risk are discussed. *Prerequisite: FRE 6151.*

FRE 6151 Foundations of Financial Technology *1.5:0:0:1.5*

Every year, financial institutions spend billions to exploit the latest development in information technology. This course introduces a framework with which to understand and leverage information technology. The technology components covered include telecommunications, groupware, imaging and document processing, artificial intelligence and object-oriented analysis and design. The course also covers the entire technological-planning process specifically for financial institutions.

FRE 6791 Operational Risk Measurement and Management *1.5:0:0:1.5*

The operational difficulties faced by financial institutions have created a need for tools to measure and manage operational risk. An accurate appreciation of risks, exposures and controls is critical to managing risk effectively in today's dynamic global business environment. This course examines the effects of transaction processing, liquidity management, organizational structure, personnel and compliance on the nature of operational risk. Qualitative and quantitative measures of operational risk are discussed. *Prerequisite: FRE 6711.*

FRE 6431 Electronic Market Design *1.5:0:0:1.5*

This course covers the design and analysis of electronic marketplaces. This exciting new research area incorporates ideas from economics (in particular game theory and mechanism design), AI and theoretical computer science. Electronic markets have many interesting applications, from the obvious, such as automated negotiation for e-commerce, to non-obvious applications such as resource allocation in grid-computing settings. The course focuses on computational and game-theoretic questions related to electronic markets and looks at what it means to design electronic markets with good properties. Topics include Introduction to game theory and mechanism design; winner determination in combinatorial auctions; bidding languages; approximate single-shot auctions; iterative auctions; preference elicitation and communication complexity; mechanisms for selling digital goods; false-name bids; reputation mechanisms; computationally-limited agents; trading agents; and privacy and auctions. *Prerequisite: Graduate status.*

TRACK: RISK FINANCE

FRE 6021 Financial Insurance and Credit Derivatives *1.5:0:0:1.5*

Financial insurance and Derivatives have moved to the center of modern corporate finance, investments and the management of financial institutions. Option pricing concepts are applied to price complex structured financial products and to price portfolios of equity-linked life insurance. This course also introduces modeling and the pricing of credit derivatives such as CDOs and the many other vehicles used to securitize portfolios of MBS, Loans, etc. Applications to Fixed Income problems, interest rates and bond derivatives, the management of portfolio risks and their like are considered. *Prerequisite: FRE 6103.*

FRE 6051 Finance Insurance *1.5:0:0:1.5*

This course highlights essential facets of actuarial science, insurance and finance insurance. The course assumes that students are familiar with basic notions of expected utility and stochastic processes, and options pricing. Topics include Insurance Business and Insurance Firms Management; Principles of Actuarial Science and Risk Pricing by both actuarial (historic and data based) and financial approaches (based on implied estimates of future losses). The expected Utility Approach to Insurance Risk Pricing and Management is briefly reviewed and greater attention is given to financial insurance derivatives; pricing Insurance Products (Life Insurance, Casualty, Pension Funds and Defined Benefits). The course concludes with an appreciation of the Principles of Insurance Management in a Dynamic and Global Setting. Throughout, the course uses numerous cases centered on financial insurance and actuarial problems and analyzes them from a financial markets perspective. Particular problems such as insurance pension funds, CATBOND and weather (insurance) derivatives and regulation are presented as case problems. *Prerequisite: FRE 6103.*

FRE 6143 Life Insurance and Related Financial Products *1.5:0:0:1.5*

This course begins with an introduction to the Mathematics of Life Insurance. Basic topics covered are survival distributions, time-of-death as a continuous random variable, life tables and their interpretation. Insurance applications include estate planning, tax ramifications and other specific issues related to the multiple uses of life insurance. Characteristics of life annuities are exhibited; the equivalence principle is introduced and used to evaluate future benefits. Prospective future loss on a contract already in force is investigated. An emphasis lies on the integration of life contingencies into a full risk-theory framework and the use of modern probabilistic and financial methods that are based on financial pricing. *Prerequisite: FRE 6051.*

FRE 6223 Credit Risk and Actuarial Models *3:0:0:3*

Many problems in actuarial science involve building a mathematical model to forecast or predict future insurance losses and revenues. Historical data guide the actuary in selecting the model and in calibrating its unknown parameters. The course introduces discrete and continuous actuarial models such as loss, frequency and severity models and their specific characteristics. It then studies aggregate loss models in which individual risks are pooled into a manageable aggregate risk. Finally, financial tools are used to market price theses losses and allow a securitization of insurance firms' portfolios. *Prerequisite: FRE 6051 Insurance Finance and Actuarial Science.*

FINANCIAL LABS

FRE 6811 Financial Software Laboratory *1.5:0:0:1.5*

This course teaches students to use financial software tools commonly employed in industry. Examples include: @Risk, Yieldbook, Excel, R, and C++.

FRE 6821 Financial Econometrics Laboratory *1.5:0:0:1.5*

This course teaches students to use financial econometrics software. Examples include: Eviews, Stata and others.

FRE 6831 Computational Finance Laboratory *1.5:0:0:1.5*

This course teaches students to use the software tools employed in computational finance. Examples include: MATLAB, GAMS and other optimization software.

FRE 6861 Financial Software Engineering *1.5:0:0:1.5*

This financial lab requires students to publicly participate in a large software project. This participation could take the form of innovation, such as contributing to an open-source financial software project with the contributions being accepted and committed to the main branch, or invention, such as publishing a stand-alone library or package for a programming language commonly used in financial applications, or pure entrepreneurship, such as the development or updating of a brand-new industrial strength financial software application. As the students work on their project, this course will focus on important software engineering considerations specifically as they apply to the real-time world of financial projects, such as formalized procedures for revision control and bug tracking and other proven methods of software management in a fast-paced financial and business environment.

CAPSTONE OPTIONS

FRE 7003 Financial Engineering Capstone: Thesis *3:0:0:3*

In this research course, students undertake proprietary or non-proprietary research and write a thesis-type research paper. Generally,

students work under faculty supervision. However, the course is intended to be largely self-directed within guidelines established by the supervising faculty member. Prerequisites: This course should be taken during the student's final semester. *Prerequisites vary depending on the student's track and the nature of the thesis project.*

FRE 7023 Financial Engineering Capstone: Internship *3:0:0:3*

In this course, the Career Management Center helps the student to secure an internship. Students work under faculty supervision. However, the course is intended to be largely self-directed within the guidelines established by the supervising faculty member. A paper based on the internship work is required. This course is graded on the S/U basis. Prerequisites: This course should be taken during the student's final semester. *Prerequisites vary depending on the student's track and the nature of the internship.*

FRE 7043 Financial Engineering Capstone:Project *3:0:0:3*

In this project course, students work with faculty on proprietary or non-proprietary research projects. Generally, students work under faculty supervision. However, the course is intended to be largely self-directed within the guidelines established by the supervising faculty member. A significant written research component is required. Prerequisites: This course should be taken during the student's final semester. *Prerequisites vary depending on the student's track and the nature of the project to be undertaken.*

ELECTIVES

FRE 6031 Money, Banking and Financial Markets *1.5:0:0:1.5*

Financial econometrics has matured into an important and necessary field, providing an opportunity to deal with practical problems in finance. For example, techniques such as ARCH and GARCH and their subsequent development are used to estimate the volatility of underlying financial processes; the analysis of intra-day trading data requires particular mathematic techniques; memory-based and persistent stochastic processes can be used for algorithmic trading and detecting markets incompleteness; and copulas are now applied routinely to model and estimate dependent risks. These financial and risk problems require the application of advanced financial-econometric techniques, which the course provides from theoretical and empirical-applied viewpoints. Selected cases provide a real-world sense of financial engineering when it is faced with financial-market reality and complexity.

FRE 6071 Derivatives, Financial Markets and Technology *1.5:0:0:1.5*

This course covers basic derivatives, including futures contracts, forward contracts, option contracts and swap contracts. The principal focus is on the use of these instruments by financial institutions. Basic valuation concepts are discussed, as are the use of derivatives for speculation, hedging and arbitrage. The specifics of the contracts and the markets in which they trade are also discussed. The main focus gives students in the Financial Technology track a general understanding of the derivatives market and risk management. *Prerequisites: FRE 6003, FRE 6023 and FRE 6103.*

FRE 6111 Investment Banking and Brokerage *1.5:0:0:1.5*

This course introduces an overview of Wall Street, the back office and general brokerage operations, investment banking and capital markets. The course covers subjects essential to understanding how products, once created, are distributed and sold. The course relies heavily on The Wall Street Journal, Financial Times and other trade publications. Topics include a brief history of Wall Street, an understanding of the major securities laws and how they have changed over time, basics of equity and debt securities, creation of debt and equity securities, and pricing and sale of debt and equity securities. The course seeks to understand how and where opportunities for creating new securities arise.

FRE 6131 Clearing and Settlement of Financial Transactions *1.5:0:0:1.5*

This course focuses on issues involved in processing financial transactions, from order execution to final settlement of transactions. The course examines the procedures and market conventions for processing completed transactions, verifying transactions, confirming transactions, resolving conflicts, decisions involved in developing clearing operations or purchasing clearing services, the role played by the clearing houses, and numerous issues associated with cross-border transactions.

FRE 6151 Foundations of Financial Technology *1.5:0:0:1.5*

Every year, financial institutions spend billions to exploit the latest development in information technology. This course introduces a framework with which to understand and leverage information technology. The technology components covered include telecommunications, groupware, imaging and document processing, artificial intelligence and object-oriented analysis and design. The course also covers the entire technological planning process specifically for financial institutions.

FRE 6163 Life Contingencies II *3:0:0:3*

The course investigates annuity and insurance contracts involving two lives. Subsequently, a more realistic model is introduced in which several causes of decrement are possible. An overview of risk-theory application to insurance is given. Also covered are an extension of the individual model to incorporate operational constraints such as acquisitions and administrative expenses, accounting requirements and the effects of contract termination. *Prerequisite: FRE 6143.*

FRE 6171 Management of Financial Institutions *1.5:0:0:1.5*

This course focuses on managing institutions from a financial-management perspective. By analyzing the factors that define the dynamics of the rapidly changing financial-services industry, the course explores the normative consequences of financial management decision-making to create shareholder value. *Prerequisites: FRE 6031 and FRE 6023.*

FRE 6191 Advanced Topics in Financial Technology *1.5:0:0:1.5*

This course complements the Foundations of Financial Technology by treating in-depth advanced topics in this rapidly changing field. Students prepare and present case studies applying the concepts covered in class. *Prerequisite: FRE 6151.*

FRE 6211 Financial Market Regulation *1.5:0:0:1.5*

This course considers the role and forms of regulation in the U.S. financial markets, the role of the Securities and Exchange Commission (SEC), the Commodity Futures Trading Commission (CFTC), the Federal Reserve, the Office of the Controller of the Currency (OCC), and self-regulating organizations (SROs) such as the National Association of Securities Dealers and the National Futures Association. Also examined are the roles of the state insurance commissions and the state or federal Department of Labor. *Prerequisite: FRE 6031.*

FRE 6231 Stochastic Calculus and Financial Modeling *1.5:0:0:1.5*

This course extends the core course FE6083 to Applied Stochastic Calculus in Finance, emphasizing the stochastic modeling approach to formulate and resolve important problems in derivatives finance, in pricing assets and complex financial products. In addition, cases highlighting the impact of theoretical finance on practical market trading, portfolio management and related problems are emphasized. To do so, the course introduces the elements of stochastic processes and stochastic calculus as they apply to financial engineering. Some techniques covered include Markov chains, random walks, stochastic differential equations and Ito Calculus. These techniques are applied to model, assess and simulate (using MATLAB) essential derivative and related problems of practical importance in finance. *Prerequisite: FRE 6083 or admission to Actuarial Track of study.*

FRE 6243 Credibility and Loss *3:0:0:3*

This course deals with actuarial models and the estimation of their parameters. Statistical parameter estimation techniques and Bayesian methods are used to study and interpret survival models. Quantitative methods for model selection and model testing are introduced. The basics of credibility theory provide the mathematical tools for an insurer's prospective experience rating on a risk or a group of risks (e.g., to justify policy prices). Finally, model simulation techniques are treated in theory and practice. *Prerequisite: FRE 6223.*

FRE 6251 Numerical and Simulation Techniques in Finance *1.5:0:0:1.5*

The course presents numerical techniques to solve ordinary and stochastic differential equations. These techniques are analyzed by using mathematics and computer-aided software that allows for solving and handling such problems. In addition, the course introduces Monte Carlo simulation techniques and their use to deal with theoretically complex financial products in a tractable and practical manner. The course employs self-writing of software and use of outstanding computer programs routinely employed in industry. *Prerequisite: FRE 6083.*

FRE 6271 Valuation of Equity Securities and Financial Statement Analysis *1.5:0:0:1.5*

This course examines in detail the tools and techniques to analyze financial statements for credit evaluation, forecasting, identifying merger candidates, enhancing the efficiency of decision making, and diagnosing problem areas within the firm before crises develop. Students learn to use financial ratios to conduct duPont (i.e., decomposition) analysis, a methodology to track down sources of poor performance through interrelationships among a firm's financial ratios. *Prerequisites: FRE 6003 and FRE 6103.*

FE 6291 Options and Derivatives *1.5:0:0:1.5*

This course covers basic derivatives, including futures contracts, forward contracts, option and swap contracts. The focus is on the application of these instruments by financial institutions. Basic valuation concepts and the use of derivatives for speculative purposes, hedging purposes and arbitrage are discussed, as are the specifics of the contracts and the markets in which they trade. Also discussed are financial derivatives, such as interest rate, currency and equity contracts; and commodity contracts and specialty contracts, such as insurance derivatives and credit derivatives. *Prerequisites: FE 6003, FE 6023 and FE 6103.*

FRE 6311 Dynamic Assets and Option Pricing *1.5:0:0:1.5*

The course focuses on inter-temporal assets pricing, both in discrete and continuous time. The course distinguishes between problems in complete and incomplete markets of both theoretical and practical interest, all of which requires an appreciation of financial economic theories and computational techniques. Problems and cases are presented that span Fixed Income (Bonds), Stocks and Derivatives (Options of various sorts), and Implied Risk Neutral Pricing. Reference text: *Applied Stochastic Models and Control for Finance and Insurance* by C.S. Tapiero (Kluwer, 1998). *Prerequisites: FRE 6083 and FRE 6123.*

FRE 6321 Casualty I *1.5:0:0:1.5*

This course broadens perspectives on the business environment in which actuaries work and analyzes insurance-pricing cycles and regulatory developments. Rating and solvency issues are covered, as well as the rating of individual risks and the concept of loss reserve. The course also touches on issues behind daily events and the impact of current developments in the actuarial sciences on the actuarial function. *Prerequisite: FRE 6051.*

FRE 6331 Financial Risk Management and Optimization *1.5:0:0:1.5*

This course provides a solution to the inter-temporal management of portfolios, various financial products, credit risks and market making using dynamic optimization techniques. Dynamic and stochastic dynamic programming techniques and optimal and stochastic control principles of optimality are presented in financial contexts that emphasize the theoretical and practical facets of the inter-temporal management of financial risks. *Prerequisites: FRE 6083 and FRE 6123.*

FRE 6341 Casualty II *1.5:0:0:1.5*

This course continues FRE 6321. It covers operational issues of Property and Casualty insurance. Specialized Lines of Business are treated. An introduction to Classification Analysis is given. *Prerequisite: FRE 6321.*

FRE 6351 Advanced Financial Econometrics *1.5:0:0:1.5*

Financial econometrics has matured into a necessary field that provides opportunities to deal with the essential problems of finance. For example, techniques such as ARCH and GARCH and their subsequent development are used to estimate the volatility of underlying financial processes; the analysis of intra-day trading data requires particular mathematic techniques; memory-based and persistent stochastic processes can be used for algorithmic trading and detecting markets' incompleteness; and copulas are applied routinely to model and estimate dependent risks. These financial and risk problems require the application of advanced financial-econometric techniques, which the course provides from theoretical and empirical-applied viewpoints. Selected cases provide a real-world sense of financial engineering when it is faced with the reality and the complexity of financial markets. *Prerequisite: FRE 6083.*

FRE 6371 Contract Economics *1.5:0:0:1.5*

This course covers advanced material in applied economics for students of financial engineering. The topics discussed include the development of contractual relationships between parties with dissimilar interests. These include risks of moral hazard and the design of incentives, adverse selection and market signaling, auction theory and the winner's curse, and distributed and integrative negotiation. Students who complete this course successfully obtain an appreciation for the theoretical and practical challenges in completing contracts that provide satisfac-

tory economic incentives to each party and satisfy the other party's belief that the required terms will be met. *Prerequisite: FRE 6023.*

FRE 6391 Advanced Corporate Finance: Mergers and Acquisitions *1.5:0:0:1.5*

This course examines the theories and empirical evidence related to mergers and acquisitions and other corporate transactions and reorganizations. The course looks at friendly mergers, hostile takeovers (including takeover and anti-takeover tactics), leveraged buyouts and bankruptcy. Throughout, the course examines the motives behind these transactions and reorganizations. *Prerequisite: FRE 6103.*

FRE 6411 Valuation of Fixed Income Securities and Basic Interest Rate Derivatives *1.5:0:0:1.5*

This course examines the body of analytical tools and measures that constitute modern fixed-income markets. The valuation of interest rate-sensitive cash flows is the unifying theme. Major topics include theories of term structure, institutional aspects of fixed-income markets and analytical techniques for managing interest-rate risk. Bond refunding, defeasance, corporate bonds, mortgage-backed securities, forwards, futures, options and interest rate swaps are discussed. The course gives an overview of the major classes of fixed-income securities and the markets in which they trade. Among the major classes of fixed-income instruments discussed are Treasury and agency securities, mortgage-backed securities (including CMOs and Strips), asset-backed securities, municipals, floating and inverse floating-rate securities. *Prerequisites: FRE 6023, FRE 6083 and FRE 6103.*

FRE 6451 Behavioral Finance, Trading and Investment Strategy *1.5:0:0:1.5*

This course discusses investors' systematic deviations from the level of financial rationality assumed by modern financial theory. Such biased behavior can lead to market inefficiencies, market opportunities and market failure. After a brief introduction to the topic and its research history, the course focuses on the limits to arbitrage created by decision bias, the equity premium puzzle, market over-reaction and under-reaction. The course seeks to understand how and where opportunities for and threats to wealth accumulation exist as a result of the mismatch between investor behavior and the assumptions about investment behavior inherent in financial theory. *Prerequisite: FRE 6023.*

FRE 6471 Applied Financial Econometrics *1.5:0:0:1.5*

This course builds on the concepts covered in FRE 6091 and addresses the design, estimation and application of both univariate and multivariate time-series models that are used widely in finance and risk engineering. Financial econometric techniques such as ARCH-GARCH methods and the use of numerical techniques and simulation. *Prerequisites: FRE 6083 and FRE 6091.*

FRE 6491 Municipal and Public Finance *1.5:0:0:1.5*

This course provides an overview and analysis of the market for debt obligations of state and local governments. Topics will include the micro structure of the market, including the types of debt issued, and characteristics of the buyers. Federal and state taxation of munis will be discussed, along with industry regulatory structure. Bond structure, risk assessment and risk management using cash bonds, futures and options will be covered. *Prerequisite: FRE 6411.*

FRE 6511 Derivatives Algorithms *1.5:0:0:1.5*

This course focuses on the algorithms behind derivatives valuation and applications. The focus is on the principles and practice of financial engineering and risk management and on developing intuition: understanding the reasons for the existence of the product, simulating possible paths and possible parameter values as an exploratory process, approximating complex derivatives as a combination of simpler ones, and attempting to replicate the payout. The goal is to prepare students to be able to evaluate an arbitrary derivative given only its term sheet. To that end, the course requires a project almost every week. Projects can be done in any programming language (Excel, Mathematica, R, Python, etc.), but the final result must be stand-alone tables and graphs. The primary prerequisite is familiarity with standard option pricing and Greeks. A portion of the final exam may involve a live computation project. *Prerequisite: FRE 6123.*

FRE 6551 Accounting for Financial Products *1.5:0:0:1.5*

This course addresses accounting issues pertaining to innovative financial products, risk-management strategies, tax-driven strategies and other manifestations of financial engineering, particularly those in which derivative financial instruments play an important role. Accounting and tax rules are reviewed and applied. *Prerequisite: FRE 6003.*

FRE 6571 Asset-backed Securities and Securitization *1.5:0:0:1.5*

This course examines essential contributions in this field and provides a comprehensive coverage of financial securitization and their application to major asset-backed securities, structuring issues and relative value analysis. Topics include the expanding frontiers of asset securitization; introduction to ABS accounting; trends in the structuring of ABSs; and prepayment nomenclature in the ABS market. *Prerequisites: FRE 6411 and FRE 6511.*

FRE 6591 Real Estate Finance and Mortgage-backed Securities *1.5:0:0:1.5*

This course takes the student from a general introduction to real estate finance and applied mortgage-backed securities (MBS) to a detailed treatment of issues that make real estate and these instruments some of the most complex. Students learn the fundamentals of yield curves, mortgage-cash flows, prepayments and analysis. The course covers pass-throughs, CMOs, mortgage derivatives and ARMs. Asset/Liability management of MBS will be discussed. Students build a price-yield calculator for MBS pass-throughs (using a spreadsheet) and complete a course project. *Prerequisites: FRE 6411 and FRE 6571.*

FRE 6611 Credit Derivatives *1.5:0:0:1.5*

This course introduces credit derivatives and Collateralized Debt Obligations (CDO's). The course reviews the most important credit instruments and their marketing, starting with risky bonds and credit default swaps, through basket swaps, structured products and CDO's. Each instrument is defined and explained, including its markets, modeling, pricing and risk management. Class work is illustrated with theoretical homework and practical Excel projects. *Prerequisites: FRE 6411 and FRE 6511.*

FRE 6631 Applied Derivatives and Real Options Finance *1.5:0:0:1.5*

This course focuses on financial-engineering applications using derivatives, alone and in combination with other financial instruments. In addition to studying complex financial-engineering structures, students consider applications of real options to the many industrial and assets management problems dealt with by business firms. Examples of applications include case problems in real options as well as issues in tax arbitrage, the construction of equity collars on restricted stock, the alteration of the investment characteristics of large portfolios, and the creation of synthetic financial instruments. *Prerequisites: FRE 6411 and FRE 6511.*

FRE 6651 Term Structure Modeling and Advanced Interest Rate Derivatives *1.5:0:0:1.5*

This course covers term-structure models, the term structure of volatility, interest-rate processes with time-dependent volatility and mean reversion, a closer look at path-dependent securities, including sinking fund bonds and options with look-back features, multi-factor models and multinomial methods of discrete numerical implementations. Course readings are drawn from current literature. *Prerequisites: FRE 6411 and FRE 6511. Students are expected to know numerical analysis.*

FRE 6671 Global Finance *1.5:0:0:1.5*

This course covers the international dimensions of finance. It focuses on markets, players and instruments. It explores the main theoretical insights into the workings of the foreign exchange, international currency and bond markets, and how their integration is used to price securities. *Prerequisites: FRE 6411 and FRE 6511.*

FRE 6691 Intermediate Credit Derivatives Valuation and Applications *1.5:0:0:1.5*

Credit derivatives have emerged as an area of significant interest in global derivatives and risk- management practice. These instruments have the potential to revolutionize the management of credit risk in banking and capital markets. This course introduces the full range of products available in today's marketplace, the economic value of credit derivatives, valuation techniques and guidelines on using them to manage and control risk. *Prerequisites: FRE 6411 and FRE 6511.*

FRE 6711 Portfolio Theory and Applications *1.5:0:0:1.5*

This course examines in-depth modern portfolio theory and investment selection. It considers the mathematics of portfolio analysis, single-period risk and return measures and the process of optimal portfolio selection. The basic portfolio model is extended to consider alternative risk concepts and multi-period portfolio horizons. Single-factor and multi-factor models are discussed. Optimization techniques, such as linear programming and quadratic programming, are applied. The basic portfolio model is extended to explain hedging theory and to build firm-wide risk management models. *Prerequisites: FRE 6411 and FRE 6511.*

FRE 6731 Basel 2 and Value at Risk *1.5:0:0:1.5*

This course addresses financial risk management and particularly focuses on Basel 2 directives and Value at Risk (VaR), a method to assess risk that employs standard statistical techniques routinely used in other fields. VaR analysis is used by bank and corporate managers and by financial market regulators. *Co-requisite: FRE 6711.*

FRE 6751 Credit Risk Measurement and Management *1.5:0:0:1.5*

This course deals with issues in credit-risk measurement, credit-risk management and related areas in which credit considerations are important. These issues arise in credit-rating activity, credit extension by banks and other financial services and in derivative markets where counter-party risk is perceived to be an important management issue. *Co-requisite: FRE 6711.*

FRE 6771 Financial Optimization Techniques *1.5:0:0:1.5*

The course introduces optimization concepts intended for coping with financial stochastic processes. The course involves both numerical analysis with commercial solvers and analytical approaches for gaining insights into underlying problems. The course covers three major optimization areas: convex optimization, non-convex optimization and stochastic programming. Conceptual frameworks and techniques are taught through applications and problems in financial engineering and management. *Prerequisite: FRE 6311.*

FRE 6803 Financial Engineering (research course) *3:0:0:3*

This course is a research/case effort and can be handled in different ways at the discretion of the faculty supervisor. The course may involve a series of cases that are dissected and analyzed. It may involve teaming students with industry personnel for proprietary or non-proprietary research projects. Or it may involve thesis-type research. Generally, students work under faculty supervision, but the course is intended to be largely self-directed within guidelines established by the supervising faculty member. A significant written research component is required. Prerequisites: This course should be taken during the student's final semester. *Prerequisites vary depending on the student's track and the nature of the chosen project.*

FRE 6911 Financial Regulation *1.5:0:0:1.5*

The course provides an overview of the legal and institutional framework of regulations for capital markets, with a strong emphasis on the United States with some discussion of the financial regulation of banks, insurance firms and financial services in general. In addition, attention is given to regulation in global and emerging markets. The goal is to develop a practical understanding for application in business decision making. The course explores the interplay of regulation (both intended and unintended effects), risk management and the evolution of global modern banking. In light of current market developments, the course develops a critical perspective and discusses potential approaches to the structure of financial regulation.

FRE 6901, 6921-6991 Selected Topics in Financial Engineering *1.5:0:0:1.5*

Current topics of particular importance in finance and risk engineering are analyzed and discussed. Selected topics are emphasized and provide focus for further study. Examples might include infrastructure and projects finance, international and global finance, economics and finance in developing countries, global finance in a global world, international investment strategies, finance and taxes, among others. *Prerequisites: Advanced standing and instructor's permission.*

FRE 7103 Macroeconomics *3:0:0:3*

Macroeconomics deals with the performance, structure and behavior of a national or regional economy as a whole. This course provides the basic tools for analyzing macroeconomic phenomena. Economic models are developed that explain the relationship between factors such as national income, output, consumption, unemployment, inflation, savings, investment, international trade and international finance. Applications investigate the causes and consequences of short-run fluctuations in national income and attempts at predicting long-run economic growth.

FRE 7211 Forensic Financial Technology and Regulatory Systems *1.5:0:0:1.5*

The goal of this course is to understand the technology behind financial forensics and regulatory systems. These include innovative database techniques ("dataveillance"), artificial intelligence, data mining, and non-parametric outlier methods used by the Securities Exchange Commission (SEC), the Financial

Industry Regulatory Authority (FINRA), as well as the FBI, and other federal and state agencies. Students will learn how to incorporate these technologies in the regulatory environment of the future. Student teams will prepare and present projects or case studies applying the concepts covered in class. *Prerequisite: FRE 6151.*

FRE 7221 Databases and Financial Information Technology *1.5:0:0:1.5*

This is an advanced course on practical computer science topics most relevant to financial applications. As such it covers fundamental concepts such as database design, use, and maintenance, algorithmic complexity and efficiency considerations, memory optimization and grid performance, and, primarily, the use and importance of financial specification languages such as MDDL and FpML and financial communication standards such as FIX. Students will work on numerous projects, including attaining hands-on experience with a FIX engine. *Prerequisite: FRE 6151.*

FRE 7241 Algorithmic Portfolio Management *1.5:0:0:1.5*

This course focuses on portfolio construction and rebalancing strategies such as momentum, value, and size strategies, among others. The course emphasizes backtesting and risk factor analysis as well as optimization to reduce tracking error. It will also address how a quantitative investment approach can help both individual and institutional investors make sound long-term investment decisions. *Prerequisite: FRE 6123.*

FRE 7251 Algorithmic Trading and High-Frequency Finance *1.5:0:0:1.5*

Algorithmic trading refers to the utilization of special computer programs in an order management system that restructure an order into a sequence of sub-orders based on the dimensions of submission time, price, size, and side. The goal of this course is to survey several algorithmic strategies used by financial institutions and to understand their implementation in the context of order management systems and standard financial protocols (such as FIX and FIXatdl). Student teams will prepare and present projects or case studies applying the concepts covered in class. *Prerequisites: FRE 6151 and FRE 7221.*

FRE 7261 News Analytics and Strategies *1.5:0:0:1.5*

The fast-growing field of news analytics requires large databases, fast computation, and robust statistics. This course introduces the tools and techniques of analyzing news, how to quantify textual items based on, for example, positive or negative sentiment, relevance to each stock, and the amount of novelty in the content. Applications to trading strategies are discussed, including both absolute and relative return strategies, and risk management strategies. Students will be exposed to leading software in this cutting-edge space. *Prerequisites: FRE 6151 and FRE 7221.*

FRE 7801 Topics in Finance and Financial Markets I *1.5:0:0:1.5*

Current topics of particular importance in finance and risk engineering are analyzed and discussed. Selected topics are emphasized and provide focus for further study. Examples might include Financial Economics, Macroeconomics and Finance, the Bond market, the securities markets, Derivatives markets, Contract Theory, Credit and Counterparty Risks, Banking Finance and others. *Prerequisites: Graduate standing and instructor's permission.*

FRE 7811 Topics in Finance and Financial Markets II *1.5:0:0:1.5*

The course analyzes and discusses current topics of particular importance in finance and risk engineering. Selected topics are emphasized and provide focus for further study. Examples can include Behavioral Finance, Personal Finance, Investment Theories and Alternative Finance, Corporate and Financial Responsibility, Financial Ethics, Hedge Funds Investment Strategies and their Management and macro hedge funds management, among others. *Prerequisites: Graduate standing and instructor's permission.*

FRE 7821 Topics in Actuarial Science I *1.5:0:0:1.5*

Current topics of particular importance in Actuarial Science are analyzed and discussed. Course topics may include for example: Pension Funds management, Actuarial Science and Social Security, Life Insurance, Insurance and Financial Products design and management. *Prerequisites: Advanced standing and instructor's permission.*

FRE 7831 Topics in Financial and Risk Engineering I *1.5:0:0:1.5*

Current and selected topics of particular importance in finance and risk engineering are analyzed and discussed. Selected topics are emphasized and provide a focus for further study. Topics include Credit Risk and Credit Derivatives, Quantitative Methods in Rare Events, Energy, Oil and Water Finance as well as advanced topics in financial econometrics and computational finance. *Prerequisites: Graduate standing and instructor's permission.*

FRE 7841 Topics in Actuarial Science II *1.5:0:0:1.5*

Current and selected topics of particular importance in Actuarial Science and in the insurance-finance convergence are analyzed and discussed. Course topics may include Risk Engineering and the Insurance Business, Principles of Insurance Management in a Dynamic and Global Setting, Finance-insurance convergence. *Prerequisites: Advanced standing and instructor's permission.*

FRE 7851 Topics in Financial and Risk Engineering II *1.5:0:0:1.5*

Current topics of particular importance in finance and risk engineering are analyzed and discussed. Selected topics are emphasized and provide a focus for further study. Examples can include urban finance engineering, environmental finance, infrastructure and projects finance, real-estate finance, insurance finance and derivatives, and macro hedge funds management. *Prerequisites: Graduate standing and instructor's permission.*

HISTORY OF SCIENCE AND TECHNOLOGY PROGRAM

Academic Adviser: Myles W. Jackson

The Master's program in the History of Science and Technology was the first of its kind to be offered in the New York City area. The need for advanced study of the growth of science and technology and their interactions with human society and values has become increasingly evident. Intense specialization has further heightened the need for understanding among various branches of science and the humanities.

Students who consider ideas, time, process, transfer and social changes in the history of science and technology can explore the historically contingent connections that exist among science, technology, engineering, the social sciences and humanities. Prospective teachers of science and engineering can increase their effectiveness through knowledge of the history of their own and related disciplines. Museum employees can learn how historical representations of nature often embodied powerful political messages. The NYU-Poly MS is particularly suitable for students wishing to pursue a PhD in the history of science and technology or science and technology studies at leading research universities. Polytechnic's libraries contain many important and rare works on the history of science, and they can be used for original research.

GOALS AND OBJECTIVES

The objectives of the Master of Science in History of Science are:

- To survey the historical contexts in which scientific and technological knowledge has been constructed.
- To consider the ways in which science and technology frame, and are shaped by, society and culture.
- To investigate the complex interactions between science and technology in industrial and preindustrial contexts.

REQUIREMENTS FOR THE MASTER OF SCIENCE

Polytechnic is reinvigorating its MS degree in the history of science and technology by incorporating the expertise and courses of scholars at New York University's Washington Square campus. Please contact Prof. Myles W. Jackson (mjackson@poly.edu) for further information.

AREAS OF FACULTY INTEREST AND STRENGTH

History of U.S. technology, history of German and British science and technology, genetic patenting and intellectual property in the U.S. and Europe, bioethics, philosophy of science and technology, history and philosophy of quantum theory.

INDUSTRIAL ENGINEERING PROGRAM

Program Director: Michael Greenstein

The Department of Mechanical and Aerospace Engineering offers a program in industrial engineering at the master's level.

Industrial engineering addresses how systems operate and is concerned with the effective and efficient delivery of quality products and services. The tools applied include analytic modeling, system simulation, queuing systems, work design, project planning, facilities design and quality management and control. Courses are available in each of these topics, many with course projects suited to the practice-oriented degree offered at Polytechnic.

Many students seek a graduate degree in industrial engineering after completing an undergraduate degree in another engineering discipline. Because industrial engineers often work on multidiscipline teams, students are encouraged to use their electives to add strength in some area related to their career interests, such as the following:

- Mechanical engineering
- Manufacturing
- Operations management
- Construction management
- Management of technology
- Electrical engineering

Graduate advisers work with students to develop a suitable program for either full-time or part-time study, with a product or service orientation.

Opportunities exist in many diverse areas. For example, industrial engineers are called upon to:

- design quality into products and processes;
- apply the principles of total quality management (TQM);
- develop efficient work methods;
- locate facilities and design plant layouts;
- improve productivity and competitiveness;
- schedule and manage projects;
- use computers to simulate physical systems and processes; and
- apply their knowledge in manufacturing and service industries, including finance, health care, logistics and construction. Industrial engineers seek to allocate limited resources effectively. A unifying theme focusing this body of knowledge and methods into a coherent entity is the systems point of view.

Industrial engineering encompasses the search for similarity among concepts, laws and models of different disciplines; the emphasis on the adaptation, integration and exploitation of existing techniques in areas other than their fields of origin; and, above all, a unique point of view dealing with relationships rather than with components. Industrial engineers are thus in a strategic position to bring about the best integration of people, materials, machines, time and money in any endeavor.

These techniques are applied in a wide range of organizations. Industrial engineers work in banks, hospitals, government, transportation and communications, construction, social service, facilities design, manufacturing, warehousing and information processing.

Many industrial engineers move from analyzing and designing productive systems to managing those systems. While engineering and management are different fields, both require the ability to make decisions based on valid information. Industrial engineers are especially trained to obtain and evaluate such information.

GOALS AND OBJECTIVES

The objectives of the Master of Science in Industrial Engineering are for students to:

- develop and apply a systems point of view to the effective supply of quality products and services;
- understand how to adapt, integrate and exploit existing technologies in manufacturing and services, including the application of analytic modeling, system simulation, queuing systems, work design, facilities design and quality management and control;
- learn to measure and allocate the resources of an enterprise optimally;
- become aware of today's industrial drivers and learn tools and techniques to analyze problems and improve performance; and
- acquire a broad knowledge base through the choice of a concentration of courses in industrial engineering and related fields to suit their career needs.

REQUIREMENTS FOR THE MASTER OF SCIENCE

The general Polytechnic requirements for the degree Master of Science are stated in this catalog under "Degree Requirements". Detailed requirements for this degree are shown below.

Admission to the Master of Science program requires a bachelor's degree in a related discipline from an accredited institution. Applicants should have a superior undergraduate academic record. Students who do not meet these requirements are considered individually for admission and may be admitted subject to their completion of courses to remove deficiencies. Students are encouraged to seek waivers (and have approved substitutes designated) for all required courses in which they can demonstrate competence, thereby using their time effectively.

Prerequisite Courses (or equivalent knowledge)

Students must have knowledge of engineering economics and probability and statistics. Prospective students lacking the relevant knowledge may satisfy the requirement by taking probability and statistics (MA 6513 or equivalent).

Up to 3 credits of graduate courses in this category of prerequisite knowledge can be counted toward the degree as electives, although the electives needed for the student's concentration also must be satisfied.

Required Core Courses		**12 credits**
IE 6113	Quality Control and Improvement	
IE 6213	Facility Planning and Design	
IE 6823	Factory Simulation	
MN 7893	Production Science	

Other Courses **18 credits**

Students must take three electives from manufacturing or industrial engineering for a total of 9 credits.

Three electives are taken from any other graduate curriculum with the approval of the Program Director to ensure their compatibility with the student's professional objectives for 9 credits.

Total **30 credits**

Students should elect other courses in consultation with their adviser. Concentrations in areas suited to students' career interest are encouraged (e.g., manufacturing, mechanical engineering, operations management, construction management and management of technology). Courses from computer science or management may supplement such a concentration.

CERTIFICATE PROGRAM

The certificate program in industrial engineering is for professionals with work experience. A certificate program requires five courses selected to meet the needs of individuals. Applicants must hold a bachelor's degree. Students receive a certificate after completing a sequence with a B average or

better. Students who are later admitted to study for a master's degree usually may apply all certificate courses toward the master's degree.

If a student took the equivalent of any required courses as an undergraduate, or more than one as a graduate student, then they may substitute courses in consultation with the adviser. Additional information is available from the department. The certificate program is shown below.

Certificate in Industrial Engineering

IE 6123 Quality Engineering Using Robust Design
IE 6193 Production Planning and Control
IE 6453 Productivity Management
or
MG 6173 Performance Measurement and Reward Systems
MN 6183 Introducing New Methods: Leading Change
IE 6203 Project Planning and Control
or
MG 8203 Project Assessment and Management

GRADUATE COURSES

IE 6113* Quality Control and Improvement *3:0:0:3*

This course provides students with a solid foundation in the cost of quality, quality assurance and quality management. Emphasis is on the basic tools of quality control such as control charts and their use, the concept of "out of control," acceptance sampling, variables and attributes charts and producer's and consumer's risk. A unique aspect of this course is the demonstration of the power of teams of people with different expertise to improve quality. A course project is required. *Prerequisite: MA 6513 or familiarity with the concepts of probability and statistics. Also listed under MN 6113. *Online version available.*

IE 6123 Quality Engineering Using Robust Design *3:0:0:3*

This course provides a broad review of procedures to improve manufacturing quality. By employing both Taguchi techniques, such as the use of signal-to-noise ratio representations and other techniques less sensitive to parameter interactions, a full spectrum of robust design methods are presented. Applications of these procedures are reviewed, including online trouble-shooting methods to assure manufacturing quality. *Prerequisite: IE 6113. Also listed under MN 6123.*

IE 6163* Job and Workplace Design *3:0:0:3*

This course examines theory, research and applications of job and workplace design. Job design is presented from an interdisciplinary perspective, focusing on how job design influences attitudes and work behavior within organizations. Students are exposed to diagnostic tools for measuring and evaluating jobs and the psycho-social aspects of the workplace environment, as well as the principles of work redesign. Topics include influences on work design by innovations in information technology, modern manufacturing, virtual work arrangements and open office systems; design and support of effective work teams; re-engineering and total quality management; and privacy and communication in the workplace. **Online version available. Also listed under MG 6163.*

IE 6193 Production Planning and Control *3:0:0:3*

This is a survey course in basic and advanced manufacturing planning and control systems, covering short-term forecasting systems, master production scheduling, material requirements planning, inventory management, capacity management, production activity control and just-in-time.

IE 6203 Project Planning and Control (Project Management) *3:0:0:3*

This course discusses the knowledge and process required to manage a project through its life cycle, from concept to completion. Topics include engineering analysis, screening and selection, configuration and total quality management, scheduling using Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM), budgeting and resource management, computer support and software. Case studies are used to illustrate the process.

IE 6213* Facility Planning and Design *3:0:0:3*

Topics in this course include facilities design for global competitiveness, strategic master-site planning, site selection, factory layout and design, facility-management systems and materials handling and storage planning. Also presented are guidance on selecting alternative facility plans and application of queuing methods and computer modeling for facility design and evaluation. **Online version available.*

IE 6273 Operations Research: Deterministic Models *2.5:0:0:3*

Development of mathematical models for solving decision problems of deterministic nature. Classical optimization, Lagrange multipliers, linear programming, transportation method, network procedures, games. Dynamic programming. *Prerequisite: Calculus.*

IE 6283 Operations Research: Stochastic Models *2.5:0:0:3*

Mathematical models for solving decision problems of stochastic nature. Queuing, Markov processes, inventory models, reliability, probabilistic dynamic programming. IE 6273 and IE 6283 constitute standard one-year survey course in operations research. *Prerequisite: MA 6813.*

IE 6453 Productivity Management *3:0:0:3*

This course examines modern approaches to productivity measurement, evaluation, planning and improvement in both manufacturing and service industries. Participants develop productivity models for various types of organizations.

IE 6823 Factory Simulation *3:0:0:3*

This course examines modeling and simulation of complex industrial, commercial and service systems, such as factories and hospitals. Students develop, run and test several simulation models using different software packages. *Prerequisite: Computer literacy.*

IE 7113 and IE 7213 Engineering Applications in the Business Environment *3:0:0:3*

This course fills the gap between theory and practice by immersing the student into actual engineering problems in operating businesses. Students work with an engineering manager in the client company and under the academic supervision of a faculty member to solve real engineering problems. Student will apply the knowledge acquired through course work to solving current industrial problems. By identifying a single project for the student, the course will focus on applying theory and academic knowledge to the analysis and improvement of the clients' processes, products and operations. Students will experience the difference between the class room setting and business setting in applying engineering skills to problem solving. Students will experience the demands of meeting deadlines and pro-

viding cost – benefit solutions as professional engineers in the practice of engineering. This course provides the student with an opportunity to bridge the gap between theory and practice while still in school. *Prerequisite: Permission of the Instructor.*

IE 7763 Manufacturing Resources Planning *3:0:0:3*

This course studies computerized systems to effectively run a manufacturing business. Also covered is the process of software specification, evaluation, selection and implementation. Topics include Manufacturing Resources Planning (MRP) logic, enterprise resource planning, manufacturing execution systems, inventory management and bill of materials. Several software systems and their features are highlighted. *Also listed under MN 7763.*

IE 7853 Computer Integrated Manufacturing Systems *3:0:0:3*

This course examines the basic concepts of manufacturing complex products with complex processes. It relies heavily on computer and data processing technologies, which are introduced. Also a variety of perspectives are addressed from all aspects relative to products and processes-planning, design, manufacturing and shipping. Students explore techniques for managing and optimizing manufacturing productivity. *Also listed under MN 7853.*

IE 7873* Lean Manufacturing *3:0:0:3*

This course provides an overview to the basic principles, and theories of lean manufacturing which involves identifying and eliminating non-value-adding activities in design, production, and supply chain management. Students will learn an integrated approach to efficient manufacturing with emphasis on synchronized product, quick changeover, cell design, visual factory, value stream, one-piece flow and understand the metrics used to monitor performance. *Also listed under MN 7873. *Online version available.*

IE 7883 Manufacturing Systems Engineering *3:0:0:3*

Topics in this course concentrate on contemporary techniques for product design and manufacture, including financials of the manufacturing firm, quality, reliability, Taguchi methods of product and process design, scale-up and partitioning, production flows, modern manufacturing methods such as JIT/TQC, pull and synchronized manufacturing. Cultural factors are also discussed. *Also listed under MN 7883.*

IE 7923* Design for Manufacturability *3:0:0:3*

This course introduces concepts and techniques for economical, functionally sound and high-quality product design for manufacture. Emphasis is on designing for easy assembly, manually and with robotics and on the effective use of plastics to reduce manufacturing costs. Managerial and organizational approaches and case studies of successful designs are reviewed. *Also listed under MN 7923. *Online version available.*

IE 7933* Environmental Health and Safety *3:0:0:3*

This course presents an overview of environmental, health and safety management, and introduces students to management systems within a manufacturing operation. The course explores motivations and strategies for environmental, health and safety management. Students learn about the mandatory standards understanding the technical and legal rationale for insuring that workers are provided with a safe and healthy workplace. These skills are needed to work effectively in operations, human resources and employee development as well as in industrial relations, since the law provides workers specific safety and health rights. *Also listed under MN 7933. *Online version available.*

IE 7993 Supply Chain Engineering *3:0:0:3*

Students in this course gain an understanding of how companies plan, source, make and deliver their products with a global competitive advantage. The course stresses the engineering components in developing an integrated supply chain that covers the entire manufacturing enterprise. It looks at the supply-chain infrastructure and the velocities of different models. The focus is on understanding and detecting the constraints of the infrastructure and the lowest common denominator of the information system used. Students also gain an understanding of logistical networks and the optimizing of the various traffic and location alternatives. Synchronization of supply and demand is examined in detail, looking at variability in both processes with the objective of maximizing throughput and capacity, emphasizing partnering, e-commerce and the bullwhip effect. Finally, the course establishes global performance measurements that compare companies in different industries. *Also listed under MN 7993.*

IE 9113/9123 Selected Topics in IE *each 3:0:0:3*

These topics cover areas not covered in other courses. Specific topics vary according to instructor, who may be a visiting professor. Topics and prerequisites announced during the term before classes.

IE 9303/9313 Readings in Industrial Engineering I/II *each 3 credits*

In this course, students individually read selected papers and current literature in specialized area and are guided by a faculty member. *Prerequisite: Approval of adviser, instructor and department head.*

THE FOLLOWING COURSES ARE OFFERED IRREGULARLY IN RESPONSE TO INDUSTRY DEMAND:

IE 6003	Engineering Economics
IE 6063	Work Design and Measurement
IE 6183	Inventory Models
IE 6273	Operations Research: Deterministic Models
IE 6283	Operations Research: Stochastic Models
IE 6503	Queuing Systems I
IE 6853	System Reliability
IE 7653	Human Factors in Engineering Design
IE 7753	Industrial Safety Engineering

INFORMATION MANAGEMENT EXECUTIVE MASTER'S PROGRAM (eIM)

Program Director: Joseph Nadan

GOALS AND OBJECTIVES

The Information Management Executive Master's Program (eIM) delivers a high-level learning experience focusing on the intersection of broadly defined information technology and management, which is at the heart of the modern economy. Offered by Polytechnic for over two decades, the Information Management Program (eIM) is geared for the growing set of professionals who must use information and networking technology and the Internet for carrying out critical tasks and in developing and delivering value within their organizations and for customers.

IT managers must learn how to innovate in a world in which the use of wireless and Internet-based technologies has changed traditional organizational structures into a seamless, 24/7 global entity. eIM participants learn how to be effective by capitalizing on an advanced IT infrastructure, which has accelerated product lifecycles, enlarged the diversity of sources of innovation, and intensified global competition.

KEY CHARACTERISTICS OF THE eIM PROGRAM

- Provides knowledge to manage information-intensive corporations.
- Focuses on strategic implications of technology and innovation and entrepreneurship.
- Encompasses innovation management in all modern information arenas such as financial and professional services, media/entertainment, bio-medical/pharma/chemical, new materials, IT and telecommunications.
- Deals with the impact of information and innovation throughout an enterprise.
- Addresses physical, digital (including Internet-based) and mobile innovation.
- Enables key transition from information specialists to high-level, effective information managers.
- Assumes a global perspective.
- Explores and develops new business models based upon information-enabled innovation.

In the eIM curriculum, even traditional subjects such as finance, operations management and marketing are taught with information-enabled-innovation issues in mind. Subjects, concepts and issues directly related to information management and accessing innovative capabilities that form the eIM Program core include:

- Customers, suppliers and other partners as sources and co-creators of innovation;
- New product and services development;
- The global search for innovation and information technology and choosing among increasingly global information sources and markets, including Europe, the Pacific Rim, Israel, India and others;
- Entrepreneurship;
- Integrating information technology and management;
- Venture capital and venture creation;
- The Internet and the Web-innovation as new platforms for innovation;
- Innovation-friendly cultures and organizations;
- The IT-innovation connection;
- Revitalized R&D;
- Advanced products and services;
- Strategic information planning and innovation-intensive new product business models;
- Knowledge management;
- Information selection and acquisition; and
- Multiple and diverse levers for information-enabled innovation.

The program is well-suited for engineers and scientists with increasing managerial responsibility, and for professionals, functional and business managers in finance, banking, telecommunications, design, retailing, media/entertainment and other environments increasingly dependent on information.

eIM is an executive program. As such, it has the following general features:

- Full-semester and half-semester courses to use limited time effectively;
- Carefully selected elective courses to maintain flexibility in meeting diverse professional needs;
- A blend of live classes and modern Web-based technology;
- Effective information technology-enabled remote-collaboration learning and teamwork learning materials that are often in digital Web-based format to capitalize on Internet-based technologies and methods.

eIM also has more focused concentration areas: Information Management (IMCIO) and Information Management in Information Security and Privacy (IMCISO).

eIM classes are held every other week on Wednesday or Thursday evenings and all day Saturday at 55 Broad Street, in the heart of lower Manhattan. An all-inclusive fee covers tuition and fees, textbooks and other educational material, special tutorials and lectures and meals on class days. For the most current information go to http://www.poly.edu/academics/programs/information-management-executive-ms.

EXECUTIVE FORMAT

The eIM Program is based on a cohort system in which all participants enter at the same time and take the same courses throughout the program except when electives are selected. eIM is a rigorous 15-calendar month, four-semester state-of-the-art program.

Additional features of the executive format include:

- Close interaction and teamwork;
- A professional, modern, and informal learning environment;
- Close collaboration with respected partners in industry and relevant scholarly communities;
- A curriculum that is continually updated; and
- Participants viewed as partners in the learning process (in class and in the joint generation of intellectual capital as presentations, reports or cases—in paper and digital formats).

KEY BENEFITS OF THE INFORMATION MANAGEMENT (eIM) PROGRAM AT NYU-POLY

Key benefits of the program include:

- An emphasis on information technology, nurturing innovation and entrepreneurship;
- Integration of local, regional and global perspectives;
- Active involvement of highly respected faculty in management and engineering and applied science;
- A focus on leadership;
- A holistic educational approach that connects the worlds of technology and business;
- Modern learning methods, e.g. individualized and team-based coaching, experiential project-based education, and advanced learning platforms;
- Close involvement with leading companies, entrepreneurial ventures, and professional services firms;
- Information reflective of modern value creation as practiced in the nation's most advanced global city; and
- Participants who complete this program will receive a Master of Science in Information Management from the Polytechnic Institute of New York University.

LOCATION
The Executive Master's Program in Information Management is offered at our Manhattan Graduate Center in the Wall Street financial district.

COACHING AND MENTORING PROGRAM
The NYU-Poly Technology Management Department faculty recognizes the impact that mentors and coaches have in accelerating the development of aspiring managers. All full-time Executive students participate in this unique Coaching and Mentoring Program that includes individual and group meetings with a coach/mentor. Each full-time Executive student has a one-on-one intake interview with their coach/mentor and is then encouraged to seek advice on significant work related presentations and special situations. The coach/mentor and student then develop a Personal Development Plan based upon the intake interview and several confidential online assessments, and then review progress against its objectives at least once a semester. The continuing program consists of group meetings held once a month during which topics of common interest are discussed and to-be-scheduled individual sessions in which the student may discuss matters on a confidential basis with their coach/mentor.

OPTIONAL COURSE AUDITING
Full-time Executive students may elect, at no additional costs and with permission from the Program Director and Instructor, to supplement their degree program by auditing one additional course per semester within the Graduate School.

GUEST SPEAKERS
The Metro NYC area is blessed with an abundance of thoroughly experienced highly-qualified technology managers that have valuable knowledge and insight into many of the topics that are taught in the eMOT and eIM programs. Professors often invite guest speakers to their classes to enrich coursework and enable our students to learn from their experiences and have an opportunity to discuss timely topics directly with them.

JUMP-STARTING ENTREPRENEURSHIP
NYU-Poly introduced a new mode of education we call invention, innovation and entrepreneurship (i^2e). We believe that research universities have to expand to provide not just education and research, but economic impact. Students in our executive programs embody this philosophy by managing technological innovation to launch new products, services and businesses within their own companies or as startups within our business incubation centers.

ADMISSIONS REQUIREMENTS
Admission to the eIM Program is based on an in-depth evaluation of a candidate's academic record, work experience and overall intellectual and professional qualifications and potential. Applicants must demonstrate strong commitment, and an ability to benefit professionally from the rigorous 15-month executive program. Because of the heavy demands of this program, it is important that employers also explicitly support such professional education. In general, GRE and GMAT tests are not required for applying to the eIM Program. But the Department of Technology Management may ask an applicant to submit scores later in the admissions process. The Program Director will schedule interviews with applicants to assure that they are ready for the commitment involved in this program. This program does not accept transfer credits. Applicants should apply online at www.poly.edu/academics/programs/management-technology-ms.

HOW TO APPLY
The Executive Master's Program uses an admission process called the Self-Managed Application (SMA). Applicants must gather the materials required by the program and forward them in a single envelope to:
Administrative Director
eMOT-eIM Programs
Polytechnic Institute of NYU
55 Broad Street, Suite 13B
New York, NY 10004

APPLICATION CHECKLIST
1. Complete the application and attach a copy of your professional resume and the application fee.
2. A Statement of Purpose that describes in brief your:
   a) Prior background and experience
   b) Motivation in pursuing graduate studies
   c) Long-term career goals
3. Please ask the registrar at all colleges and universities you attended to send official transcripts directly to you. For these documents to remain official, they must be sealed in the original envelope. Opened transcripts are not considered official.
4. Please arrange for two (2) letters of recommendation to be sent directly to you. These letters are generally from a supervisor or high-level colleague who is familiar with your professional work. As with transcripts, to be considered official, recommendations must be sent directly from the recommender to the applicant unopened. Use the enclosed forms for this purpose. Write your name at the top of this form, sign the waiver (which waives your right to see the recommendation) if you wish, and give one form and one of the enclosed envelopes to each person writing to support your application.
5. The final step for admission is a personal interview with an Academic Co-Director to discuss career objectives and to ensure that the program fits your goals.

For more information, contact the eIM Program Administrative Director:
Tel: (718) 260-4015
Fax: (212) 547-7029
Or e-mail: mot-im@poly.edu

eIM CURRICULUM
The eIM 36 credit curriculum consists of 24 credits of core courses and 12 credits of elective courses. To give students greater flexibility in choosing electives, the program has both full-semester courses that are 3.00 credits each and half-semester courses (marked with **) that are 1.50 credits each. Students may substitute one full-semester elective with two half-semester electives or vice-versa.

CORE COURSES
First Semester
MG 6093 Managerial Accounting and Finance
MG 6903 Managerial Decision Making for Information-Intensive Businesses
MG 8703 Introduction to Modern Information Technology Strategy

Second Semester
MG 6083 Managerial Economics
MG 6303 Operations Management
Full-semester Elective

Third Semester
MG 6073 Marketing
Full-semester Elective
MG 9601 IM Capstone-1 **
Half-semester Elective **

Fourth Semester
MG 8203 Project Management
Full-semester Elective
MG 9611 IM Capstone -2 **
Half-semester Elective **

eIM CONCENTRATIONS
Elective courses are grouped into three different areas of interest referred to as concentrations:
- The Information Management (IM) business-driven base program concentration trains information-technology-based professionals to lead and oversee the process of invention, innovation, and entrepreneurship — what we call i^2e.
- The Information Management (IMCIO) concentration allows information-technology professionals to develop their management and leadership skills with a focus on running IT as a business and receive certification from New York State (pending approval) as a CIO.
- The Information Management in Infor-

mation Security and Privacy (IMCISO) concentration allows information-technology-based professionals to develop their management and leadership skills with a focus on cyber-security and receive certification from New York State* as a CISO.

* New York State CISO certification from Global Information Cyber Security Association

SUGGESTED FULL-SEMESTER ELECTIVE COURSES GROUPED BY CONCENTRATION

All full-semester elective courses are 3.00 credits. All eIM students may, with the written permission of the Program Director, substitute any of the following courses for any full-semester elective:

MG 8573 Managing Cleantech and Renewable Energy Innovation
MG 8783 Managing Cloud Computing
MG 9683 Technology Management-Internship and Action Learning

All eIM students may take full-semester electives from any of the following concentration areas:

Information Management (IM)
Second semester:
MG 8753 Information Technology: Systems
Third semester:
MG 8763 Information Technology: Operations
Fourth semester:
MG 7743 Advanced Trends in Technology Management and Innovation

Information Management (IMCIO)
Second semester:
MG 8753 Information Technology: Systems
Third semester:
MG 8763 Information Technology: Operations
Fourth semester:
MG 7743 Advanced Trends in Technology Management and Innovation

Information Management (IMCISO)
Second semester:
MG 8213 Information Security and Privacy for Managers
Third semester:
MG 7883 Information Security and Privacy: Systems
Fourth semester:
MG 8333 Information Security and Privacy: Operations

HALF-SEMESTER ELECTIVE COURSES

All half-semester elective courses are 1.50 credits. All eIM students may take any of the following half-semester electives.

MG 7841 Negotiation in Technology-intensive Sectors
MG 7851 Leadership (Semester 4 requirement for CIO Certificate)
MG 7861 High-technology Entrepreneurship
MG 7871 Introduction to Managing Intellectual Property
MG 7881 Modern Supply Chain Management: Integration through Technology
MG 7891 Special Elective Topics for eMOT and eIM
MG 7971 Financing for Value Creation
MG 9651 The Modern CIO: Challenges and Opportunities (Semester 3 requirement for CIO Certificate)
MG 9691 The Modern CISO: Challenges and Opportunities (Semester 3 requirement for CISO Certificate)

COURSE DESCRIPTIONS

CORE COURSES

The following courses are unique to the eIM Executive Program.

MG 6073 Marketing *3:0:0:3*

This course emphasizes the imperative to be customer-focused in the information sectors. Topics include market definition and redefinition due to technological change; analysis of customer decisions; strategic choices of markets and products; positioning for competitive success; product pricing, distribution and communications decisions; new product development; market-system dynamics and the value chain.

MG 6083 Managerial Economics *3:0:0:3*

This course focuses on microeconomic analysis and the macroeconomic environment for managers. It discusses the economic basis for managerial decisions in production, investment and technology strategy. Topics include the economics of the firm; business cycles; economic growth; international trade; financial institutions; currency systems; economics of innovation and entrepreneurial activity; the role of technology in economic growth and in international competition.

MG 6093 Managerial Accounting and Finance *3:0:0:3*

This course covers principles and practices of the modern finance function, including accounting and corporate finance and their relevance for all information business managers. Topics include strategic perspectives—balancing long-term development and short-term returns; financing of ventures and innovative activities. Special emphasis is placed on financial decision-making in the information-business sectors and the financial assessment of increasingly important knowledge-intensive assets.

MG 6303 Operations Management *3:0:0:3*

This course focuses on developing a deeper understanding of the role that operations management plays in determining business strategy and in developing competitive advantage. The primary emphasis is on how to develop and effectively manage operations in knowledge-intensive enterprises. Participants discuss the operational design and managerial implications when the emphasis of the operations group is more on knowledge management than on production and facilities management; managing the effective integration of technology, people and operating systems; understanding the complexities and challenges of operations management; the challenges of developing and managing supply chain networks; and the critical role of technology in developing operational capabilities in an organization. *Also listed under MN 6303.*

MG 6903 Managerial Decision Making for Information-Intensive Businesses *3:0:0:3*

This course introduces managerial decision making and strategies, emphasizing information-intensive businesses and the fast-changing environment in which they compete. This course explores such issues as competing in both the digital and physical spaces, technology as an enabler of change, the role of the professional manager and managing in an increasingly globalized environment.

MG 8783 Managing Cloud Computing *3:0:0:3*

Many corporations and governments around the world are either planning or are in the process of migrating into a "Cloud". Cloud computing as a technology is proliferating at a rapid pace, and as such, there are myriad definitions, architectures, and models that are being developed. Cloud is a significant part of information management, and business managers should become well versed in managing and leading this cutting edge technology. They need to clearly understand how IT components such as virtualization, automation and security fit into and define a Cloud. This course provides a comprehensive overview of managing cloud computing. The course starts by developing a comprehensive technology foundation and then deals with the economics of cloud computing by analyzing its benefits, risks and obstacles.

The course then examines Virtualization, Automation, and Security, the three essential components of cloud computing. Specific case studies on private and public clouds are illustrated. The course concludes with the development of specific templates and roadmaps that help an organization migrate from managing traditional IT into a cloud based infrastructure.

MG 8203 Project Management *3:0:0:3*

This course covers managing technology-based projects, ranging from individual research and development to large-scale and complex technological systems. Topics covered: feasibility and risk analysis; project selection and portfolio optimization; alternative financing methods; functional and administrative structures, coordination and scheduling of activities, personnel planning, negotiations, contracts and computer-based techniques. Other topics include cost estimation, capital budgeting, cost controls and effective matrix management. Actual case studies are used as are relevant and modern project management software applications.

MG 8703 Introduction to Modern Information Technology Strategy *3:0:0:3*

This course deals with applied competitive strategy. Students completing this course master a basic understanding of the competitive implications of information technology and the strategies for using information technology in business. This competence in analysis is arrived at through understanding how availability of information (through technology or otherwise) affects the basic strategic options available, and how firms and industries are likely to be affected. In addition, students are introduced to the process of evaluating potential systems innovations. They then are able to participate in strategic and systems planning from a managerial point of view.

MG 9603 eIM Capstone Project Course *3:0:0:3*

This course provides an integrative and state-of-the-art intellectual experience for participants at the conclusion of the program. The course is divided into two half semester. The first half semester enables participants to focus on discerning the overarching trends which are driving innovation in various industry sectors. The class is divided into small groups each of which develops a comprehensive view of a particular industry sector. In the second half of the course, participants focus on the culminating project of the eIM program. Participants can choose to do their final projects on firms, issues related to technology management or as an outgrowth of the emphasis on entrepreneurship in the program, a business plan. Participants are encouraged to employ relevant concepts and insights that they have acquired during the course of the program.

MG 9601 eIM Capstone-1 *1.5:0:0:1.5*

First half of the eIM Capstone course. Please see MG 9603 eIM Capstone Project Course for full description. Both MG 9601 and MG 9611 courses may be taken in same semester.

MG 9611 eIM Capstone-2 *1.5:0:0:1.5*

Second half of the eIM Capstone course. Please see MG 9603 eIM Capstone Project Course for full description. Both MG 9601 and MG 9611 courses may be taken in same semester.

FULL-SEMESTER ELECTIVES

MG 7743 Advanced Trends in Technology Management and Innovation *3:0:0:3*

This course explores several trends that have emerged in the technology management and innovation arena in the past decade. These include the advent of digital-based innovation in the late 1990s which has had a profound effect on how many firms conduct business; the effect of the crash of the NASDAQ in March 2000 and the September 11 event which had a major effect on corporations which now had to operate within major economic and creative constraints; the development of the concept of networks as it relates to the organization and strategy of the firm; the development of the wireless technology platform and its effect on technology innovation; and the development of a new innovation paradigm which suggests a relationship between information technology, creativity and business practices. The course emphasizes classroom discussions as well as team based and individual projects.

MG 7883 Information Security and Privacy: Systems *3:0:0:3*

This course centers on management issues in information security and privacy in systems planning and development. Students learn to take a risk-based approach to integrating security into the planning and development of information systems at organization and enterprise levels. Topics covered: Risk analysis and management; integrating security into system design processes; security policies; legal, ethical, and privacy issues; and security in the software design process.

MG 8213 Information Security and Privacy for Managers *3:0:0:3*

This course addresses the principles of information security and privacy from a risk management perspective. Students learn why security is important to the enterprise and the potential impacts of security and privacy failures. Attacks will be discussed in terms of the goals of the attackers, their capabilities and the concept and high-level technical aspects of the attack's operation. Each of the leading security controls is discussed in terms of the kinds of attacks it is meant to thwart, the concept of the defensive operations of both technologies and related processes, and management issues concerning the control.

MG 8333 Information Security and Privacy: Operations *3:0:0:3*

This course focuses on management issues related to information security and privacy in operations. Students design security programs and processes that foster strong lifecycle security. Topics addressed include security organization structure, security program models, economics of security, security management of operations, incident response, contingency planning, compliance, security considerations of outsourcing and global operations, and security audits.

MG8573 Managing Cleantech and Renewable Energy Innovation *3:0:0:3*

This course focuses on Cleantech/renewable energy innovation and technology management and entrepreneurship. It covers technology management in several distinct Cleantech/renewable technology regimes in varied company venues (e.g. small, medium size and large firms). It encompasses local and global modes of Cleantech/renewable energy innovation and diverse innovation perspectives. Throughout, maintains a primarily managerial perspective. Students are often asked to assume the role of managers charged with the responsibility of designing, supporting and implementing a Cleantech/renewable energy innovation strategy.

MG 8753 Information Technology: Systems *3:0:0:3*

This course prepares the student to be an educated consumer of information technology systems, thereby maximizing the strategic advantage of IT to an organization. Information technologies, architectures and products are categorized and analyzed with a view to develop and maintain the most favor-

able IT asset portfolio to carry out successfully business goals and strategies. Students learn techniques for making group decisions in assessing technology, outsourcing decisions, bidding on projects and negotiating contracts. Students also learn to manage a reliable, high-quality portfolio of information-technology systems, based on new insights into the relationship between the technology and business needs.

MG 8763 Information Technology: Operations *3:0:0:3*

This course covers IT operations and services. Students learn to deliver reliable, high-quality IT services through an automated, optimized IT infrastructure and operation, based on new insights into the relationship between those services and business needs. Topics covered: IT governance, data center automation, infrastructure optimization, service management, application performance management, and security management.

MG 8783 Managing Cloud Computing *3:0:0:3*

This course provides a comprehensive overview of managing cloud computing. The course starts by developing a comprehensive technology foundation and then deals with the economics of cloud computing by analyzing its benefits, risks and obstacles. The course then examines Virtualization, Automation, and Security, the three essential components of cloud computing. Specific case studies on private and public clouds are illustrated. The course concludes with the development of specific templates and roadmaps that help an organization migrate from managing traditional IT into a cloud based infrastructure.

MG 9683 Technology Management-Internship and Action Learning *3:0:0:3*

This course provides graduate students with the opportunity to work in the field in an action-learning context under faculty supervision. This course exposes graduate students to relevant, state-of-the-art and best practices in modern technology management from the perspective of reflective involvement and interaction in the field.

HALF-SEMESTER ELECTIVES

MG 7841 Negotiation in Technology-Intensive Sectors *1.5:0:0:1.5*

Negotiation is the art and science of creating good agreements. This course covers the science of negotiation by discussing and applying theories of negotiation. Students develop the art of negotiation by negotiating with each other in realistic cases. A wide variety of negotiation applications is covered, including single and multi-issue negotiations and two-party and multi-party bargaining. Special emphasis is placed on negotiations in technology-intensive environments. The course uses the case method. Many examples are cases that students actually negotiate with each other. Students' grades are based on their performance in these negotiations and on class participation.

MG 7851 Leadership *1.5:0:0:1.5*

Leaders set a vision, communicate it well and influence and inspire others to achieve their vision. However, there are many ways to achieve these goals and many challenges and ineffective ways in implementing them. This course develops the student's leadership style by analyzing individual styles, understanding their impact and enabling each student to create the right leadership style. This course addresses fundamental leadership issues and frameworks, drawing on current organizational research. Most of all it provides students with ways to gain insights on their own leadership style. The course emphasizes hands-on experience and focuses on experiential learning. Course objectives include assessment of eadership styles; developing leadership skills; and understanding the role of leadership coaching in managing teams.

MG 7861 High-Technology Entrepreneurship *1.5:0:0:1.5*

This course focuses on entrepreneurship as a critical engine for wealth creation in the high-technology and innovation-intensive economy. This covers such key issues as: (1) assessing attractiveness of opportunities; (2) launching a new venture: (3) obtaining the necessary financial, human and technology resources; (4) managing the transition from a small entrepreneurial firm to a large, sustainable professionally managed but still entrepreneurial corporation; and (5) being an entrepreneur and promoting entrepreneurship in a large corporation.

MG 7871 Intellectual Property for Technology and Information Managers *1.5:0:0:1.5*

This course focuses on the role of intellectual property (e.g., patents, trade secrets, copyrights and trademarks) as a major element in modern technology and information strategy. Relevant concepts and case studies are used, with examples representing classical and digital innovations.

MG 7881 Modern Supply Chain Management: Integration Through Technology *1.5:0:0:1.5*

This course introduces the role of information technology in supply-chain management. It builds on some of the concepts covered by MG 7833 New Frontiers in Electronic Business. Both qualitative and quantitative aspects of supply chain management are covered. Students discuss and analyze articles about leading-edge research and management thought. The underlying objective is to prepare participants to develop skills that are useful in analyzing technology, marketing, logistics, operations and broader channel-management issues. Classes use the case method. A high level of class interaction is expected.

MG 7891 Special Elective Topics for eMOT and eIM *1.5:0:0:1.5*

This course covers selected key emerging trends and issues in the MOT and IM domains. The course provides topical treatment of technologies, markets, business practices, government regulations and the relationships among them.

MG 7971 Financing for Value Creation *1.5:0:0:1.5*

Financial skills required by managers of entrepreneurial and innovative firms at various stages of evolution: from new, stand-alone entrepreneurial ventures to innovative, technology-driven projects of established corporations.

MG 9651 The Modern CIO: Challenges and Opportunities *1.5:0:0:1.5*

The Chief Information Officer (CIO) role has evolved from keeper of the infrastructure under the CFO, to an executive managing the organization's information and sitting at the executive table. The CIO is the key strategic agent for the organizational use of technology and is the key agent in the creative-destructive process mediated by technology. Today technology is the single greatest factor in strategic change in a firm. The CIO is the executive best positioned to manage the creative-destructive power of technology and effect firm sustainability in the face of massive changes in markets. This course helps aspiring CIOs investigate this new and evolving role, using presentations, research and interviews of industry and public sector CIOs and CTOs as well as studying the market demands for CIOs and CTOs.

MG 9691 The Modern Chief Information Security Officer: Challenges and Opportunities *1.5:0:0:1.5*

The role of Chief Cyber Security Officer or Chief Information Security Officer has evolved from securing computer systems under the CIO to an executive managing the organization's information security and sitting at the executive table. The officer is a key strategic agent for the organizational use of cyberspace. The CISO has become the key player in the increasingly dangerous and insecure area of cyberspace, where firms must operate for maximum competitive advantage. The CISO is the executive best positioned to manage the security of the firm's assets/infrastructure and operations in cyberspace. This course helps aspiring CISOs investigate this new and evolving role, using lectures, research, and interviews of industry and public sector CISOs, as well as by studying the market demand for CISO positions.

INFORMATION SYSTEMS ENGINEERING PROGRAM

Program Director: Robert Flynn

The Master of Science in Information Systems Engineering (ISE) Program is for professionals who want to be leaders in designing, developing and running today's information systems, and systems based on information using the latest software tools, middleware and technologies.

The program provides rigorous training in computer science, management and emphasizes the field of information-systems engineering.

Much of the infrastructure is in place for today's enterprise-information systems. Incompatible software and protocols, however, often separate applications on networked systems. In a Web-based world, information-systems designers need core skills to understand machine organization, operating systems and networking. Designers need enabling training in software engineering, databases and groupware. They need to understand the role of middleware and the role of management.

Systems engineers need to understand not just how to design software systems but how to lead the efforts of people carrying out the design. Engineers must create viable solutions and understand the associated business and human issues.

Students selected for the program are professionals in computing or telecommunications with two or more years of working experience.

This Master of Science program in 1987 began as a joint effort between the Department of Computer and Information Science and New York State's Center for Advanced Technology in Telecommunications (CATT). The rigorous program consists of 10 courses including an optional independent project. The curriculum is being redesigned to allow for fewer courses (10 vs. 13)—each of which will be longer (3 credits vs. 3 units)—and to explore the technical issues surrounding service-oriented system architecture (SOA). These changes will be phased in as designed.

The program is given in two formats. Two classes meet on alternate Saturdays for the whole day. A third class can be taken during the week in conventional mode. Alternatively, classes meet every other weekend for a full Saturday and one class on the other Saturday. All-day Saturday courses typically meet at Polytechnic's Westchester Graduate Center in Hawthorne, New York.

Alternate formats are under consideration.

GOALS AND OBJECTIVES

The ISE Program produces information-systems designers and integrators who can lead the development of heterogeneous systems and who are aware of new software tools and interfaces. The program provides people with management and technology skills to help them become leaders in the integration of software components into complex systems.

ADMISSION REQUIREMENTS AND APPLICATION INFORMATION

Admission to the program requires a baccalaureate degree with a superior undergraduate academic record and a demonstrated familiarity with and exposure to the issues associated with the development of complex information systems. Applicants must have two years of relevant work experience in computing or telecommunications.

Applications are accepted throughout the year, but admission is for the fall semester only. Admission is contingent on an interview with the director or designee. Because enrollment is limited, early application is strongly recommended.

DEGREE REQUIREMENTS AND CURRICULUM

The general requirements for a Master of Science, stated elsewhere in this catalog, apply to this program. The curriculum consists of 10 courses, including an optional independent project of 3 credits. The project must be completed by the end of second year and can begin as soon as the first semester.

Courses may change or new courses may be substituted to respond to changes in technology. The courses currently constituting the curriculum appear below:

Four software courses, typically from among:

CS 6062 Software Engineering
CS 6083 Database Systems
CS 9023 Web Technologies and Integrated Environments
CS 9033 Web Services and SOA
CS 9223 Cloud Computing Technology

One systems course typically from among:

CS 6133 Computer Architecture
CS 6233 Operating Systems

One networking course, typically from among:

CS 6843 Network Protocols
CS 5823 Network Management and Security

Management electives, not more than three, typically from the following:

MG 8203 Project Management
MG 6303 Operations Management
MG 6013 Organizational Behavior
MG 6083 Economics

A project course, CS 9963, is typically taken for the degree. The content and scope of the project is typically discussed with and approved by the Program Director. Electives are chosen in consultation with the Director.

COURSES OFFERED AS PART OF THE INFORMATION SYSTEMS ENGINEERING PROGRAM

CS 9023 Web Technologies and Integrated Environments *3:0:0:3*

Application Architecture in a three tier (web client, application server and data base server) environment is explained and analyzed. The impact of relevant open source tools (MySQL, CSS, AJAX etc. on the final application architecture is examined. Different integrated environments are contrasted. The content of this course is expected to change each semester as technology emerges. *Prerequisite: Graduate status.*

CS 9033 Web Services and SOA *3:0:0:3*

The service oriented architecture (SOA) is the latest application integration paradigm in the industry, developed to address the challenges of software development which anticipates the internal friction of interacting with incompatible architectures and programming models. SOA is a model of distributed software components which encapsulates business function in a reusable, composable way. SOA components, or services, are accessible using standardized protocols and are composed (or choreographed) into new applications using standard composition languages. The term "Web services" stands for a realization of the SOA paradigm as a set of XML based standards for component communication, description and composition. Middleware is soft ware that allows different applications to interact on typically distributed computer systems. *Prerequisite: Graduate status.*

CS 9223 Cloud Computing Technology
3:0:0:3

Cloud Computing with emphasis on hands-on design and implementation. The first part of the course covers basic building blocks such as virtualization technologies, virtual appliance, automated provisioning, and monitoring. The second part of the course delves into more advanced topics: cloud migration, cloud programming paradigms, security and storage cloud, and IT optimization leveraging Cloud Computing. *Prerequisite: Graduate status.*

INTEGRATED DIGITAL MEDIA PROGRAM

Academic Adviser: Andres Pang-Becker

MISSION

How does NYU-Poly define "integrated" digital media? As a synthesis of cutting-edge technology, creative mastery and critical thinking. NYU-Poly has long been at the forefront of developments in education and research and in computing, telecommunications, imaging sciences and the Internet. We maintain close ties to New York's media-related industries and leaders. Faculty members bring to their academic and research programs a practical, real-world perspective.

NYU-Poly offers Bachelor of Science, Graduate Certificate and Master of Science programs in Integrated Digital Media. These programs use NYU-Poly's extensive resources to unite the traditionally separate dimensions of creation, critical analysis and technology development. NYU-Poly's location offers access to a rich mix of digital-media leaders—artists, academics, designers, developers, producers and engineers.

NYU-Poly programs allow students to develop mastery not only of technique, but also of concepts and context. To achieve this synthesis without compromising quality or depth, NYU-Poly offers (and requires) an exceptional level of commitment leading to an exceptionally desirable credential in industry and culture. These programs provide a full understanding of and experience in all aspects of media invention, production and distribution. NYU-Poly prepares graduates not just for their first entry-level position or proof-of-concept, but for a future in which they can rise within existing institutions, genres and companies, or confidently build new ones.

BROOKLYN EXPERIMENTAL MEDIA CENTER (BXmC)

The Brooklyn Experimental Media Center provides a point of contact between top-level investigators in technological, creative and strategic areas across the academic, civil and private sectors. A program of exhibitions, performances and demonstrations showcase the best in the field at one of digital media's epicenters: New York City. The center also hosts visiting scholars and artists and collaborates with partner institutions to develop interdisciplinary projects and exchange programs. BXmC provides a vehicle for strong working relationships within NYU-Poly (music, humanities, computer science, electrical engineering), NYU (Courant Institute's Media Research Lab, the Steinhardt Music Technology program, the Tisch School's Game Center and Interactive Telecommunication program) and a global network of VFPs (Very Fun People).

CITE GAME INNOVATION LAB

The Game Innovation Lab is an interdisciplinary, open-floor-plan research and learning space at NYU-Poly that takes games as an innovation challenge. Sample projects in the Lab include user interface innovation (sensor-based tracking, multi-touch), network and video quality research, and research on games for learning.

FACILITIES

NYU-Poly's integrated digital media lab, one of several accessible to students at the Brooklyn campus, provides access to state-of-the-art audio, video, web and multimedia tools for studio and field production. Individual students and small teams are organized to produce professional work under the direct supervision of senior faculty. Where pertinent, leaders in allied professions work hands-on with students and faculty. The 344-seat Pfizer auditorium is available for special projects and public events organized by faculty, students or guests. The control room and excellent acoustics offer a broad range of technical setups. The Polytechnic Hall of Fame, a nine-screen multimedia venue with 5.1 sound system, can be used as a development environment or public space for special projects. The sound studio is a continuing development project, enabling everything from podcasting, mixing and mastering to ambisonic sound-installation projects.

The labs offer digital video and audio production and postproduction, 2D and 3D interactive design and programming, web, single and multiplayer game development and experimental interfaces. NYU-Poly partners with other institutions and firms to provide access to professional television and radio production environments, multimedia facilities and specialized communications facilities—as required for specific projects. In keeping with the industry's creative side, NYU-Poly digital media labs are Mac-based. Facility development is continuous. Linux and Windows facilities are available. NYU-Poly also uses and supports open-source tools and practices where they are most effective.

FACULTY

NYU-Poly faculty and technical staff, with their diverse backgrounds, offer a complete range of expertise in digital media from television production to database programming, from the principles of audio filters to the art of interface design. All technical work is grounded in first-class science and engineering and backed by NYU-Poly's strong history as a center of technological research, development and innovation. The Department of Technology, Culture and Society offers further resources including a research center for the history and philosophy of science and technology, as well as experts in behavioral psychology, environmental studies and music theory. The permanent faculty is supplemented by visiting instructors and a program of guest speakers. Students can find opportunities to work with scholars and creators in residence on projects selected for their relevance to a student's program of study.

STUDENTS

The program unites students with the right mix of educational and professional backgrounds and helps them capitalize on their own and each other's expertise and initiative. This approach reflects the working reality of the best in digital media: small interdisciplinary teams of people with complementary skills working together on exciting projects with tight deadlines. No one person can expect to combine all the necessary skills (or do all the work), so the program looks for people who already have demonstrated proficiency in one or more areas and who are team players.

ELIGIBILITY

Candidates for the Bachelor of Science program are subject to NYU-Poly's general-admissions procedures and standards. Special consideration is given to applicants who present a portfolio of work demonstrating relevant ability and commitment. Students wishing to pursue a Graduate Certificate in Integrated Digital Media should contact the academic adviser.

All candidates for the Master of Science program will be selected for their demonstrated ability and motivation. From the best applicants, the program selects a group with a mix of experience and skills to maximize opportunities for the kind of teamwork and learning characteristic of media professions. A bachelor's degree or equivalent is required. NYU-Poly does not require GRE scores but will admit applicants based on an interview and review of previous work.

CONTACT
Andres Pang-Becker, Academic Adviser and Coordinator
Integrated Digital Media Program
Polytechnic Institute of NYU
Six MetroTech Center
Brooklyn NY 11201
apang@poly.edu
(718) 260-3693

Further Information:
www.poly.edu/academics/programs/integrated-digital-media-bs

PROGRAMS

BACHELOR OF SCIENCE PROGRAM

Candidates for a Bachelor of Science in Integrated Digital Media are required to complete DM Core Courses (minimum 45 credits), free electives (12 credits), Math and Science Courses (17 credits) and NYU-Poly's general-education requirements in the Humanities and Sciences (60 credits, including restricted electives) for a total of 120 credits over four years. The electives may be taken as supplementary studio courses or toward a minor in any subject at NYU-Poly, subject to course prerequisites and the approval of the host department.

NYU-Poly encourages students to maximize the use of its full range of disciplines and to develop the best combination of knowledge and skills for their career. This approach helps students to choose careers with experience-based awareness of their abilities and interests. Students should carefully choose foundation courses and electives so that they have the right prerequisites for specific upper-level courses, especially in science and technology. For detailed current information about available options and requirements, students should contact a program adviser who will consult with faculty in the host departments.

All DM courses are offered as Studio Seminars. Students will be expected to produce finished projects of professional quality under the guidance of active digital-media practitioners who are informed by a powerful understanding of the creative and critical context of their work. While NYU-Poly provides top-quality equipment and facilities, students will be expected to obtain and maintain their own laptop computer (consult the department for current specifications) as well as basic peripherals and consumables. In general, digital-media production calls for teamwork and a willingness to produce innovative, high-quality work. At NYU-Poly, "excellent" equals "acceptable."

The Bachelor of Science program in Integrated Digital Media provides a foundation for professionals and for those preparing for postgraduate study in particular by flowing into the Master of Science program. With planning and hard work, students can complete a BS (120 credits) and MS (30 credits) in five years.

BACHELOR OF SCIENCE DEGREE REQUIREMENTS

1. Engineering and Technology Forum (1 credit)
2. Digital Media Core (45 credits minimum)
- DM 1113 Music Studio 1 (3 credits)
- DM 1123 Digital Graphics Foundation Studio (3 credits)
- Other Digital Media Studio courses, as approved by adviser (39 credits)
- DM 4003 Senior Project or
- DM 4903 Undergraduate Thesis in Digital Media (3-6 credits)

3. Humanities and Social Sciences required courses (15 credits)
- EN 1013W College Writing Workshop (3 credits)
- HuSS 1023W First Year Writing Seminar (3 credits)
- MD 2163 Media Studies 1 (3 credits)
- MD 3163 Media Studies 2 (3 credits)
- MD 4163 Media Studies 3 (3 credits)

4. Electives (42 credits)
- 2000/3000-level Humanities and Social Sciences elective x 4 (12 credits)
- 3000/4000-level Humanities and Social Sciences elective x 2 (6 credits)
- Restricted Electives (12 credits)
- Free Electives (12 credits)

5. Math and Science (17 credits)
- MA 1324 Integrated Calculus I
- MA 1424 Integrated Calculus II
- CS 1213 Introduction to Object-Oriented Programming
- PH 1213 Physics I: Motion and Sound
- PH 1223 Physics II: Electricity and Light

TOTAL: 120 credits

MASTER OF SCIENCE

The Master of Science Program in Integrated Digital Media provides students the tools, skills and insight to craft a better future. The Master of Science degree balances specialized knowledge and experience with a high standard of cultural capital. Whether undertaken as the beginning of a career in academic research, industry or service, a MS must provide mastery of a particular discipline with a broad understanding of the long-term patterns and tendencies of society and culture. As the reach and impact of new technologies increases, so must the wisdom of those who decide on their use.

The MS in Integrated Digital Media is the best preparation for a rewarding future in the rapidly expanding field of digital-media communications across a wide spectrum of interests. These interests include creative experience, an understanding of the broad forces shaping communications technologies and society and the people's ability to use what they know and imagine. Individual students and small teams directed by senior faculty are organized to produce professional work. Where relevant, leaders in allied professions work hands-on with students and faculty, including faculty from other departments at NYU-Poly or elsewhere in New York City.

The Master of Science in Integrated Digital Media is full-time and intensive: three consecutive semesters including a major creative/research thesis project. This program requires complete commitment for a manageable time span from "literate practitioners" prepared to make the most of their personal resources. While the formal course requirement of 30 credit hours, including a 6-credit thesis project may seem manageable, students should know that a considerable out-of-class work commitment is expected.

The curriculum combines hands-on production work with a study of historical, legal and philosophical aspects of digital-media communications. Guest scholars and conferences supplement the regular program and maximize personal contact with leaders in various fields: business, advocacy, service, entertainment and education. The production side emphasizes developing skills that apply to a broad spectrum of media and mandates: small groups working on specific projects focusing on content-driven design and planning and creation. NYU-Poly's facilities and s trategies use top-of-the line portable equipment rather than capital-intensive studio setups. This approach makes it practical for labs to offer up-to-the-minute technology and for students to prepare for freelance work and their own start-ups, as well as for work in the corporate and public sectors.

MASTER OF SCIENCE DEGREE REQUIREMENTS

The degree requires 30 credit hours of course work spread over three semesters. Students typically take a four-course load (at 3 credits per course) in the fall and spring of their first year. In the second year, students enroll in a 6-credit thesis seminar.

Distribution requirements for the degree mandate that all DM students enroll in their first year in a first-semester Media Studies Seminar (DM 6043) as well as Media Organizations (DM 6033) in the fall and Media Law (DM 7033) in the spring. The first-year seminar provides a dual role

as a graduate-level course in media studies (complete with a writing-intensive research project) and a forum for students to present creative and technical work for peer review and group critique.

For the remainder of the coursework, the curriculum is:

Fall: Studio courses are offered in Performance, Sound, Cinema, 3D, Interaction Design, Game Design, Web and Networked Media. Students enroll in two of these courses their first semester, based on interest and the thesis project they are considering. Students will enroll in those courses they think will best raise their expertise level in a specialty for which they are well prepared. In addition, they collaborate with colleagues who have complementary skills and interests. While these studio courses are broad in scope (they cover a conceptual theme prevalent in digital media rather than a specific sub-topic), they each require focused production work on a final project.

Spring: Students may choose among three elective courses ("Specials"), which may include an Independent Study course (DM 9103) or a 3-credit Internship. "Special" electives, taught by regular and adjunct faculty, are selected each year from a group of possible courses based on the interests of the first-year class. For example, if the entering DM class is specifically interested in Machine Vision (based on its project work in the first-semester seminar), the faculty will "commission" an elective on that topic. Independent Study enrollment is permitted for DM students interested in specific research areas outside of the electives offered. Internships are available for students seeking to gain job experience outside of NYU-Poly in the commercial or nonprofit sector. A final grade for the three credits of an Internship is determined by the faculty supervisor based on consultation with the host-firm internship supervisor, and students submit a 2,000-word report by the last day of the semester (last day of regular exams).

The third semester in the DM program centers on a 6-credit Thesis Seminar in which students develop MS thesis projects and write in a group environment supervised by a faculty member. At the end of the seminar, students prepare and defend their thesis projects before a faculty committee. After a successful thesis defense, students deposit their thesis papers with NYU-Poly and receive their degrees.

GRADUATE CERTIFICATE

Students may take a five-course sequence for a Graduate Certificate in Integrated Digital Media. The program is available as a minor for students in other graduate programs or for students applying directly for the certificate. Students who complete this certificate may then apply to complete a Master of Science in Integrated Digital Media.

GRADUATE CERTIFICATE REQUIREMENTS

Two theory seminars and three studio seminars are required for a total of 15 credits at the graduate level.

COURSES

UNDERGRADUATE COURSES

DM 1113 Audio Foundation Studio
3 credits

This course, an orientation to the essential concepts and practices of acoustic media, is a creative and theoretical foundation studio. It combines an orientation to sound and listening with the fundamentals of digital-audio production: project planning, recording and mixing. The course emphasizes high-quality field recording and mobile (laptop) postproduction. *Co-requisite: EN 1013W.*

DM 1123 Visual Foundation Studio
3 credits

This studio introduces the fundamentals of visual communication design: color, composition, motion and interaction. The primary creation tool will be Processing, a Java-based graphics development tool for nonprogrammers. Once students learn general compositional principles with Processing, they are introduced to video for capturing color, form and motion. *Prerequisites: EN 1013W and CS 1213. Co-requisite: HuSS 1023W.*

DM 2113 Sound Studio 1 *3 credits*

This course follows the general principles treated in DM 1113 with a series of more advanced projects, organized to reflect the practical realities of professional work: elements of preproduction, production and postproduction for different genres. Students are expected to demonstrate not only an understanding of the principles and tools, but also a true commitment to quality. Projects may be narrative/dramatic or music according to each student's skills and goals. *Prerequisites: HuSS 1023W and DM 1113.*

DM 2123 Cinema Studio 1 *3 credits*

In this course, students complete a coordinated sequence of short projects that add up to a finished, live-motion video project. The course strongly emphasizes the relevance of particular tools and techniques to the specific project. Concepts are introduced through the screening of historical examples from 1895 to the present. The course format is modeled on professional standards and workflow for preproduction, production and postproduction. *Prerequisites: EN 1013W and HuSS 1023W.*

DM 2133 3D Graphics Studio 1 *3 credits*

In this studio introduction to creative work with 3D graphics, students learn and apply fundamental principles and technical requirements for 3D model construction and surfacing for a broad range of applications from animation and game development to rapid prototyping and simulation. Individual imaginative experiments are highly encouraged. *Prerequisites: EN 1013W and HuSS 1023W.*

DM 2143 Interaction Design Studio 1
3 credits

To design interfaces requires an understanding of how humans interpret visual, tactile and auditory phenomena and how these perceptions inform their actions in the physical world. This course familiarizes students with the relevant principles of cognition and address basic interaction design issues through two solo projects and one group project. *Prerequisite: DM 1123.*

DM 2153 Game Development Studio 1
3 credits

This class introduces the principles of 2D and 3D computer-game design. Students learn the range of game types and understand their conceptual building blocks. Students complete a structured sequence of assignments toward the completion of a new-game design. Students prepare through a staged sequence of assignments a fully worked-out design for an original game. Criteria include storyline quality, graphics quality and appropriateness of design to the game concept originality. For games with an educational or instructional purpose, clarity and effectiveness for the target audience is considered. *Prerequisite: DM 1123.*

DM 2183 Digital Photography Studio 1 *3 credits*

This studio is a general introduction to digital photography in its two most fundamental aspects: as a technology and as an art form. Students explore fundamentals of color, composition and narrative through structured assignments, leading to the presentation of a final portfolio. Technique is developed to professional standards, making the most of simple equipment and studio setup. *Prerequisites: EN 1013W and HuSS 1023W.*

DM 2193 Web Studio 1 *3 credits*

Assignments in this web-design project studio are arranged in sequence to enable the production of a website of professional quality in design and production. The studio is for those seriously interested in web design and stresses interactivity, usability and the quality and appropriateness of look and feel. Students are expected to develop content and complete a professional-quality site. *Prerequisites: EN 1013W and HuSS 1023W.*

DM 3113 Sound Studio 2 *3 credits*

"Contemporary" in this course has two meanings. One is postclassical: minimalism, serialism and musique concrète. The other is postpopular: dub, trance and experimental. Music made largely with sampling, multitracking and found sound rather than traditional instruments is emphasized. The studio component includes developing postproduction technique as a genre in its own right. The format is two two-hour sessions a week, each split into one hour of lecture/seminar and one hour of studio/practice. Students must devote considerable out-of-class time to the written and studio components. *Prerequisite: DM 2113.*

DM 3123 Cinema Studio 2 *3 credits*

Students in DM 3123 use skills developed in the prerequisite DM 2123 to explore and make the most of digital-video technology. Course themes and material center on documentary and pseudo-documentary forms. Class time is divided among hands-on technical demonstrations, group work and case studies of relevant historical work in film and video. This approach informs the high-quality and cutting-edge results expected from DM students. The emphasis on experiments and group work reflects the realities of professional production. *Prerequisite: DM 2123.*

DM 3133 3D Graphics Studio 2 *3 credits*

The project is a sequence of three phases to balance the need for structure with the reality of high-quality animation work: it takes time. Students must devote considerable out-of-class time to achieve good results. Through case studies and group discussion, students are encouraged to develop creative and critical skills as well as proficiency. The course is a combination of "art" and "technique." *Prerequisite: DM 2133.*

DM 3143 Interaction Design Studio 2 *3 credits*

On-screen computer interfaces are well established. Anyone who has used a computer in the past twenty years knows how to navigate WIMP (Windows, Icons, Menus, Pointer). This course looks at the foundations of WIMP. Building upon this well-developed model, the course focuses on usability, user- testing and user-centered design. The course explores interfaces that move beyond established metaphors to provide new ways of interacting with the computer screen and starts with small assignments to illustrate concepts. The last half of the semester is spent developing a group project. *Prerequisite: DM 2143.*

DM 3153 Game Development Studio 2 *3 credits*

This class continues from DM 2153, moving into advanced technological implementations of 2D games. Taking designs from DM 2153 and working in teams, students create a complete game. Students, based on abilities and individual goals, are assigned individually to work in production areas ranging from sprite creation, mapping and level design to engine coding and interaction scripting. Students are responsible for completing their assignments as if they were members of a professional game-development team. *Prerequisite: DM 2153.*

DM 3173 Visualization and Simulation Studio *3 credits*

This course is a design and production studio geared to completing a professional-quality project. Students must have the necessary design/scripting/programming skills to be prepared to make the most of them. Students are strongly encouraged to produce a project relevant to research and teaching initiatives underway in other Polytechnic programs, subject to faculty permission and counsel in the host departments. *Prerequisite: DM 1123.*

DM 3183 Digital Photography Studio 2 *3 credits*

This is the second of a general two-course studio sequence in the technical and creative dimensions of digital photography. Together, the courses offer a good introduction to digital-photographic practice for non-DM majors, or an opportunity for DM majors to gain more experience in image capture and composition to apply in their graphics and video work. *Prerequisite: DM 2183.*

DM 3193 Web Studio 2 *3 credits*

The assignments in this web-design project studio are arranged sequentially to enable the production of a website of professional-quality design and production. The studio, for those seriously interested in web design, stresses interactivity, usability and the quality and appropriateness of look and feel. Students also are expected to develop content and complete a professional-quality website. *Prerequisite: DM 2193.*

DM 3213 Computer Music Studio *3 credits*

This composition-studio course aims to have each student generate music using algorithmic procedures. The studio will explore algorithmic thinking in music dating from the distant past to the present in pre-compositional and performance situations. Participants listen to a broad repertoire and learn to use a wide variety of algorithmic techniques. *Prerequisites: HuSS 1023W and DM 1113.*

DM 4003 Senior Project in Digital Media *3 credits*

This research/production project is completed in the final term under faculty guidance. Before the project begins, the student, instructor and program director agree on topic, approach and schedule. This studio/seminar is the capstone for DM students. Students conduct a thesis-quality design and production supervised by a faculty member active in the relevant field. Where appropriate and by special agreement, students may receive supplementary guidance from faculty in another department. *Prerequisite: Permission of adviser.*

DM 4023 Digital Media Internship *3 credits*

Students may undertake an internship for academic credit with an appropriate host company with permission and supervision from academic advisers. The scope and topic are determined in advance among the student, host firm and faculty supervisor. A final grade is determined by the faculty supervisor based on consultation with the host-firm internship supervisor, and students submit a 2,000-word report by the last day of the semester (last day of regular exams). *Prerequisite: Permission of adviser.*

DM 4113 Sound Studio 3 *3 credits*

This course provides students the flexibility to undertake a sustained creative project. The genres developed and discussed are contemporary and intended to inform a professional-level studio practice for students committed to advancing the field, critically and creatively. Seminars led by an active practitioner culminate in the production of a public presentation. *Prerequisite: DM 3113.*

DM 4123 Cinema Studio 3 *3 credits*

Students use most of their introductory and intermediate-studio experience to produce professional-quality short video pieces. Since project-management skills are a key part of proficiency at this level, projects must be largely self-directed. Appropriate group work is encouraged, though each student must take personal responsibility for specific project aspects. The class emphasizes formal structure and postproduction (editing and compositing). *Prerequisite: DM 3123.*

DM 4133 3D Graphics Studio 3 *3 credits*

Students produce a complete, professional-quality animation sequence showcasing skills developed in prerequisite courses. Projects may be geared to scientific, engineering or entertainment applications according to individual skills and professional aspirations. *Prerequisite: DM 3133.*

DM 4143 Interaction Design Studio 3 *3 credits*

People think of human-computer interaction as sitting in front of a monitor and using a mouse and keyboard to manipulate on-screen visual elements. In this unnatural, asymmetric interaction, humans communicate using physical input while the computer communicates visually. This model greatly restricts the possibilities. In this studio, students develop a project based on other modes of human-computer interaction, individually or within a small group, and regularly present work for class discussion and criticism. *Prerequisite: DM 3143.*

DM 4153 Game Development Studio 3 *3 credits*

This class continues from DM 3153 and focuses on advanced technological implementations of 3D games, specifically the Unity 3D Game Engine, but with concepts applicable to general game production. Working in teams, students implement a complete game during the semester. Students, based on abilities and individual goals, are assigned individually to work in production areas, ranging from sprite creation, mapping and level design to engine coding and interaction scripting. Students are responsible for completing their assignments as if they were members of a professional game-development team. *Prerequisite: DM 3153.*

DM 4193 Web Studio 3 *3 credits*

This web-design project studio is for advanced designers and developers. It provides a rich mix of critical concepts and creative challenge for students planning a career in the field. Participants must be ready to do portfolio-quality work that will open doors, whether at the cutting edge, beyond the marketplace or at the top of the heap. Students are expected to handle technical issues independently and to maximize each other's time in class. *Prerequisite: DM 3193.*

DM 4903-6 Undergraduate Thesis, Digital Media *3 credits*

The undergraduate thesis allows students to apply knowledge gained in their major field and use it to plan, conduct and report original research. The thesis may be a discourse on a subject in students' courses of study, an original investigation or research account, a report on a project, or an explanatory statement of an original design. All undergraduate students who plan to do a thesis should meet with the program director about topic choices at least one year before graduation. Department heads approve requests and appoint a thesis adviser. Students must register for the thesis course every fall and spring semester until it is completed and accepted. *Prerequisite: Permission of adviser.*

DM 4911-3 Special topics in Digital Media *3 credits*

This course, completed under the DM faculty guidance, may be repeated for credit on a different topic. By special permission of the program director, this course may be offered from time to time in subjects relevant to, but not regularly offered by, the Digital Media program. To suggest a subject, students must file a course syllabus or proposal with the program office. *Prerequisite: Permission of adviser.*

GRADUATE COURSES

DM 6033 Media Organizations *3 credits*

This course is a general orientation to a broad range of media-producing organization types from pirate radio stations and ad-hoc collectives to major corporations. Each organization has specific advantages and disadvantages, and each has a specific range of work types it can support effectively. The ultimate purpose of the course is to provide a "big-picture" orientation to the different environments in which media get made and distributed and to help students clarify goals and needs so they can make wiser choices about directing their studies and work toward the right career.

DM 6043 Media Studies Seminar *3 credits*

This course provides students a critical background in media studies. This semester focuses on a particular moment in the intersection of critical philosophy, avant-garde art and political action, the Situationist International, and work that derives from, reacts against or "détourns" it. Students work through a selection of texts and media work in chronological order from the critique of urbanism to the theory of the society of the spectacle, from the practice of the dérive to détournement, and then the take-up and reaction against these theories and practices. Nearly all readings are available online. The instructor may direct students toward a website and encourage them to poke around and get to know the body of work of an artist or group.

DM 6103 Performance Studio Seminar *3 credits*

This course introduces students to contemporary digital-performance techniques and issues, i.e., integrating computing technology into traditional performing arts. Drawing on contemporary research in performance studies

as well as technical advances in performing-arts production design, students perform research on how digital technology and media are integrated into dance, theater, performance art and concert-music performance. Students develop performance technologies as part of their research and present them to the group at the end of the semester.

DM 6113 Sound Studio Seminar *3 credits*

This course introduces DM students to contemporary techniques and issues in audio, sound and musical research. The class covers digital signal processing, synthesis, musical informatics and interaction design as it applies to contemporary music production, postproduction and live performance. Students are expected to achieve competence in a number of technologies and to create brief studies based on them.

DM 6123 Cinema Studio Seminar *3 credits*

Students use developed skills to explore and exploit digital-video technology. Course material centers on the documentary and its many forms. To inform the high-quality and cutting-edge results expected from BxmC students, class time is divided between hands-on technical demonstrations, group work and case studies of relevant historical work in film and video. A range of video-documentary approaches is demonstrated and encouraged.

DM 6133 3D Studio Seminar *3 credits*

This course examines topics in 3D modeling from the perspective of graduate-level research in digital media. As with video, a working understanding of technological practice vis-à-vis 3D is crucial for DM students working in interaction design, game design or computer graphics. The class explores techniques and methodologies through regular studio practice to give students an overview of the possibilities and the current state of the art, and to prepare them for thesis work or subsequent course work.

DM 6143 Interaction Design Studio Seminar *3 credits*

This seminar introduces students from diverse backgrounds to interaction design as a creative design practice. The course surveys application areas, supporting technologies and their impact on individual and group relationships. Group projects introduce the collaborative and interdisciplinary development process common in the professional technology and design. Students are expected to develop technology competencies, including software programming, configuration of hardware devices and the operation of standard digital-media hardware and software tools. Students are also expected to demonstrate interpretive positions regarding analysis of the impact of technology on individuals and social interactions.

DM 6153 Game Design Studio Seminar *3 credits*

This course guides graduate students through contemporary thought in game design, development, user testing and deployment. The course will benefit DM students interested in research or employment opportunities in game design or in related fields that require an understanding of human-computer interaction. This seminar provides a foundation understanding of how games are developed, tested and experienced.

DM 6193 Web Studio Seminar *3 credits*

This project studio is offered for students who have web-design and/or development experience and who are ready to take on new technologies and approaches. Students may participate in large-scale projects directed by the instructor or work on a personal or small-group project. Participants are expected to complete a major semester project at a level beyond basic professional standards.

DM 6213 Networked Media Studio Seminar *3 credits*

This seminar looks at the power of computer networks and their potential in digital media. Technologies such as network communication, peer-to-peer file transfer, media broadcasting, cluster and parallel computing, database research, multiplayer online environments and online social spaces are explored with the goal of creative applications. Students complete a semester-length research project based on their creative and technical interests.

DM 7033 Media Law Seminar *3 credits*

This advanced seminar explores in-depth the theoretical and practical aspects of media-communications principles and regulations. Knowledge of media law is crucial for professionals. A full range of models from Open Source public license to Digital Rights Management will be explored, as well as working definitions of Fair Use and the practical limits of sampling/mixing in different idioms and economic sectors.

DM 9101-3 Special Topics in Digital Media *3 credits*

Offered by special arrangement with faculty, visiting scholars and professionals in the field, this course may be repeated for credit with different topics. *Prerequisite: permission of adviser.*

DM 9906 Digital Media Thesis Project *6 credits*

This 6-credit course is the capstone of the MS program in Integrated Digital Media. Each student, guided by a thesis adviser and with the other faculty support as required by the specific project, completes a major media-production project. The thesis form and format are determined by agreement between the student and adviser with department approval. The goal is to advance the student's career and to contribute to the profession. Students are encouraged to seek professional outlets for their thesis. The department and NYU-Poly will do everything possible to help ensure that graduates' excellent work find an audience and a market. The thesis may be undertaken in consecutive 3-credit increments, or all at once by agreement with the thesis adviser.

Typical Course of Study for the Bachelor of Science in Integrated Digital Media

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Cr.
MA 1324	Integrated Calculus I	4
CS 1213	Intro to Programming with Java	3
DM 1113	Audio Foundation Studio	3
DM 2xxx	DM Studio Elective	3
EN 1013W	College Writing Workshop	3
EG 1001	Engineering and Technology Forum	1
		17

Spring Semester

Course No.	Course Title	Cr.
MA 1424	Integrated Calculus II	4
PH 1213	Physics I: Motion and Sound	3
DM 1123	Visual Foundation Studio	3
DM 2/3xxx	DM Studio Elective	3
HuSS 1023W	First-Year Writing Seminar	3
		16

SOPHOMORE YEAR

Fall Semester

PH 1223	Physics II: Electricity and Light	3
DM 2/3/4xxx	DM Studio Elective	3
DM 2/3/4xxx	DM Studio Elective	3
MD 2163	Media Studies I	3
	Humanities and Social Sciences Elective	3
		15

Spring Semester

DM 3/4xxx	DM Studio Elective	3
DM 3/4xxx	DM Studio Elective	3
MD 3163	Media Studies II	3
	Humanities and Social Sciences Elective	3
	Humanities/Math/Natural Science	3
		15

JUNIOR YEAR

Fall Semester

DM 3/4xxx	DM Studio Elective	3
DM 3/4xxx	DM Studio Elective	3
MD 4163	Media Studies III	3
	Humanities and Social Sciences Elective	3
	Free Elective	3
		15

Spring Semester

DM 3/4xxx	DM Studio Elective	3
DM 3/4xxx	DM Studio Elective	3
	Humanities and Social Sciences Elective	3
	Humanities/Math/Natural Science	3
	Free Elective	3
		15

SENIOR YEAR

Fall Semester

DM 3/4xxx	DM Studio Elective	3
	Humanities and Social Sciences Elective	3
	Humanities and Social Sciences Electivee	3
	Humanities/Math/Natural Science	3
	Free Elective	3
		15

Spring Semester

DM 3/4xxx	DM Studio Elective	3
DM 4003	Senior Project	3
	Humanities/Math/Natural Science	3
	Free Elective	3
		12

Total credits required for the degree: 120

INTERDISCIPLINARY STUDIES IN ENGINEERING PROGRAM: MASTER OF ENGINEERING

GOALS AND OBJECTIVES

The Interdisciplinary Studies in Engineering Program leads to the Master of Engineering degree. It is for students seeking in-depth knowledge in fields requiring courses from multiple disciplines, especially those taught by different academic departments. The degree meets the needs of many companies seeking professionals who, working at the intersection of many fields, conduct innovative research from which new knowledge is created and innovative products are made.

REQUIREMENTS

To obtain the degree, students must satisfactorily complete 30 credits in graduate courses with a Capstone experience and at least one 12-credit graduate advanced certificate in an engineering department or in the Department of Computer and Information Science.

The Institute offers these advanced certificates and courses and will create new ones as the program evolves to meet the needs of students and industry. Admission to the program requires a bachelor's degree from an accredited institution, a superior academic record and completion of all prerequisite courses. Applicants who are otherwise sufficiently prepared for admission still may be required to take specific undergraduate and introductory-level graduate courses. Such graduate courses may count toward the master's degree, depending on the department offering the advanced certificate.

To administer this interdisciplinary program, each academic department has a dedicated adviser (or more than one, if needed, as the program grows). These advisers evaluate applicants for admission. After a student selects the first certificate, an adviser from the relevant department will be the student's adviser. Advisers help students select courses and determine their progress.

To satisfy the requirements for the Master of Engineering degree, students must complete 30 credits, as described below, and maintain a B average for each certificate.

REQUIREMENTS:

1. Students must complete Certificate 1: a 12-credit advanced certificate in any engineering department or in the Department of Computer and Information Science.
2. Students also take additional courses with adviser approval, to total 30 credits.

One or more courses in management are generally encouraged. A student also may choose to complete a second certificate as part of the additional courses beyond the first certificate.

The majority of the 30 credits must be from engineering disciplines, and the first advanced certificate included in the degree must be from an advanced certificate listed below. Prospective students must specify the first advanced certificate as part of their application. This degree program has no option for a thesis. An average GPA of at least 3.0 is required in all graduate courses at Polytechnic for graduate credit. No more than 9 of the 30 credits may be transferred as part of this degree, based upon prior work at other acceptable institutions in subject matter relevant to the degree. No transfer credits may be applied toward any certificate.

The degree will include a Capstone experience in one of the following ways: (a) a Capstone course within one of the advanced certificates included in the degree; (b) a for-credit internship that builds on the program of study within the degree and is monitored by a faculty adviser; or (c) an advanced design course that builds on the program of study and is designated explicitly by the adviser as the Capstone course for the student's program. Where feasible, Polytechnic will designate in the Institute catalog a capstone course within each advanced certificate. Generally, the course is a laboratory or design project or includes a major design project. The alternative choices for completing the degree are the for-credit internship or advanced design course detailed above.

ENGINEERING ADVANCED CERTIFICATES

Examples of engineering advanced certificates currently available for the first certificate from Polytechnic's departments include:

Department of Civil Engineering
- Executive Construction Management (Exec 21)
- Traffic Engineering
- Construction Management

Department of Computer Science and Engineering
- Software Engineering

Department of Electrical and Computer Engineering
- Wireless Communications
- Image Processing
- Computer Engineering
- Telecommunication Network Management

Interdisciplinary (Offered outside departments)
- Achieving World Class Quality
- Industrial Engineering
- Manufacturing Engineering and Production Science
- Manufacturing Excellence by Design: Holistic Approach

A second advanced certificate (optional) may be selected from among the first group or may include:

Department of Civil Engineering
- Hazardous Waste Management
- Transportation Planning
- Transportation Management and Economics

Department of Electrical and Computer Engineering
- Telecommunication Network Management

Department of Financial and Risk Engineering
- Financial Engineering

Department of Technology, Culture and Society
- Environment-Behavior Studies

Department of Technology Management
- Human Resource Management
- Organizational Behavior
- Technology Management
- Telecommunications Management

In addition, some departments offer specific course sequences that may be applied toward the Master of Engineering program.

WIRELESS INNOVATION

The selection of courses below, focused on wireless innovation, fulfills requirements for the degree Master of Engineering in Interdisciplinary Studies in Engineering. A subset of these courses also satisfies the requirements for the certificate of wireless communication. (Also refer to the section of Graduate Certificates in Electrical Engineering Program.)

GROUP 1: Required Courses

EL 6303 Probability (Required)
EL 9953 Advanced Project I (Required Capstone Experience)

GROUP 2: Restricted Electives

Choose 3 courses (9 credits) from the following:

EL 5013 Wireless Personal Communication Systems
EL 5023 Wireless Information Systems Lab I
EL 5033 Wireless Information Systems Lab II
EL 6013 Principles of Digital Communications: Modulation and Coding
EL 6023 Wireless Communications: Channel Modeling and Coding
EL 6033 Modern Wireless Communications: Techniques and Systems
EL 6063 Information Theory
EL 6073 Coding Theory
EL 7023 Space-Time Wireless Communications
EL 6753 Radio Propagation for Wireless Systems

GROUP 3: Electives

Choose 5 courses (15 credits) in electrical engineering, management or computer science. A maximum of three management courses is allowed. Sample courses are listed below:

EL 5363 Principles of Communication Networks
EL 6373 Local and Metropolitan Area Networks
EL 6393 Advanced Network Security
MG 8673 Technology Strategy
MG 6073 Marketing
MG 7503 Electronic Business
MG 8653 Innovation Management
CS 6813 Information, Privacy and Security
CS 6823 Network Management and Security
CS 9153 Mobile Computing

MASTER OF SCIENCE IN MANAGEMENT PROGRAM

Academic and Administrative Director: Bohdan Hoshovsky

The Department of Technology Management at th Polytechnic Institute of NYU is the New York City/Tri-State region's academic hub for technology and innovation management.

The Master of Science in Management degree (MSM) is recognized by the Graduate Management Admission Council as a graduate professional-management degree. NYU-Poly's modern MSM curriculum prepares working professionals for increasing responsibility in management in technology-intensive settings and entrepreneurial venues. Unlike longer and more general management programs elsewhere, the MSM is structured so that students, without losing needed breadth, can more quickly concentrate on their specialized areas of interest—all within the larger technology and innovation management domain. In short, the MSM represents an efficient, focused, up-to-date and unique professional learning experience.

The program has been thoroughly designed to develop competencies in modern decision making and to select, allocate and direct human, financial, physical, technological and organizational resources during rapid, technology-driven change. These management skills can be applied in a broad range of professional settings in the private and public sectors, in production and service-oriented activities, and in traditional and high-technology environments.

The MSM program in management takes a pragmatic, modern, results-oriented approach that emphasizes integrating technology, people and advanced managerial approaches to create value in the marketplace and in modern organizations. Unlike a traditional MBA, the MSM possesses an efficiently designed curriculum, wherein students specialize quickly. Even subjects such as finance and marketing are taught not as special areas of expertise, but as basic tools for managerial decision making in a technology-intensive and knowledge-based environment. NYU-Poly supports these courses with a modern, Web-based infrastructure. The program continually introduces state-of-the-art material in paper and digital format. MSM graduates are ready to advance swiftly in a competitive business world.

The department tailors class schedules and teaching to the specific needs of its students, many of whom are working professionals. Classes are typically offered after regular office hours. Class structure enables participants to receive individual attention and to work closely with faculty. The course of study is for those aspiring to work in, or currently working in, technology-intensive industries and in companies that depend on technology and innovation for products and services.

After completing the core courses, MSM degree candidates build further managerial skills by choosing from the following concentrations, all of which are designed for success in a global economy in which on-going innovation is required. MSM concentrations include:

- Entrepreneurship
- Electronic Business
- Project Management
- Technology Management
- Information and Telecommunications Management
- Human Resource Management
- Construction Management
- Custom Concentration (only with pre-approval of the MSM Program Director)

The program concludes with an overarching capstone project course, MG 9703 Project in Strategy and Innovation. Students also may elect, with the TM Chair's and MSM Program Director's pre-approval, to conclude the MSM with a MG 9973 Thesis for Degree of Master of Science instead of MG 9703.

The program requires some fundamental knowledge of probability and statistics. Students without such a background are required to take a managerial probability and statistics course such as MA 2054, MG 5050, or its equivalent. Students with this background may apply to waive this requirement.

Visit the program's website for further information.

GOALS AND OBJECTIVES

The goal of the Master of Science in Management is to provide the highest quality and most effectively designed learning experience that centers broadly on modern managerial arenas encompassing innovation, technology and information management, e-business and entrepreneurship in the New York City/Tri-State Region and beyond.

We encourage NYU-Poly graduate students to broaden their knowledge through our technology management course offerings. The MSM Program espouses a synergistic approach with several NYU-Poly Graduate degree programs outside of TM which have incorporated MSM courses in their curricula.

ADMISSION AND DEGREE REQUIREMENTS

Criteria for admission include a bachelor's degree with at least a B average from an accredited college or university and demonstrated evidence of motivation, maturity, and the ability to benefit from and contribute to professional graduate studies. Students must exhibit a strong desire to make a difference in fields associated with innovation, technology and modern change. An applicant who lacks certain criteria may be admitted as a nondegree (nonmatriculated) student with the subsequent opportunity to become a matriculated degree candidate. Satisfactory scores on the Graduate Record Examination (GRE) or an acceptable equivalent test, such as the Graduate Management Admission Test (GMAT), may be requested to support admission.

The MSM requires completion of 12 courses, for 36 credits with a B average or better. A maximum of nine transfer credits may be granted for graduate courses taken elsewhere prior to enrollment in MSM after they are evaluated by an MSM adviser.

UNDERGRADUATES IN GRADUATE MSM CLASSES

With three exceptions, undergraduates may not enroll in graduate MSM classes. The exceptions are: (1) undergraduate students enrolled in a joint BS-MS program associated with the Management Department, with the approval of an adviser in the Technology Management Department, may register for Graduate Management courses; (2) undergraduate seniors with a 3.0 GPA or better, with the signature of the MSM program director, may register for MSM core courses: MG 6013, MG 6073, MG 6083, MG 6093, MG 6503 and MG 8673; and (3) undergraduate seniors majoring in BTM with a 3.0 GPA or better, with the signature of the MSM program director, may register for any MSM course.

ADVANCED CERTIFICATE PROGRAMS

The Department of Technology Management offers several advanced certificate programs for professionals with work experience. Applicants for advanced certificate programs must hold bachelor's degrees. Matriculation in an advanced certificate program requires formal application and acceptance to one of the Advanced Certificate Programs. All Advanced Certificate Programs described here are comprised of five courses (totaling 15 credits) that meet individual needs and meet the certificate's requirements, as indicated below.

Students are issued certificates after they complete a sequence with an average grade of B or better. Those who choose to apply for a Master of Science in Management are able, upon admission, to apply all courses completed for a certificate toward fulfillment of the graduate degree requirements. Additional information can be obtained from the TM department.

Advanced Technology Management Certificates are offered in the following fields:

- Electronic Business Management
- Entrepreneurship
- Construction Management*
- Human Resource Management
- Information Management
- Project Management
- Technology Management
- Telecommunications Management

* Offered jointly with the CE Department. Please refer to the Construction Management section of this catalog for further details.

THE MS MANAGEMENT CURRICULUM

1. Core Courses

The six required core courses shown below provide an 18 credit foundation upon which students can pursue cutting-edge specializations within the degree program. These core courses expose students to the disciplines required of a professional manager. Students who have taken these courses elsewhere or previously at NYU-Poly, or who have had equivalent experience, may apply to substitute elective courses for such core courses; however, all students are required to complete the MSM degree's 36 credits.

MG 6013 Organizational Behavior
MG 6073 Marketing
MG 6083 Economics
MG 6093 Accounting and Finance
MG 6503 Management of Information Technology and Information Systems
MG 8673 Technology Strategy

Core courses should be taken as early in the program as possible.

2. Areas of Concentration

Students must formally choose and declare a 15 credit area of concentration, which can be from among those listed below or, with the MSM Program Director's pre-approval, a set of courses that meet individual needs through a custom MSM concentration. A minimum of four courses must be selected in any one concentration area. Courses in all the available concentrations are shown below.

3. Capstone Project Course

This required, integrating three-credit course, MG 9073 Project in Strategy and Innovation Management, is recommended for a student's final semester. In special cases, MG 9973 Thesis for Degree of Master of Science may be substituted for students wishing to produce a major dissertation in a specialty with the permission of the MSM Program Director and the TM Chair. Such a student must follow the Master's Thesis course requirements.

CONCENTRATION COURSE REQUIREMENTS

Each MSM concentration sequence comprises a minimum of five courses totaling 15 credits. Substitutions may be made with the MSM Program Director's pre-approval in any concentration area.

ELECTRONIC BUSINESS

The Electronic Business Management Concentration focuses on the arena of electronic business and the Internet. Students study the process of digital-intensive market creation and the key aspects for managing a firm that operates increasingly in digital space. Relevant methods and concepts for effective electronic-business decision making are explored and applied.

Required:

MG 7173 Enterprise Data Systems
MG 7503 Management of Electronic Business

Select three 3-credit courses of interest (for nine credits) with an "MG" or "FRE*" prefix.

ENTREPRENEURSHIP

The Entrepreneurship Concentration is offered for the manager, professional or specialist interested in entrepreneurial management—as an entrepreneur starting a new business, as an "intrapreneur" in a large, established firm, or as a professional (e.g., venture capitalist) interested in playing a role in new enterprises. This concentration develops a valuable entrepreneurial state of mind for any business setting. Modern entrepreneurial concepts and cases are learned and applied.

Required:

MG 7703 Entrepreneurship
MG 8653 Managing Technological Change and Innovation

Select Two:

MG 7733 Managing Intellectual Property and Intellectual Capital
MG 8713 Entrepreneurial Finance
MG 8723 Corporate Entrepreneurship
MG 8743 Entrepreneurial Marketing and Sales

Select one 3 credit course of interest with an "MG" or "FRE" prefix.

CONSTRUCTION MANAGEMENT

The Concentration in Construction Management enables engineers and other construction-industry professionals to understand relevant managerial and physical, infrastructural-technological developments. The concentration also helps students become effective and innovative by integrating construction and management.

Required:

MG 6303 Operations Management
MG 8203 Project Management

Select Three:

CE/MG 8243 Construction Modeling Techniques**
CE/MG 8253 Project Management for Construction**
CE/MG 8263 Construction Cost Estimating**
CE/MG 8273 Constructs and Specifications**
CE/MG 8353 Construction Scheduling**

** For complete Construction Management course descriptions please see course listings in the NYU-Poly Catalog section of the Construction Management Program. Registration may require permission from a Construction Management adviser.

HUMAN RESOURCE MANAGEMENT

The Concentration in Human Resource Management prepares professionals for today's technology-intensive environment. The program provides the knowledge and techniques to deal with human-resource issues and to achieve high-quality innovation and productivity in often-turbulent organizational settings. The changing nature of work and shifting professional expectations are explored.

Required:

MG 6123 Human Resource Management

Choose One:

MG 6173 Performance Management and Reward Systems
MG 6223 Staffing Organizations

Select Three:

Select three 3-credit courses of interest (for nine credits) with an "MG" or "FRE*" prefix. However, it is recommended that students select courses from Technology Management's MA in Organizational Behavior Program.

INFORMATION MANAGEMENT AND TELECOMMUNICATIONS MANAGEMENT

The Concentration in Information Management and Telecommunications Management is for professionals in information technology (IT), telecom and networking, programmers, systems experts and others with IT-related career goals and experience. Students learn to understand how IT and networking enhance the effectiveness of modern firms and the ability to manage creative and professional people.

Required:
MG 6553 Telecommunications Management I
MG 7173 Enterprise Data Systems

Select Three:
Select three 3-credit courses of interest (for nine credits) with an "MG" or "FRE*" prefix.

PROJECT MANAGEMENT
The Concentration in Project Management is for managers who manage, finance or facilitate projects in modern enterprises. This concentration provides managers with the latest managerial knowledge and methods to manage an array of projects effectively.

Required:
MG 6303 Operations Management
MG 8203 Project Management

Select Three:
Select three 3-credit courses of interest (for nine credits) with an "MG" or "FRE*" prefix.

TECHNOLOGY MANAGEMENT
The Technology Management Concentration is for managers, engineers and other professionals in technology-intensive environments and for those involved with technology-intensive products, processes or services. The program provides the modern methods and concepts necessary to make strategic technology-investment decisions; to understand technology and innovation strategy, product-life cycles and competitive factors; and to develop special skills need to manage creative people and professionals.

Required:
MG 8203 Project Management
MG 8653 Managing Technological Change and Innovation

Select Three:
Select three 3-credit courses of interest (for nine credits) with an "MG" or "FRE*" prefix.

*NOTE: FRE courses may require pre-approval from the FRE Department.

REQUIREMENTS FOR ADVANCED CERTIFICATES***

ADVANCED CERTIFICATE IN CONSTRUCTION MANAGEMENT (15 credits):
Offered jointly with the Civil Engineering Department's Construction Management Program presented in this catalogue.

ADVANCED CERTIFICATE IN ENTREPRENEURSHIP (15 credits):

Required (6 credits):
MG 7703 Entrepreneurship
MG 8653 Managing Technological Change and Innovation

Electives (9 credits) selected from the following:
MG 7873 Managing Intellectual Property and Intellectual Capital
MG 8713 Entrepreneurial Finance
MG 8723 Managing Growing Enterprises
MG 8733 Corporate Entrepreneurship
MG 8743 Entrepreneurial Marketing and Sales

ADVANCED CERTIFICATE IN ELECTRONIC BUSINESS MANAGEMENT (15 credits):

Required (6 credits):
MG 7173 Enterprise Data Systems
MG 7503 Electronic Business Management

Electives (9 credits):
Select any three 3-credit MSM courses to complete a particular advanced interest.

ADVANCED CERTIFICATE IN HUMAN RESOURCE MANAGEMENT (15 credits):
Offered through the MS in Organizational Behavior program presented in this catalogue.

ADVANCED CERTIFICATE IN INFORMATION MANAGEMENT (15 credits):

Required (6 credits):
MG 6503 Operations Management
MG 7173 Enterprise Data Systems

Electives (9 credits):
Select any three 3-credit MSM courses to complete a particular advanced interest.

ADVANCED CERTIFICATE IN ORGANIZATIONAL BEHAVIOR (15 credits):
Offered through the MS in Organizational Behavior program presented in this catalogue.

ADVANCED CERTIFICATE IN PROJECT MANAGEMENT (15 credits):

Required (6 credits):
MG 6303 Operations Management
MG 8203 Project Management

Electives (9credits):
Select any three 3-credit MSM courses to complete your particular advanced interest.

ADVANCED CERTIFICATE IN TECHNOLOGY MANAGEMENT (15 credits):

Required (6 credits):
MG 8203 Project Management
MG 8653 Managing Technological Change and Innovation

Electives (9 credits):
Select any three 3-credit MSM courses to complete your particular advanced interest.

NOTE: Other MG courses may be substituted only with the pre-approval of the MSM Program Director. All Advanced Certificates from the Department of Technology Management require 15 credits of courses with the prefix "MG", except for the Advanced Certificate in Construction Management presented in this catalogue under Civil Engineering's Construction Management Program.

ADVANCED CERTIFICATE IN TELECOMMUNICATIONS MANAGEMENT (15 credits):

Required (6 credits):
MG 6553 Telecommunications Management I
MG 6563 Telecommunications Management II

Electives (9 credits):
Select any three 3-credit MSM courses to complete a particular advanced interest.

***Note: Other MG courses may be substituted only with the pre-approval of the MSM Program Director. All Advanced Certificates from the Department of Technology Management require 15 credits of courses with the prefix "MG", except for the Advanced Certificate in Construction Management presented in this catalogue under Civil Engineering's Construction Management Program.

MSM GRADUATE COURSES

MG 5050 Probability and Managerial Statistics *3:0:0:0*

This course starts with the basic concepts of random phenomena and goes on to advanced applications of statistics relevant to managers. Topics include probability theory, discrete and continuous probability variables, sampling, measures of central value and dispersion, hypothesis testing, statistical inference, quality control, analysis of variance, regression, correlation and nonparametrics. The course emphasizes application of concepts. *No credit is allowed toward any graduate degree program administered by the Department of Technology Management. This course is pass/fail only.*

MG 6013 Organizational Behavior *3:0:0:3*

Introduction to theory, research and practice to better understand human behavior in organizations. Topics include motivation and job satisfaction; decision making; group dynamics; work teams; leadership; communication; power, politics and conflict; organization culture, structure and design; impact of technology; management of work stress; organizational change and development; and career management. Analysis of organizational behavior problems by self assessments, case studies and simulations.

MG 6073 Marketing *3:0:0:3*

This course covers marketing concepts, processes and institutions. Topics: Positioning,

segmentation and product-life cycles. Integration of marketing with new product planning, design and development. Strategies for technology-based products, services and processes. Market research, consumer behavior, advertising, promotion and sales. The special character of governmental and international markets.

MG 6083 Economics *3:0:0:3*

The course examines the fundamentals of microeconomics needed by managers. Topics: Demand theory (theory of the consumer) including models of demand, demand elasticities and demand forecasting. Supply theory (theory of the firm) including diminishing returns, profit-maximizing production levels, labor/capital tradeoffs, and long-run vs. short-run issues. Market structures and how they affect optimal production and profit levels. Positive and negative externalities and government intervention including regulation, tariffs and subsidies. Selected applied topics. All topics are presented with examples that emphasize managerial applications.

MG 6093 Accounting and Finance *3:0:0:3*

The course covers elements of accounting and finance of importance to managers. Topics: Analysis of principles and practices of the finance function. Financing methods for internal and external ventures and innovations; capital budgeting; R&D portfolio analysis. Contrast of strategic perspectives emphasizing innovation and development with those emphasizing short-term return and investment.

MG 6103 Management Science *3:0:0:3*

This course introduces major concepts and methods associated with Management Science, which deals with the application of quantitative modeling and analysis to management problems. Students learn to employ important analytical tools, to determine the assumptions used, and to recognize the limitations of such methods. The course discusses methods of linear and nonlinear programming, queuing, decision analysis, simulations and game theory. The course also introduces modeling with spreadsheets.

MG 6113 Career Management *3:0:0:3*

Provides an integration of theory, research and practice pertaining to careers in organizations, particularly as they change through the life span. Examination of careers from the perspectives of both the individual and the organization, including topics such as career stage models, organizational entry, early career development, mid-career transition, career change and career issues for women. Facilitates the development of greater understanding and insight into one's own career growth and development through the use of career assessment techniques and standardized instruments for self evaluation. *Co-requisite: MG 6013 or instructor's permission.*

MG 6123 Human Resource Management *3:0:0:3*

Introduction to the broad range of human resource functions and their organizational role. Addresses issues in managing people that impact not only HR professionals but also line managers. The course is divided into four modules: (1) an overview of HRM from a strategic perspective; (2) the management of human resources, including recruitment and selection, performance management, compensation and benefits, training and career support; (3) human resource challenges, including diversity, procedural justice and ethics, collective bargaining and managing change and innovation; and (4) professional roles in HRM.

MG 6133 Labor Relations *3:0:0:3*

Introduction to labor relations from various perspectives in both union and non-union organizations. Topics include labor movement history; the current state of the labor movement; labor statistics; labor laws and practices; union organizing; negotiating; economics and labor unions; contract administration; achieving cooperation; grievances; labor and employment arbitration; employee discipline; engineering and professional unions, public sector unions; global aspects; and the future for unions.

MG 6143 Conflict Management *3:0:0:3*

Investigation of the nature and meaning of conflict in professional and technical organizations as well as in society. Analysis of the design of conflict avoidance and mitigation programs. Alternative dispute resolution modalities are presented and demonstrated. Addresses strategies to build successful relationships on an ongoing basis. Skill building around collaborative conflict resolution. *Co-requisite: MG 6013 or instructor's permission.*

MG 6153 Leadership and Team Development *3:0:0:3*

Focuses on the essential role of multifaceted leadership in diverse organizational settings, especially those utilizing technology. Explores the nature of leadership and its relationship to team development and organizational effectiveness. Includes a broad survey of theory and research on leadership and teams in organizations. Includes a hands-on approach involving experiential learning and case analyses, which will be conducted in teams, requiring students to be active participants. *Co-requisite: MG 6013 or instructor's permission.*

MG 6163 Job and Workplace Design *3:0:0:3*

Examination of theory, research and applications of job and workplace design. Job design is presented from an interdisciplinary perspective focusing on how job design influences attitudes and work behavior within organizations. Exposure to diagnostic tools for measuring and evaluating jobs and the psychosocial aspects of the workplace environment, as well as the principles of work redesign. Topics include the influences on work design by innovations in information technology, modern manufacturing, virtual work arrangements and open office systems; design and support of effective work teams; reengineering and total quality management; and privacy and communication in the workplace. *Co-requisite: MG 6013 or instructor's permission.*

MG 6173 Performance Management and Reward Systems *3:0:0:3*

Introduction to creating performance appraisal systems that includes theoretical and applied issues. Topics include coaching and feedback; team settings; multi-source feedback and self-ratings; executive performance; and improving evaluations. The role of compensation, benefits and other rewards in attracting, retaining and motivating employees is addressed, including technical and professional personnel. *Co-requisite: MG 6123 or instructor's permission.*

MG 6181 Talent Management *1.5:0:0:1.5*

A survey course that provides a knowledge and understanding of the strategies and range of processes, methods and tools that are currently used by organizations in effective Talent Management programs. Includes a focus on the development and management of leadership talent as well as Talent Management practices for general management, professional, technical and other positions. Topics include identifying and competing for critical talent pools; alignment and integration of HR practices; recruiting and employment branding; identifying, selecting, developing, reviewing and managing leadership talent; retention and recognition strategies; and career paths and career planning. *Co-requisite: MG 6123 or instructor's permission.*

MG 6191 Coaching in Organizations *1.5:0:0:1.5*

Focuses on the role of coaching in organizations as part of a talent management program to develop human resources. Provides an understanding of the definition, theoretical basis, functions and models of coaching, Examines how coaching is linked to the adult development lifecycle and the range of contexts in which coaching is applied. Addresses how coaching is used in leadership development as well as performance management, the multicultural aspects of coaching and the access minorities have to coaching. Provides a familiarity with the different coaching tools and instruments as well as how leading organizations are using coaching in their talent management programs. Issues related to certification as a coach are addressed. *Co-requisite: MG 6013 or instructor's permission.*

MG 6201 Consulting in Organizations *1.5:0:0:1.5*

Provides a practical orientation to consulting in organizations within an academic framework. Prepares students from a variety of disciplines for roles as internal as well as external consultants by building knowledge and skills to successfully take a client and project from entry through termination and evaluation. Each student is required to take a project from conception to presentation, thereby providing an indepth understanding of the details and issues that need to be addressed in the consulting role.

MG 6211 Outsourcing: A Human Capital Strategy *1.5:0:0:1.5*

A comprehensive course that prepares students from a variety of disciplines with the knowledge and skills necessary to make the "build" or "buy" decision when considering outsourcing as an alternative. Topics covered include strategic implications, financial aspects, project management, internal consulting, metrics, legal considerations, development of an effective template RFP (request for proposal), internal communication details and management of the vendor/provider relationship. *Co-requisite: MG 6123 or instructor's permission.*

MG 6271 Managing Human Resource Technology in Organizations *1.5:0:0:1.5*

Examination of factors critical to the effective organizational adoption and utilization of technology in human re source applications. Topics covered include: project management; HR data and process standardization; organizational governance; the unique security requirements of HR data; metrics; and HR process and technology outsourcing. By understanding these issues and how organizations can address them, students will be better prepared to more effectively plan and implement HR process re-engineering and technology enablement. *Co-requisite: MG 6123 or instructor's permission.*

MG 6223 Staffing Organizations *3:0:0:3*

Examination of the design and management of successful staffing practices used to build, deploy and retain a quality workforce in order to achieve organizational effectiveness and individual job satisfaction. Topics include staffing strategy; human resource planning and workforce diversity; job analysis; recruitment; hiring methods; the reliability and validity of employee assessment methods; and retention management. Psychological theories of personnel assessment are reviewed. Legal issues pertaining to staffing practices are integrated. *Co-requisite: MG 6123 or instructor's permission.*

MG 6233 Training in Organizations *3:0:0:3*

An overview of the many forms of training and related learning activities found in the modern workplace, including management development, technical training, career planning and mentoring. The course will focus on training as both an asset to the organization and a necessity for delivering goods or services that will be valued by the customer. Topics addressed include needs analysis, preparation of employees for jobs, training program design, traditional training methods, computer-based methods, development, implementation and evaluation of training, targeting various groups with special training needs and management development.

MG 6243 Organization Development *3:0:0:3*

Survey of theory, research and applications related to the process of managing planned change in organizations. Organization development (OD) encompasses a variety of interventions and techniques, including strategic management sessions, team building, organizational climate studies, career development and job enrichment. Addresses the practical application of group, inter-group and individual changes; planned structural revisions in formal organizations; and the dynamics of organizational change processes. Experiential techniques emphasized. *Co-requisite: MG 6013 or instructor's permission.*

MG 6253 Seminar in Organization and Career Change *3:0:0:3*

Examination of organizational restructuring, including downsizing, reengineering, delayering, mergers and acquisitions, focusing on the impact of such change on professional and managerial careers. Emphasis on current organizational and individual management practices in coping with rapid structural, cultural and technological change in the work environment. Experts from the private and public sectors as well as consulting firms address these management practices. *Co-requisite: MG 6013 or instructor's permission.*

MG 6263 Human Resource Information Systems *3:0:0:3*

Introduction to the design, selection, implementation, enhancement and operation of human resource information systems (HRIS), a computer-based tool that allows the efficient entry and updating of employee-related information. Focus is on the design and use of HRIS to facilitate the objectives of HR functions as well as the organization. Provides a "hands-on" experience with the design of prototype simulations and database programming systems used to solve common HR problems and efficiently manage employee information. *Co-requisite: MG 6123 or instructor's permission.*

MG 6283 Web-Based Human Resource Management *3:0:0:3*

Survey of the effective use and application of Internet and Intranet technologies for HR functions. Topics include employee self-service and online recruiting as well as software that handles peer reviews, applicant tracking, performance management, succession planning and benefits administration. Issues addressed include: Best practices in utilizing web technology for HRM; creating websites to achieve organizational goals; determining HR information to include in an organization website; impact of Web technology on organization design; evaluating privacy and security issues; and developing a vision and a plan for utilizing Web technology in HRM. *Co-requisite: MG 6123 or instructor's permission.*

MG 6293 Managing Technical Professionals *3:0:0:3*

This course provides a survey of research and practice focusing on the effective management of technical professionals, who have come to represent a significant segment of the labor force. The success of organizations today is largely a result of the knowledge and skills applied by their technical professional

employees. The effective management of such a work force has been one of the most critical problems faced by organizations that depend on their contributions. This course closely examines research and case studies that examine various management techniques to improve the utilization, development and motivation of technical professionals for achieving high levels of performance, innovation and creativity. *Prerequisite: MG 6013 or instructor's permission.*

MG 6303 Operations Management *3:0:0:3*

This course covers analytical techniques to design and operate production and service systems, including facility layouts and locations, capacity planning, job sequencing, inventory control and quality control. Topics include introductory linear programming and other formal methods, and case studies and computer usage. *Also listed under MN 6303.*

MG 6313 Organization Theory and Design *3:0:0:3*

Introduction to theories of organizations including structure, design and culture. Provides an understanding of how organizations work and their interrelationship with the external environment. Examines the process by which managers select and manage aspects of structure and culture to achieve organizational goals. Topics include characteristics of bureaucracy, adhocracy, sub-optimization, human dynamics and informal systems; influence and control systems; management of technology; and planned change. Examination of organizations through research and case studies.

MG 6321 Global Human Resource Management *1.5:0:0:1.5*

An overview of human resource management practices in today's global work environment. Topics addressed include international/socio-cultural diversity; key characteristics of select countries international business behavior; international strategic alliances; identification, recruiting and selection of international personnel; training and development of expatriates and home country nationals; evaluation and coaching of employees in international organizations; intercultural skills acquisition for the line manager and human resources professional; team development strategies; and design of practical language learning tools for the HR professional and the line manager. *Co-requisite: MG 6123 or instructor's permission.*

MG 6333 Research Methods *3:0:0:3*

Introduction to theories and techniques related to research methods applied to organizations. Provides an understanding of why and how organizational research is carried out. Focus on analyzing organizational problems and the use of research as a problem-solving tool. Topics include problem definition, theoretical framework, hypotheses development, research design, experimental designs, measurement, data collection methods, sampling strategies and preparing research proposals. Development of a research proposal applied to a problem of interest. *Prerequisite: MG 5050 or undergraduate statistics course.*

MG 6353 Quality Management *3:0:0:3*

Companies have found that focusing on quality and overall customer satisfaction as a primary objective of manufacturing and service operations is a proven competitive weapon. This course examines the concepts and methods to building quality into the management process. Total quality management (TQM) and similar approaches are covered through readings, case studies and examples. *Also listed under MN 6353.*

MG 6463 Supply Chain Management *3:0:0:3*

This course introduces supply-chain management and covers its qualitative and quantitative aspects. The underlying objective is to: (1) introduce students to the standard business concepts (and associated terminology) involved in the retailing and supply-chain management; (2) develop skills in understanding and analyzing retailing, marketing, logistics, operations, channel management and allied issues and the interactions between them; and (3) examine and discuss the important role played by technology and integration at various points in the supply chain. *Also listed under MN 6463.*

MG 6503 Management of Information Technology and Information Systems *3:0:0:3*

This course is for managers who need to understand the role and potential contribution of information technologies in organizations. The course focuses on different information technologies and their applications in managing business-critical data, information and knowledge. The course concentrates on the current state of IT in organizations; challenges and strategic use of IT; IT infrastructure and architecture; building, implementing and managing IT applications; and emerging issues such as intelligent systems, business-process re-engineering, knowledge management and group-support systems.

MG 6523 Telecommunications Policy *3:0:0:3*

This course looks at relationships among the development of the telecommunications industry and national growth and examines the development of telecommunications-policy issues as well as policy-making organizations. The course analyzes the major issues that affect the telecommunications industry and commerce and society. The options and opportunities afforded by recent regulatory and policy issues are examined.

MG 6543 Economics for Information Sectors *3:0:0:3*

This course in applied competitive strategy draws upon recent experiences associated with the impact of information technology upon diverse industries. Students master a basic understanding of the economic and competitive implications of information technology. Students gain competence in analysis by understanding how the availability of information (through technology or otherwise) affects the basic strategic options available, and how firms and industries are likely to be affected. Students are introduced to the often poorly-structured process of evaluating the economics of potential systems innovations. Students then can participate in strategic-systems planning from a managerial point of view.

MG 6553 Telecommunications Management I *3:0:0:3*

This course introduces the fundamentals of modern telecommunications and networking for current and future managers. Topics include basic concepts such as components of data communication, data transmission, Open System Interconnection (OSI), TCP/IP and other models, data link and network layers and local area networks (LANs). The course expands technical knowledge and discusses related managerial issues.

MG 8573 Managing Cleantech and Renewable Energy Innovation *3:0:0:3*

This course focuses on the rise of cleantech/renewable energy (aka sustainability green, etc.) as a possible major locus of Twenty-First-Century innovation. The course deals with the diverse ways innovation is taking pace in the broadly defined cleantech arena. The

course covers technology management in several distinct cleantech/renewable technology regimes and varied company venues (e.g. small, medium size and large firms). The course encompasses local and global modes of cleantech/renewable energy innovation. The course requires single-firm, multi-firm and "systems" perspectives for understanding with cleantech/renewable energy innovation. The course employs both intellectual and practitioner-oriented orientations. Throughout, this course maintains a primarily managerial perspective. Students are often asked to assume the role of managers charged with the responsibility of designing, supporting and implementing a cleantech/renewable energy innovation strategy. An overarching concern is on discovering ways to improve the effectiveness of cleantech/renewable energy innovation and technology management and, where appropriate, entrepreneurship.

MG 6563 Telecommunications Management II *3:0:0:3*

This course explores advanced issues and trends in modern enterprise networking. The course also examines the implications of such developments in the business environment and the infrastructural needs of organizations and clusters of organizations; reviews ramifications of the TCP/IP revolution leading to commercialization of the Internet/World Wide Web; discusses the network infrastructure required to implement Intranets/Extranets, electronic commerce and inter-organizational business communication and collaboration generally; evaluates emerging technologies (such as electronic payment systems, corporate digital libraries, push technology, multicasting, firewalls and digital signatures); and deals with the implications of Internetworking, such as digital cities, smart buildings, distance learning, telecommuting and teleconferencing. *Prerequisite: MG 6553.*

MG 6603 Management of New and Emerging Technologies *3:0:0:3*

This course surveys and explores the business implications of selected new and emerging technologies with the potential to change business practices and create new industries. Technologies discussed include new Internet architectures, Wikis, Open Source, security issues, new Web services, social networking and Web 2.0. This course is for the manager who is interested in staying current with, and learning about, new technologies for use in business. No specific engineering background is required. A variety of reference texts, journals, case studies and websites is used.

MG 6643 Management and the Legal System *3:0:0:3*

This course discusses the impact of the legal system on corporate strategy, managerial decisions and planning processes. Issues covered include protection of intellectual and technological properties; consumer, contract and commercial laws; employer liability; negligence and risk-management from legal and corporate viewpoints; and constitutional and regulatory aspects of conducting business.

MG 7173 Enterprise Data Systems *3:0:0:3*

The course addresses modern issues of large-scale information and knowledge management through the design, development and implementation of different kinds of database technologies. The course introduces and elaborates data modeling through relational models, SQL applications, database architecture, different types of database-management systems, and data integrity and administration. The course introduces emerging database technologies, such as distributed Internet-based databases, distributed client/server databases, multidimensional databases, groupware, data warehousing, and data mining for decision support.

MG 7183 Strategy for the Modern Enterprise *3:0:0:3*

This course provides an overview of strategic decision making for the modern enterprise. It introduces general management perspectives of strategy, competitive strategy, emerging analytical characteristics of strategy, and current innovation and global dimensions of strategy. The course concludes with an integrative approach for strategic decision making. Such an approach is geared to a business environment that is increasingly fast-paced, complex, knowledge-intensive, global and changing continuously.

MG 7203 Intercultural Dimensions of Global Management *3:0:0:3*

This course focuses on the critical intercultural dimensions of global management. Topics covered include identifying key culture-related factors essential for effective global management, communicating across different cultures, building effective trans-cultural organizations, developing capable cross-culture managers and leveraging cultural diversity.

MG 7503 Electronic Business Management *3:0:0:3*

This course investigates the management implications of electronic business. Topics include: (1) accelerated new product development; (2) impact of technology on the value chain: the changing role of intermediaries; (3) electronic commerce: business models and strategies for survival of general lifestyle; (4) implications of "being wired"; and (5) business applications involving collaborative communication, computation and teamwork. The course material is dynamic and Internet-based, reflecting the nature of change in electronic commerce and the IT industry, and the potential implications of electronic business for managers. Students work on a project that requires following developments in the business and IT press, interviewing managers and product developers and simultaneously testing and discussing current developments in the e-commerce market space. Classes use the case method, and a high level of class participation is expected.

MG 7693 Managerial Analytics *3:0:0:3*

This course focuses on the use of "analytics"—a fast-growing element in modern management—for achieving more effective operations and heightened competitive advantage. The course provides a managerial overview of current deployment of a diverse range of analytics—internally-oriented and externally-oriented. The course also identifies the impact of analytics on a firm's performance and explores their strengths and weaknesses. The course presents best practices of analytics from a range of industries, including retailing, hospitality, financial services, consulting, healthcare and logistics. *Pre/Co-Requisites: MG 6083 and MG 6093.*

MG 7703 Entrepreneurship *3:0:0:3*

This course focuses on entrepreneurship and venture creation as key engines for wealth creation and successful business strategy in the modern, innovation-intensive, high-tech economy. The course deals with key issues such as: (1) assessing attractiveness of opportunities; (2) launching a new venture; (3) nurturing, growing and entrepreneurial venture; (4) obtaining the necessary financial, human and technology resources; (5) managing the transition from a small entrepreneurial firm to a large, sustainable, professionally managed but still entrepreneurial corporation; and (6) being an entrepreneur and promoting entrepreneurship in a large corporation.

MG 7733 Services Innovation *3:0:0:3*

This course deals with services innovation. Services have eclipsed manufacturing and dominate a modern, advanced economy. According to some estimates, services account for close to 80 percent of U.S. employment. This course examines how value creation occurs in a range of fast-growing services sectors, including retailing, hospitality, financial services, professional services, travel, logistics and healthcare. The course emphasizes that services are diverse, and distinguishes explicitly between traditional and high-value services. This course focuses especially on high-value services. A key objective of this course is introducing best practices for nurturing modern services innovation.

MG 7871 Introduction to Managing Intellectual Property *1.5:0:0:1.5*

This course introduces the topic of Managing Intellectual Property (IP), a major strategic and financial asset of a modern business. IP can protect existing products, services and business methods and accelerate development of new products, services and business methods. Firms can leverage IP to enhance their competitiveness, value and profitability. This approach is true in the physical world and in the online world of the Internet and e-business (where traditional principles of intellectual property rights are often stretched and may need re-interpretation and even modification). Intellectual property is becoming increasingly complex as emerging digital technologies advance. This course is only an introduction to managing IP. *Note: This course is not open to MSM and continuing MBA students.*

MG 7873 Managing Intellectual Property and Intellectual Capital *3:0:0:3*

Intellectual property and intellectual capital constitute major strategic and financial assets of a modern business and can be employed to protect existing products, services and business methods and to accelerate development of new products, services and business methods. Firms can leverage intellectual property and intellectual capital to enhance their competitiveness, value and profitability. This approach is true in the physical world and in the online world of the Internet and e-business (where traditional principles of Intellectual Property Rights are often stretched and may need reinterpretation and even modification). Intellectual property is becoming increasingly complex as emerging digital technologies advance. This course is a broad and full survey of the main areas and issues associated with managing intellectual property and intellectual capital. The course concludes by examining how firms can best manage their intellectual capital.

MG 8203 Project Management *3:0:0:3*

This course examines the management of technology-based projects, ranging from individual research and development to large-scale and complex technological systems. Topics: Feasibility and risk analyses. Project selection and portfolio optimization. Functional and administrative structures, coordination and scheduling of activities, personnel planning, negotiations and contracts, cost estimation, capital budgeting, cost controls, effective matrix management. *Also listed under CE 8203.*

MG 8253 Project Management for Construction *3:0:0:3*

The course covers topics specific to developing and coordinating large projects, including organizational structures, management functions, pricing and estimating project costs, bidding and contracting, risk allocation, scheduling, time and cost control, labor relations, quality management and project life-cycle activities. *Also listed under CM 8253.*

MG 8263 Construction Cost Estimating *3:0:0:3*

This course covers estimating and cost control from the viewpoint of contractors and construction engineers; details of estimating with emphasis on labor, materials, equipment and overhead. *Also listed under CM 8263.*

MG 8273 Contracts and Specifications *3:0:0:3*

This course covers principles of contract law as applied to the construction industry and legal problems in preparing and administering construction contracts. *Also listed under CM 8273.*

MG 8573 Managing Cleantech & Renewable Energy Innovation *3:0:0:3*

This course focuses on the rise of cleantech/renewable energy (aka sustainability green, etc.) as a possible major locus of Twenty-First-Century innovation. The course deals with the diverse ways innovation is taking pace in the broadly defined cleantech arena. The course covers technology management in several distinct cleantech/renewable technology regimes and varied company venues (e.g. small, medium size and large firms). The encompasses local and global modes of cleantech/renewable energy innovation. The course requires single-firm, multi-firm and "systems" perspectives for understanding with cleantech/renewable energy innovation. The course employs both intellectual and practitioner-oriented orientations. Throughout, this course maintains a primarily managerial perspective. Students are often asked to assume the role of managers charged with the responsibility of designing, supporting and implementing a cleantech/renewable energy innovation strategy. An overarching concern is on discovering ways to improve the effectiveness of cleantech/renewable energy innovation and technology management and, where appropriate, entrepreneurship.

MG 8603 Financial Planning and Control *3:0:0:3*

This course examines the latest and most relevant approaches for modern financial planning and control. Specific examples of best practices are studied. Topics covered include an overview of financial planning and control, operational-level financial planning and control, management reporting, forecasting, the application of technology and analytics, the relationship between strategic planning and operational-level financial planning and control, the challenges of implementation and emerging trends in the financial planning and control area. The course emphasizes trade-offs and balance, e.g., a need for financial planning and control and a desire to also have employee empowerment in modern firms. *Prerequisite: MG 6093.*

MG 8633 Market Research *3:0:0:3*

This course deals with the role of market research in modern firms and with the ways market research can help to make business decisions. The focus is on how market data and information is gathered, analyzed and used. Topics include experimental and questionnaire design, use of various analytical tools, interpretation of findings and development and execution of plans based on market research results. The strengths and drawbacks of various techniques are examined. *Prerequisite: MG 6073.*

MG 8643 New Product Development *3:0:0:3*

The dynamics of technology and the pressures of competition drive enterprises to make their product development and production processes strategically more effective and economically more efficient in time and cost. The

course deals with the state of the art in new product activities for services and manufacturing firms and examines in-depth the marketing, technology and manufacturing technology linkages. *Also listed under MN 8643.*

MG 8653 Managing Technological Change and Innovation *3:0:0:3*

This course focuses on how to employ a dual perspective to manage technological change and innovation effectively. One perspective is based on individual, group and organizational theory, research and practice. This body of literature, viewpoints and experience provide essential guides to manage successfully the introduction of new technologies. Realizing the full potential of new technologies requires effectively managing change to assure the commitment of all stakeholders. The second perspective is based on innovation theory, research and practice. This body of literature, viewpoints and experience provide key insights to manage effectively the process of innovation and its impact on an enterprise. The course explicitly considers a firm's need to manage and inspire people so they can communicate and innovate effectively. *Also listed under MN 8653.*

MG 8663 Technology Policy *3:0:0:3*

This course focuses on the macro-environment that influences and is relevant to technology decision making, strategy and innovation in firms, government agencies, non-profit institutions and other organizations. Primary concerns include introducing effective approaches to analyze and evaluate societal-wide factors that influence innovation; to assess various attempts and policies to stimulate innovation in a city, region, nation or globally; to explore the role of technology and innovation in diverse managerial, economic and social contexts (e.g., advanced economies, rapidly emerging economies and Third World economies); to examine the relationship between business-government and NGOs in promoting and sustaining innovation; to explore the impact of global rivalry and global cooperation in the technology and innovation arena; and to understand the place of technology and innovation in the post-Cold War era and in the early 21st century.

MG 8673 Technology Strategy *3:0:0:3*

This course examines indepth the strategic technological decisions that a general manager faces. From entrepreneurial start-ups to established companies, in dynamic as well as mature environments, a firm must create a conscious process of formulating and implementing a technology strategy to serve its business interests. Such a strategy guides investments in research and development, selection among and timing of alternate technologies, organization and communications, formation of alliances and funding of ventures.

MG 8711 Introduction to Entrepreneurial Finance *1.5:0:0:1.5*

This course is briefly introduces the financial requirements of entrepreneurial ventures and different sources of finance available to entrepreneurs. The course presents fundamentals for assessing various entrepreneurial financial strategies. The program will consider offering this course only at the request of other departments. *This course is not open to MSM and continuing MBA students.*

MG 8713 Entrepreneurial Finance *3:0:0:3*

This course focuses on the financial requirements of entrepreneurial ventures and on different sources of finance available to entrepreneurs. The course develops an understanding on how to assess various entrepreneurial financial strategies. The course also examines the unique roles in the entrepreneurial finance arena of such factors as retail banks, investment banks, VCs, angels, internal sources of capital, and incubators.

MG 8721 Introduction to Managing Growing Enterprises *1.5:0:0:1.5*

This introductory course deals with a critical challenge that potentially confronts all successful entrepreneurial small- or medium-size firms: how to sustain and accelerate major growth. At some point in the life of all growing enterprises, a firm usually must change. This course introduces several ways a growing firm can transform itself from a small to a larger enterprise. The course explores how such companies can maintain the benefits of an entrepreneurial commitment and spirit while obtaining needed skills associated with professionally managed larger firms. The program will consider offering this course only at the request of other departments. *This course is not open to MSM and continuing MBA students.*

MG 8723 Managing Growing Enterprises *3:0:0:3*

This course deals with a critical challenge that potentially confronts all successful entrepreneurial small or medium-size firms: how to sustain and accelerate major growth. At some point in the life of all growing enterprises, a firm usually must change. The firm no longer can operate on a scale that is small, possibly ad hoc and overly responsive. To adapt, the firm needs to exploit successfully its success in the marketplace and the future attractiveness of its innovative products and services. This course examines how a growing firm can transform itself from a smaller to a larger enterprise. The course focuses particularly on how companies can maintain the benefits of an entrepreneurial commitment and spirit while still obtaining needed skills associated with professionally managed larger firms. In this way, fast-growing firms can take advantage of innovation-based opportunities while scaling up.

MG 8731 Introduction to Corporate Entrepreneurship *1.5:0:0:1.5*

Large firms require professional management. To innovate, however, large corporations often must also practice entrepreneurship. This course briefly introduces how large corporations nurture and sustain entrepreneurship. *Note: Not open to MSM, MSOB and continuing MBA students. The program will consider offering this course only at the request of other departments.*

MG 8733 Corporate Entrepreneurship *3:0:0:3*

Large firms require professional management. To innovate, however, large corporations often must also practice entrepreneurship. This course focuses on how large corporations nurture and sustain entrepreneurship and on how entrepreneurship is an integral part of a successful large firm's strategy and structure today. This course examines forms of internal entrepreneurship, corporate venture capital, and the obtaining of entrepreneurial capabilities via acquisition.

MG 8741 Introduction to Entrepreneurial Marketing and Sales *1.5:0:0:1.5*

This course introduces entrepreneurial marketing and sales and covers various topics about entrepreneurial marketing and sales. The program will consider offering this course only at the request of other departments. *Note: This course is not open to MSM and continuing MBA students.*

MG 8743 Entrepreneurial Marketing and Sales *3:0:0:3*

This course focuses on critical marketing and sales challenges facing entrepreneurial firms. The course examines an underlying theme of entrepreneurship: that successful innovative enterprises must deeply understand relevant markets and must effectively cultivate and

reach those markets. Topics include market identification, segmentation, sales, overall market planning, niche and viral marketing, and customers as sources of innovative ideas.

MG 8763 Knowledge Management *3:0:0:3*

Knowledge workers, employed primarily in professional and technical occupations, are increasingly becoming an important segment of the U.S. labor force. The success of innovative organizations today often results from the knowledge and skills applied by their professional and technical employees. Effective management of such a work force has become one of the most critical problems faced by organizations in the private and public sectors. Reflecting this problem, the course addresses issues relating to creating, sharing and applying knowledge in organizations. The course examines knowledge management from various perspectives, focusing primarily on the organizational, managerial and technological perspectives.

MG 8783 Managing Cloud Computing *3:0:0:3*

Many corporations and governments around the world are either planning or are in the process of migrating into a "Cloud". Cloud computing as a technology is proliferating at a rapid pace, and as such, there are myriad definitions, architectures, and models that are being developed. Cloud is a significant part of information management, and business managers should become well versed in managing and leading this cutting edge technology. They need to clearly understand how IT components such as virtualization, automation and security fit into and define a Cloud. This course provides a comprehensive overview of managing cloud computing. The course starts by developing a comprehensive technology foundation and then deals with the economics of cloud computing by analyzing its benefits, risks and obstacles. The course then examines Virtualization, Automation, and Security, the three essential components of cloud computing. Specific case studies on private and public clouds are illustrated. The course concludes with the development of specific templates and roadmaps that help an organization migrate from managing traditional IT into a cloud based infrastructure.

MG 9343 Research Project in Organizational Behavior *3:0:0:3*

Integration and application of advanced research techniques utilized in studies of organizations. Students develop and carry out individual applied research projects. *Prerequisites: Advanced standing and MG 6333 or instructor's permission.*

MG 9683 Technology Management-Internship and Action Learning *3:0:0:3*

This course provides graduate students with the opportunity to work in the field in an action-learning context under faculty supervision. This course exposes graduate students to relevant, state-of-the-art and best practices in modern technology management from the perspective of reflective involvement and interaction in the field.

MG 9703 Project in Strategy and Innovation *3:0:0:3*

This course integrates concepts and theories from several other courses. The course usually considers issues from a holistic and top-management perspective; employs case studies and projects to focus on key interrelationships between strategy, technology, innovation, corporate culture, organization structure and human factors; and covers domestic and global corporations, small, medium and large firms; and established and new enterprises. *Prerequisite: Advanced standing.*

MG 9753 Selected Topics in Management *3:0:0:3*

Students analyze and discuss current topics in various fields. *Prerequisites: Advanced standing and Department's Chair's permission.*

MG 9763 Readings in Management *3:0:0:3*

This directed individual study of supervised readings explores advanced areas of management. *Prerequisite: Department Chair's permission.*

MG 9771 Readings in Management *1.5:0:0:1.5*

This directed individual study of supervised readings discusses advanced areas of management. *Prerequisite: Department Chair's permission.*

MG 9781 Selected Topics in Management *1.5:0:0:1.5*

Students analyze and discuss current topics in various fields. *Prerequisites: Advanced standing and Department Chair's permission.*

MG 9853 Selected Topics in Organizational Behavior *3:0:0:3*

This course discusses and analyzes current topics in organizational behavior. *Prerequisites: Advanced standing and instructor's permission.*

MG 9861 Readings in Organizational Behavior *1.5:0:0:1.5*

Directed individual study or supervised readings in advanced areas of organizational behavior. *Prerequisite: Academic Director's permission.*

MG 9873 Readings in Organizational Behavior *3:0:0:3*

Directed individual study or supervised readings in advanced areas of organizational behavior. *Prerequisite: Program Director's permission.*

MG 9973 Thesis for Degree of Master of Science *3:0:0:3*

Students choose original investigation topics for their theses. While they conduct research and draft their theses, students are required to confer with their advisers and to submit progress reports. A final written report is required at completion. The department may request an oral examination. *Prerequisites: Degree status and approval of supervising professor, MSM Program Director and TM department chair.*

If you were Chairman of the Board what innovation objectives would you assign to your CEO?
If you were your boss what innovation objective would you assign to yourself?

MANAGEMENT OF TECHNOLOGY EXECUTIVE MASTER'S PROGRAM (eMOT)

Program Director: Joseph Nadan

OVERVIEW

The Management of Technology Executive Master's Program (eMOT) was created for working professionals who aim to make a difference in an economy where bridging the technology and business worlds is crucial. It introduces participants to the latest thinking and best practices in technology management and innovation. For forward-thinking managers, the eMOT Program is a proven and unique path to leadership in the Twenty-First Century.

One of the first accredited universities to offer an advanced degree in MOT, the Polytechnic Institute of NYU is a recognized leader in the field, and has offered the MOT program for almost two decades. Rather than grafting a few courses onto a traditional MBA program, the MOT Program possesses a thoroughly innovative integrated curriculum. The program is well-suited for engineers and scientists with increasing managerial responsibility, as well as professionals, functional and business managers, and entrepreneurs in financial services, IT, security, design, retailing, media/entertainment and other increasingly technological environments.

KEY CHARACTERISTICS OF THE eMOT PROGRAM:

- Provides knowledge to manage technology-intensive corporations.
- Focuses on strategic implications of technology and innovation and entrepreneurship.
- Encompasses innovation management in all modern technology arenas such as financial and professional services, media/entertainment, bio-medical / Pharma / chemical, new materials, IT and telecommunications.
- Deals with the impact of technology and innovation throughout an enterprise.
- Addresses physical, digital (including Internet-based) and mobile innovation.
- Enables key transition from technologists to high-level, effective technology managers.
- Assumes a global perspective.
- Explores and develops new business models based upon technology-enabled innovation.

In the eMOT curriculum, even traditional subjects such as finance, operations management and marketing are taught with technology-enabled-innovation issues in mind. Subjects, concepts and issues directly related to technology management and accessing innovative capabilities that form the eMOT Program core include:

- Customers, suppliers and other partners as sources and co-creators of innovation
- New product and services development
- The global search for innovation and technology and choosing among increasingly global technology sources and markets, including Europe, the Pacific Rim, Israel, India and others
- Entrepreneurship
- Integrating technology and management
- Venture capital and venture creation
- The Internet and the Web-innovation as new platforms for innovation
- Innovation-friendly cultures and organizations
- The IT-innovation connection
- Revitalized R&D
- High-technology products and services
- Strategic technology planning and innovation-intensive new product business models
- Knowledge management
- Technology selection and acquisition
- Multiple and diverse levers for technology-enabled innovation

eMOT is an executive program. As such, it has the following general features:

- Full-semester and half-semester courses to use limited time effectively.
- Carefully selected elective courses to maintain flexibility in meeting diverse professional needs.
- A blend of live classes and modern Web-based technology.
- Effective technology-enabled remote-collaboration learning and teamwork learning materials that are often in digital Web-based format to capitalize on Internet-based technologies and methods.

eMOT has four focused concentration areas: Bio-Pharma, Management of Technology and Innovation in Financial Services (MOTIFS), Management of Technology and Innovation Media and Entertainment (MOTIME) and Management of Technology and Innovation in Retailing (MOTIR).

eMOT classes are held every other week on Wednesday or Thursday evenings and all day Saturday at 55 Broad Street, in the heart of lower Manhattan. An all-inclusive fee covers tuition and fees, textbooks and other educational material, special tutorials and lectures and meals on class days. For the most Current Information, visit http://www.poly.edu/academics/programs/management-technology-ms.

EXECUTIVE FORMAT

The eMOT Program is based on a cohort system in which all participants enter at the same time and take the same courses throughout the program except when electives are selected. eMOT is a rigorous 15-calendar month, four-semester state-of-the-art program. The MOT Program is also offered in non-Executive format; please refer to the Management of Technology catalog pages. Additional features of the executive format include:

- Close interaction and teamwork.
- A professional, modern, and informal learning environment.
- Close collaboration with respected partners in industry and relevant scholarly communities.
- A curriculum that is continually updated.
- Participants viewed as partners in the learning process (in class and in the joint generation of intellectual capital as presentations, reports or cases—in paper and digital formats).

KEY BENEFITS OF THE MANAGEMENT OF TECHNOLOGY (eMOT) PROGRAM AT NYU-POLY

Key benefits of the program include:

- An emphasis on managing technology, nurturing innovation and entrepreneurship.
- Integration of local, regional and global perspectives.
- Active involvement of highly respected faculty in management and engineering and applied science.
- A focus on leadership.
- A holistic educational approach that connects the worlds of technology and business.
- Modern learning methods, e.g. individualized and team-based coaching, experiential project-based education, and advanced learning platforms.
- Close involvement with leading companies, entrepreneurial ventures, and professional services firms.
- Information reflective of modern value creation as practiced in the nation's most advanced global city.
- Participants who complete this program will receive a Master of Science in Management of Technology from the Polytechnic Institute of New York University.

LOCATION
The eMOT is principally offered at our Manhattan Graduate Center in the Wall Street financial district. Some courses may be offered at other locations.

COACHING AND MENTORING PROGRAM
The NYU-Poly Technology Management Department faculty recognizes the impact that mentors and coaches have in accelerating the development of aspiring managers. All full-time Executive students participate in this unique Coaching and Mentoring Program that includes individual and group meetings with a coach/mentor. Each full-time Executive student has a one-on-one intake interview with their coach/mentor and is then encouraged to seek advice on significant work related presentations and special situations. The coach/mentor and student then develop a Personal Development Plan based upon the intake interview and several confidential online assessments, and then review progress against its objectives at least once a semester. The continuing program consists of group meetings held once a month during which topics of common interest are discussed and to-be-scheduled individual sessions in which students may discuss matters on a confidential basis with their coach/mentor.

OPTIONAL COURSE AUDITING
Full-time Executive students may elect, at no additional costs and with permission from the Program Director and Instructor, to supplement their degree program by auditing one additional course per semester within the Graduate School.

GUEST SPEAKERS
The Metro NYC area is blessed with an abundance of thoroughly experienced highly-qualified technology managers that have valuable knowledge and insight into many of the topics that are taught in the eMOT and Executive Master's Program in Information Management eIM programs. Professors often invite guest speakers to their classes to enrich coursework and enable our students to learn from their experiences and have an opportunity to discuss timely topics directly with them.

JUMP-STARTING ENTREPRENEURSHIP
NYU-Poly introduced a new mode of education we call invention, innovation and entrepreneurship (i^2e). We believe that research universities have to expand to provide not just education and research, but economic impact. Students in our executive programs embody this philosophy by managing technological innovation to launch new products, services and businesses within their own companies or as startups within our business incubation centers.

ADMISSIONS REQUIREMENTS
Admission to the eMOT Program is based on an in-depth evaluation of a candidate's academic record, work experience and overall intellectual and professional qualifications and potential. Applicants must demonstrate strong commitment and an ability to benefit professionally from a rigorous 15 month executive program. Because of the heavy demands of this program, it is important that employers also explicitly support such professional education. In general, GRE and GMAT tests are not required for applying to the xMOT Program. But the Department of Technology Management may ask an applicant to submit scores later in the admissions process. This program does not accept transfer credits. Applicants should apply online.

HOW TO APPLY
The Executive Master's Degree Program uses an admission process called the Self-Managed Application (SMA). Applicants must gather the required materials and forward them in a single envelope to:

Administrative Director
Executive Master's Degree Programs
Polytechnic Institute of NYU
55 Broad Street, Suite 13B
New York, NY 10004

APPLICATION CHECKLIST
1. Complete the application and attach a professional resume and the application fee.
2. A Statement of Purpose that describes in brief:
   a) Prior background and experience
   b) Motivation in pursuing graduate studies
   c) Long-term career goals
3. Please ask the registrar at all colleges and universities attended to send official transcripts directly to the applicant. For the transcripts to remain official, they must be sealed in the original envelope. Opened transcripts are not considered official.
4. Please arrange for two (2) letters of recommendation to be sent directly to the applicant. These letters are generally from a supervisor or high-level colleague who knows the applicant's professional work. As with transcripts, to be considered official, recommendations must be sent directly from the recommender to the applicant and remain unopened. Use the enclosed forms for this purpose. The applicant should write his or her name at the top, sign the waiver if they do not wish to see the recommendation and give one form and one enclosed envelope to each person writing in support of the application.
5. The final step for admission is an interview with the Program Director to discuss career objectives and to make sure the program fits the applicant's goals.

For more information, contact the eMOT Program Administrative Director:
Tel: (718) 260-4015
Fax: (718) 260-3874
Or e-mail: xmot@poly.edu

eMOT CURRICULUM
The eMOT 36 credit curriculum consists of 24 credits of core courses and 12 credits of elective courses. To give students greater flexibility in choosing electives, the program has both full-semester courses that are 3.00 credits each and half-semester courses (marked with **) that are 1.50 credits each. Students may substitute one full-semester elective with two half-semester electives or vice-versa.

CORE COURSES
First Semester
MG 6013 Organizational Behavior
MG 6093 Managerial Accounting and Finance
MG 8653 Managing Technological Change and Innovation

Second Semester
MG 6083 Managerial Economics
MG 6933 Information Technologies, Systems and Management in Organizations
Full-semester Elective

Third Semester
MG 6073 Marketing
Full-semester Elective
MG 9501 MOT Capstone-1 **
Half-semester Elective **

Fourth Semester
MG 7953 Global Innovation
Full-semester Elective
MG 9511 MOT Capstone-2 **
Half-semester Elective **

eMOT CONCENTRATIONS
Elective courses are grouped into five different areas of interest referred to as concentrations:
- The **Management of Technology (MOT)** business-driven base-program concentration trains technology-based professionals to lead and oversee the process of invention, innovation, and entrepreneurship — what we call i^2e.
- The **Management of Technology in Financial Services (MOTIFS)** concentration allows finance professionals to convert their understanding of information technology and innovation into high-level managerial decisions and strategies.

- The **Management of Technology in Media and Entertainment (MOTIME)** concentration teaches managers in the media sector to leverage a firm's competencies and gain a competitive advantage in the marketplace.
- The **Management of Technology in Retailing (MOTIR)** concentration helps retailing managers translate a keen understanding of information technology, e-business, and technological innovation into effective managerial decisions and strategies.
- The **Management of Technology in Bio-Pharma (MOTIBP)** concentration gives BioPharma managers the skills to address risk management, lead project teams toward new innovation, and concentrate a firm's resources on improving internal processes.

SUGGESTED FULL-SEMESTER ELECTIVE COURSES GROUPED BY CONCENTRATION

All full-semester elective courses are 3.00 credits. All eMOT students may, with the written permission of the Program Director, substitute any of the following courses for any full-semester elective:

MG 8573 Managing Cleantech and Renewable Energy Innovation
MG 8783 Managing Cloud Computing
MG 9683 Technology Management-Internship and Action Learning

All eMOT students may take full-semester electives from any of the following concentration areas:

Second semester:
MG 6703 Operations Management for Knowledge-Based Enterprises
Third semester:
MG 7743 Advanced Trends in Technology Manage ment and Innovation
Fourth semester:
MG 8203 Project Management and Assessment for Technology Managers

Management of Technology in Financial Services (MOTIFS)
Second semester:
MG 7963 Modern Financial Institutions and their Competitive Environment
Third semester:
MG 6043 Innovation Management in Money, Banking and Financial Markets
Fourth semester:
MG 7983 Managing Technological Innovation and Emerging Technologies in Financial Services

MANAGEMENT OF TECHNOLOGY AND INNOVATION IN MEDIA AND ENTERTAINMENT (MOTIME)
Second semester:
MG 6753 The Media and Entertainment Sector: Structure, Organization and Management
Third semester:
MG 6763 Managing Emerging Technologies in the Media and Entertainment Sector
Fourth semester:
MG 6773 Advanced Trends in Innovation and Technology in the Media and Entertainment Sector

MANAGEMENT OF TECHNOLOGY AND INNOVATION IN RETAILING (MOTIR)
Second semester:
MG 7653 The Retailing Industry: Structure, Organization and Management
Third semester:
MG 7663 Managing Technological Innovation and Emerging Technology in the Retailing Industry
Fourth semester:
MG 7671 Global Retailing and Supply Chain Management
MG 7881 Modern Supply Chain Management: Integration through Technology

MANAGEMENT OF TECHNOLOGY IN BIO-PHARMA (MOTIBP)
Second semester:
MG 7713 The Bio-Pharma Sectors: Structure, Organization and Management
Third semester:
MG 7723 Managing Technological Innovation and Emerging Technologies in the Bio-Pharma Sectors
Fourth semester:
MG 7733 Emerging Trends in Innovation and Technology in the Bio-Pharma Sectors

HALF-SEMESTER ELECTIVE COURSES

All half-semester elective courses are 1.50 credits. All eMOT students may take any of the following half-semester electives.

MG 7811 Selected Topics in Networking and Information Technologies
MG 7841 Negotiation in Technology-intensive Sectors
MG 7851 Leadership
MG 7861 High-technology Entrepreneurship
MG 7871 Introduction to Managing Intellectual Property
MG 7891 Special Elective Topics for eMOT and eIM
MG 7971 Financing for Value Creation
MG 9501 eMOT CAPSTONE-1
MG 9511 eMOT CAPSTONE-2

COURSES DESCRIPTIONS

CORE COURSES

The following eMOT courses are unique to the Executive Master's in Management of Technology Program.

MG 6013 Organizational Behavior *3:0:0:3*

This course increases the student's ability to understand and effectively lead people and groups in organizations. The course draws on concepts from the social sciences (psychology, social psychology and sociology) and explores their implications for managerial practice and leadership. It emphasizes interpersonal relations and team processes, but also includes the discussion of issues, such as organizational culture and change. The course emphasizes team work and thus provides students with the opportunity to use their team experience as a laboratory for learning. Course objectives include introducing current concepts and principles from social science to leadership issues in organizations and applying these concepts to personal and work situations; providing opportunities to participate and learn about team work; and allowing students to examine their behavior and beliefs about leadership and managerial behavior.

MG 6073 Marketing *3:0:0:3*

This course introduces marketing concepts, processes and institutions; positioning, segmentation and product life cycles. It focuses on integrating marketing with new product planning, design and development. Strategies for technology-based products, services and processes are discussed. Other topics include market research, consumer behavior, advertising, promotion and sales, global marketing and marketing on the Internet.

MG 6083 Managerial Economics *3:0:0:3*

This course focuses on microeconomic analysis and the macroeconomic environment for managers. It discusses the economic basis for managerial decisions in production, investment and technology strategy. Topics include the economics of the firm; business cycles; economic growth; international trade; financial institutions; currency systems; economics of innovation and entrepreneurial activity; the role of technology in economic growth and in international competition.

MG 6093 Managerial Accounting and Finance *3:0:0:3*

This course covers the principles and practices of the modern finance function, including accounting and corporate finance and their relevance for all information business managers. Topics discussed include strategic perspectives—balancing long-term development and short-term returns; financing of ventures and innovative activities; project selection, capital budgeting and risk analysis. Special emphasis is placed on financial decision making in the information business sectors and the financial assessment of increasingly important knowledge-intensive assets.

MG 6933 Information Technologies, Systems and Management in Organizations *3:0:0:3*

This course is for managers who need to understand the role and potential contribution of information technology (IT) within organizations. The focus is on information

technology and its business applications. The course concentrates on the current state of IT in organizations; challenges and strategic use of IT; IT infrastructure and architecture; the technical foundation of IT; building and implementing organization information systems; and emerging issues in IT, such as intelligent systems, business process re-engineering, knowledge management and group support systems. Course format is interactive with concept presentation followed by open discussion of real-world applications of IT and business cases.

MG 7953 Global Innovation *3:0:0:3*

This course focuses on global technology-enabled innovation. Topics covered include accessing global sources of innovation, coordination and organization of activities worldwide, new product development globally, the role of revitalized global R&D, growing prominence of IT and e-Business in global innovation and the role of alliances and linkages with customers, suppliers and other third parties.

MG 8653 Managing Technological Change and Innovation *3:0:0:3*

The course focuses on effectively managing technological change and innovation, which is accomplished with a dual perspective. One perspective is based on individual, group and organizational theory, research and practice. This body of literature, viewpoints and experience provide essential guides to manage successfully the introduction of new technologies. Realizing the full potential of new technologies requires effectively managing change to assure the commitment of all stakeholders. The second perspective is based on innovation theory, research and practice. This body of literature, viewpoints and experience provide key insights for effectively managing the process of innovation and the impact of innovation on all parts of an enterprise.

MG 8783 Managing Cloud Computing *3:0:0:3*

Many corporations and governments around the world are either planning or are in the process of migrating into a "Cloud". Cloud computing as a technology is proliferating at a rapid pace, and as such, there are myriad definitions, architectures, and models that are being developed. Cloud is a significant part of information management, and business managers should become well versed in managing and leading this cutting edge technology. They need to clearly understand how IT components such as virtualization, automation and security fit into and define a Cloud. This course provides a comprehensive overview of managing cloud computing. The course starts by developing a comprehensive technology foundation and then deals with the economics of cloud computing by analyzing its benefits, risks and obstacles. The course then examines Virtualization, Automation, and Security, the three essential components of cloud computing. Specific case studies on private and public clouds are illustrated. The course concludes with the development of specific templates and roadmaps that help an organization migrate from managing traditional IT into a cloud based infrastructure.

MG 9503 eMOT Capstone Project Course *3:0:0:3*

This course provides an integrative and state-of-the-art intellectual experience for participants at the conclusion of the program. The course is divided into two half semesters. The first half semester enables participants to focus on discerning the overarching trends which are driving innovation in various industry sectors. The class is divided into small groups each of which develops a comprehensive view of a particular industry sector. In the second half of the course, participants focus on the culminating project of the eMOT Program. Participants can choose to do their final projects on firms, issues related to technology management or as an outgrowth of the emphasis on entrepreneurship in the program, a business plan. Participants are encouraged to employ relevant concepts and insights that they have acquired during the course of the program.

MG 9501 eMOT Capstone-1 *1.5:0:0:1.5*

First half of the eMOT Capstone course. Please see MG 9503 eMOT Capstone Project Course for full description. Both MG 9501 and MG9511 courses may be taken in same semester.

MG 9511 eMOT Capstone-2 *1.5:0:0:1.5*

Second half of the eMOT Capstone course. Please see MG 9503 eMOT Capstone Project Course for full description. Both MG 9501 and MG9511 courses may be taken in same semester.

FULL-SEMESTER ELECTIVES

MG 6043 Innovation Management in Money, Banking and Financial Markets *3:0:0:3*

This is an intensive course that examines the critical management issues of the management of financial institutions. The principal focus of the course is on interplay between the economic and technological developments in the management of modern financial institutions.

MG 6703 Operations Management for Knowledge-Based Enterprises *3:0:0:3*

This course focuses on developing a deeper understanding of the role that operations management plays in determining business strategy and in developing competitive advantage. The primary emphasis is on developing and effectively managing operations in knowledge-intensive enterprises. Students discuss the operational design and managerial implications when the emphasis of the operations group is more on knowledge management than on managing production and facilities; managing the effective integration of technology, people and operating systems; understanding the complexities and challenges of operations management; meeting the challenges of developing and managing supply-chain networks; and understanding the critical role of technology in developing an organization's operational capabilities.

MG 6753 The Media and Entertainment Sector: Structure, Organization and Management *3:0:0:3*

This course introduces the various industries that compose the media sector and outlines the major issues confronting these industries as they grapple with incorporating digital-based and mobile innovations into their businesses. Discussions cover the structure of industries within the sector and how managers are recalibrating their business models and redesigning their organizations to compete in the current media and entertainment sector. Other issues covered include the new media industry as a catalyst for change; the transformation of traditional content-intensive industries, such as the motion picture business, the book publishing business, the newspaper business and the music industry; and the newly defined role of users and customers. Participants read case studies and articles and access other relevant materials in electronic and print format. Emphasis is on interactive discussions in class and on projects developed by individual participants and teams of participants.

MG 6763 Managing Emerging Technologies in the Media and Entertainment Sector *3:0:0:3*

This course focuses on selected emerging technologies that are changing the nature of competition in the media sector. The dynamic relationships involving changing technology, business processes and management response are viewed in light of new digital platforms

and applications, standards development, as well as legal and legislative initiatives. Topics include intellectual property rights and digital rights management; content-on-demand; and the management, archiving and preservation of digital content.

MG 6773 Advanced Trends in Innovation and Technology in the Media and Entertainment Sector *3:0:0:3*

This course explores important trends and issues with a significant impact on managing technological innovation in the media sector. The course covers a range of topics, which may vary year to year and which serve as a culmination of the ideas and issues discussed in the MOTIME track. Participants develop projects that reflect their interests in particular aspects of the sector. Examples are redefinition of the notion of convergence; the intersection of design, content and technology; and the globalization of the media industry.

MG 7653 The Retailing Industry: Structure, Organization and Management *3:0:0:3*

This course introduces the emerging structure of the modern retailing industry and effective retailing management. Students investigate how key firms in the modern retailing sector are managed and how pacesetting firms are organized and structured at both the strategic and operational levels. The course covers physical and internet-based retailing.

MG 7663 Managing Technological Innovation and Emerging Technologies in the Retailing Industry *3:0:0:3*

This course introduces technological innovation and emerging technologies in retailing. The focal point is the effective management of technological innovation in modern retailing. Also discussed are the role of technology platforms and applications, technology development and use, and the relationships between technologies and business processes.

MG 7713 The Bio-Pharma Sectors: Structure, Organization and Management *3:0:0:3*

This course introduces effective management in the modern bio-Pharma sectors. Students investigate how key bio-Pharma firms are organized and managed at both the strategic and operational levels. Particular attention is paid to various forms of technology and innovation management in the bio-Pharma arena.

MG 7723 Managing Technological Innovation and Emerging Technologies in the Bio-Pharma Sectors *3:0:0:3*

This course introduces technological innovation and emerging technologies that are changing the nature of competition in the bio-Pharma sectors. It focuses on modern approaches for research and discovery of new molecules and on developing processes to manufacture them in large quantities. The course explores the two major routes for discovery and manufacturing: the "chemical" route and the "biological" route. Students receive a blend of conceptual overviews, essential technical and scientific basics, competitive, and the regulatory and management implications of the developments, cases and industry examples that are studied.

MG 7733 Emerging Trends in Innovation and Technology in the Bio-Pharma Sectors *3:0:0:3*

This course covers selected important trends and issues that have a major influence on managing innovation and technology in the bio-Pharma sectors. The course also covers a range of topics. It includes written papers, team presentations, readings and invited speakers. The course is integrative, and requires students to apply knowledge gained in the Management of Technology Program. Actual topics explored may vary year to year.

MG 7743 Advanced Trends in Technology Management and Innovation *3:0:0:3*

This course explores several emerging trends in the technology management and innovation arena in the past decade. These trends include the advent of digital-based innovation in the late 1990s, which has affected profoundly how many firms conduct business; the effect of the crash of the NASDAQ in March 2000 and the September 11 attack that affected corporations, which then had to operate within major economic and creative constraints; the development of the concept of networks as it relates to a firm's organization and strategy; the development of the wireless technology platform and its effect on technology innovation; and the development of a new innovation paradigm that suggests a relationship between information technology, creativity and business practices. The course emphasizes classroom discussions and team-based and individual projects.

MG 7963 Modern Financial Institutions and Their Competitive Environment *3:0:0:3*

This course focuses on managing modern financial enterprises, innovation and technology management in these organizations, and the risk-return tradeoff from a financial institution perspective. It deals with the theory and practice of financial institutions by analyzing the regulatory, technological and competitive factors that define the dynamics of this rapidly changing industry. Knowledge in this course is developed primarily with a mix of textbook reading and discussions of concepts in real business contexts through case studies. The objective is to provide technology managers with a firm knowledge of the normative consequences on financial-management decision making to create shareholder value.

MG 7983 Managing Technological Innovation and Emerging Technologies in Financial Services *3:0:0:3*

This course, for current and future managers, introduces emerging information technologies and their applications in financial services industries. It covers three major financial services industries: banking, investment and insurance. Students develop a deeper understanding of concepts and analyze real-business context through case studies. The course provides adequate technical knowledge and discusses related managerial issues in depth.

MG 8203 Project Management and Assessment for Technology Managers *3:0:0:3*

This course focuses on managing technology-based projects, ranging from individual research and development to large-scale and complex technological systems. Topics include feasibility and risk analysis; project selection and portfolio optimization; alternative financing methods; functional and administrative structures; coordination and scheduling of activities; personnel planning; negotiations; contracts and computer-based techniques; and cost estimation, capital budgeting, cost controls and effective matrix management. Students use case studies and project-management software.

HALF-SEMESTER ELECTIVES

MG 7811 Selected Topics in Networking and Information Technologies *1.5:0:0:1.5*

This course explores in-depth selected modern networking and information technologies. Specific topics vary year to year. Examples are mobile communications, IP telephony, enterprise data systems. The course builds on previous TIM courses. Students receive a solid technology grounding in a learning context that also emphasizes how these selected technologies affect markets, industries, providers, integrators and users. The course's technical content is supplemented by case examples and guest speakers.

MG 7841 Negotiation in Technology-Intensive Sectors *1.5:0:0:1.5*

Negotiation is the art and science of creating good agreements. This course covers the science of negotiation by discussing and applying theories of negotiation. The art of negotiation is learned by practice. Students develop the art by negotiating with each other in realistic cases. A wide variety of negotiation applications is covered, including one-time and repeated negotiation, single and multi-issue negotiations, and two-party and multi-party bargaining. The class emphasizes negotiations in technology-intensive environments. This class is taught using the case method. Many examples are cases that students negotiate with each other. Students' grades are based on their performance in these negotiations and on class participation.

MG 7851 Leadership *1.5:0:0:1.5*

Leaders set a vision, communicate it well and influence and inspire others to achieve their vision. However, leaders face many challenges in effectively meeting these objectives and can be aided or handicapped by effective and ineffective methods. This course develops the student's leadership approach by analyzing individual styles, understanding their impact and then enabling each student to create the right leadership style. This course addresses fundamental leadership issues and frameworks, drawing on current organizational research, but most of all it provides students with ways of getting insights on their own leadership style. The course emphasizes hands-on experience and focuses on experiential learning. Course objectives include assessing leadership styles; developing leadership skills; and understanding the role of leadership coaching in managing teams.

MG 7861 High-Technology Entrepreneurship *1.5:0:0:1.5*

This course focuses on entrepreneurship as a critical engine for wealth creation in the high-technology, innovation-intensive economy. It covers such key issues as: (1) assessing attractiveness of opportunities; (2) launching a new venture; (3) obtaining the necessary financial, human and technology resources; (4) managing the transition from a small entrepreneurial firm to a large, sustainable professionally managed but still entrepreneurial corporation; and (5) being an entrepreneur and promoting entrepreneurship in a large corporation.

MG 7871 Intellectual Property for Technology and Information Managers *1.5:0:0:1.5*

This course focuses on the role of intellectual property (e.g., patents, trade secrets, copyrights, trademarks, etc.) as a major element in modern technology and information strategy. Relevant concepts and case studies use examples of classical and digital innovations.

MG 7881 Modern Supply Chain Management: Integration through Technology *1.5:0:0:1.5*

This course introduces the role of information technology in supply-chain management. Both qualitative and quantitative aspects of supply chain management are covered. Students discuss and analyze articles pertaining to leading-edge research and management thought. The underlying objective is to prepare participants to develop useful skills for analyzing technology, marketing, logistics, operations and broader channel-management issues. Classes use the case method. A high level of class interaction is expected.

MG 7891 Special Elective Topics for eMOT and eIM *1.5:0:0:1.5*

This course covers selected key emerging trends and issues in the MOT and IM domains. The course involves discussion with industry leaders and specialists from business, government and academia. The course includes topical treatment of technologies, markets, business practices, government regulations and the relationships among them.

MG 7971 Financing for Value Creation *1.5:0:0:1.5*

This course focuses on creating strategies and financial skills required by managers of entrepreneurial and innovative firms at various stages of evolution: from new, stand-alone entrepreneurial ventures to innovative, technology-driven projects of established corporations.

MG 7671 Global Retailing and Supply Chain Management *1.5:0:0:1.5*

This course focuses on current theory and practice in global retailing and supply-chain management and the link between globalization and supply-chain management. The course examines the flow and transformation of goods from the raw-material stage to the end user. Another focus is the globalization of retailing, which has triggered a range of supply-chain innovations.

MANAGEMENT OF TECHNOLOGY PROGRAM (FORMERLY - ACCELERATED MANAGEMENT OF TECHNOLOGY PROGRAM)

Academic Director: Joseph Nadan
Administrative Director: Vivek Veeraiah

OVERVIEW
The Polytechnic Institute of NYU Master's Degree Program in Management of Technology (MOT) was created for professionals who aim to make a difference in an economy where bridging the technology and business worlds is crucial. It introduces participants to the latest thinking and best practices in technology management and innovation. For forward-thinking managers, the MOT Program is a proven and unique path to leadership in the Twenty-First Century.

One of the first accredited universities to offer an advanced degree in MOT, the Polytechnic Institute of NYU is a recognized leader in the field, and has offered the MOT program for almost two decades. Rather than grafting a few courses onto a traditional MBA program, the MOT Program possesses a thoroughly innovative integrated curriculum. Whether a student is a recent college graduate, or in the early, middle, or advanced stages of their career, the MS program in Management of Technology at NYU-Poly prepares students to take part in this process of invention, innovation, and entrepreneurship — what we like to call i^2e.

The MOT program also welcomes students into a community of learners that includes faculty, strategic partners, industry leaders and business networks around the world. The Institute for Technology and Enterprise (ITE) — New York's premiere research and educational hub for management and innovation — is one of our major partners. It hosts round-tables and workshops with industry leaders and scholars, ensuring our students benefit from a wealth of resources and ideas.

KEY CHARACTERISTICS OF THE MOT PROGRAM:
FLEXIBLE SCHEDULING
The MOT program is offered with a curriculum that bridges the gap between technology and business, and may be completed in accelerated (4), full-time (3), or part-time (2) or (1) formats in anywhere from 10 to 44 months. The number in parentheses represents the number of 3.0 credit courses completed in each semester in each format. Due to this scheduling flexibility, it is well-suited for engineers and scientists with increasing managerial responsibility, as well as professionals, functional and business managers, and entrepreneurs in financial services, IT, security, design, retailing, media/entertainment and other increasingly technological environments. Courses take place in the evening, which means there is minimal disruption to a student's busy daytime routine.

GOALS AND OBJECTIVES
By the time students graduate from the MOT program, they will:
- Possess the tools to analyze strategic and global management issues;
- Be able to apply knowledge of technology and management in diverse settings;
- Understand how to formulate new business models around technology-enabled innovation; and
- Develop the skills and confidence to assume leadership positions in established firms, as well as new ventures.

ADMISSIONS CRITERIA
The MOT program is selective. Candidates must have an undergraduate degree from an institution of higher learning, either in the United States or abroad. Candidates must have a minimum 3.0 grade-point average or equivalent in their undergraduate degree. Candidates are required to take the Graduate Management Admission Test (GMAT) or Graduate Record Examination (GRE). International students must take the TOEFL exam.

HOW TO APPLY
The MOT Master's Degree Program uses a Self-Managed Application (SMA) admission process in which applicants gather the required materials and forward them in a single envelope to:

MOT Program Administrative Director
Polytechnic Institute of NYU
55 Broad Street, Suite 13B
New York, NY 10004

APPLICATION CHECKLIST
1. Complete the application and attach a professional resume and the application fee.
2. A Statement of Purpose that describes in brief:
   a) Prior background and experience
   b) Motivation in pursuing graduate studies
   c) Long-term career goals
3. Please ask the registrar at all colleges and universities attended to send official transcripts directly to the applicant. For the transcripts to remain official, they must be and remain sealed in the original envelope. Opened transcripts are not considered official.
4. Please arrange for two (2) letters of recommendation to be sent directly to the applicant. These letters are generally from a supervisor or high-level colleague who knows the applicant's professional work. As with transcripts, to be considered official, recommendations must be sent directly from the recommender to the applicant and remain unopened. The applicant should write his or her name at the top, sign the waiver if they do not wish to see the recommendation and give one form and one enclosed envelope to each person writing in support of the application.

For more information, contact the MOT program Administrative Director:
Tel: (718) 260-4015
Fax: (212) 547-7029
Or e-mail: mot-im@poly.edu

PROGRAM STRUCTURE AND CURRICULUM

The MOT Program comprises 12 courses (see listing below) for 36 credits. Courses for the MOT program are held during the evening at 55 Broad Street in Lower Manhattan and at the Brooklyn campus of Polytechnic. Full-time students may complete this MS program in 10 calendar months by completing 4 courses per semester for 3 semesters or in 15 calendar months by completing 3 courses per semester for 4 semesters. Part-time students may take from one to two courses per semester, completing the program in 22 to 44 calendar months. Participants in the MOT Program receive a Master of Science in Management of Technology. The MOT Program is also offered in Executive format; please refer to the Management of Technology Executive Master's Program catalog pages. For most current information, visit http://www.poly.edu/amot

Required Courses
MG 6093 Managerial Accounting and Finance
MG 8653 Managing Technological Change and Innovation
MG 6013 Organizational Behavior
MG 6503 Management of Information and Information Systems*
MG 6083 Managerial Economics
MG 6303 Operations Management
MG 6073 Marketing
MG 8203 Project Management
MG 7953 Global Innovation
MG 9703 Project in Strategy and Innovation Management

or
MG 9973 Thesis for Degree of Master of Science
Electives
Elective 1**
Elective 2**

* Note: To fulfill a requirement for a technology-related course, participants can substitute other courses given by the Department of Technology Management in this field, e.g., MG 6603 Management of New and Emerging Technologies; MG 7503 Electronic Business Management; or another technology-related course with permission of the Program Director.

** MOT Electives include any 3.0 credit graduate course offered by the Department of Technology Management, including MG 9683 Technology Management-Internship and Action Learning. With the MOT Program Director's permission, MOT students also may choose an elective 3.0 credit graduate courses offered by another NYU-Poly department.

COURSE DESCRIPTIONS

The MOT program's series of required courses provide participants with a deep understanding of the foundations of managerial competencies needed to manage innovation in the evolving business environment. In addition, participants can choose an elective from the Department of Technology Management or from other areas of the Institute that can enhance their understanding of a particular area of interest in the broadly defined arena of technology management.

MG 6013 Organizational Behavior *3:0:0:3*

This course increases the student's ability to understand and effectively lead people and groups in organizations. The course draws on concepts from the social sciences (psychology, social psychology and sociology) and explores their implications for managerial practice and leadership. It emphasizes interpersonal relations and team processes, but also includes the discussion of issues such as organizational culture and change. The course emphasizes team work and thus provides students with the opportunity to use their team experience as a laboratory for learning. Course objectives include introducing current concepts and principles from social science to leadership issues in organizations and applying these concepts to personal and work situations; providing opportunities to participate and learn about team work; and allowing students to examine their behavior and beliefs about leadership and managerial behavior.

MG 6073 Marketing *3:0:0:3*

This course introduces marketing concepts, processes and institutions; positioning, segmentation and product life cycles. It focuses on integrating marketing with new product planning, design and development. Strategies for technology-based products, services and processes are discussed. Other topics include market research, consumer behavior, advertising, promotion and sales, global marketing and marketing on the Internet.

MG 6083 Managerial Economics *3:0:0:3*

This course focuses on microeconomic analysis and the macroeconomic environment for managers. It discusses the economic basis for managerial decisions in production, investment and technology strategy. Topics include the economics of the firm; business cycles; economic growth; international trade; financial institutions; currency systems; economics of innovation and entrepreneurial activity; the role of technology in economic growth and in international competition.

MG 6093 Accounting and Finance *3:0:0:3*

This course covers the principles and practices of the modern finance function, including accounting and corporate finance and their relevance for all information business managers. Topics discussed include strategic perspectives—balancing long-term development and short-term returns; financing of ventures and innovative activities; project selection, capital budgeting and risk analysis. Special emphasis is placed on financial decision making in the information business sectors and the financial assessment of increasingly important knowledge -intensive assets.

MG 6303 Operations Management *3:0:0:3*

This course covers analytical techniques to design and operate production and service systems, including facility layouts and locations, capacity planning, job sequencing, inventory control and quality control. Topics include introductory linear programming and other formal methods, and case studies and computer usage.

MG 6503 Management of Information Technology and Information Systems *3:0:0:3*

This course is designed for managers who need to understand the role and potential contribution of information technologies in organizations. The focus of the course is on different information technologies and their applications in managing business critical data, information and knowledge. The course concentrates on the current state of IT in organizations, challenges and strategic use of IT, IT infrastructure and architecture, building, implementing and managing IT applications, and emerging issues such as intelligent systems, business process reengineering, knowledge management and group support systems.

MG 6603 Management of New and Emerging Technologies *3:0:0:3*

This course surveys and explores the business implications of selected new and emerging technologies with the potential to change business practices and create new industries. Technologies discussed include new Internet architectures, Wikis, Open Source, security issues, new Web services, social networking and Web 2.0. This course is for the manager who is interested in staying current with, and learning about, new technologies for use in business. No specific engineering background is required. A variety of reference texts, journals, case studies and websites is used.

MG 7503 Electronic Business Management *3:0:0:3*

This course investigates the management implications of electronic business. Topics include: (1) accelerated new product development; (2) impact of technology on the value chain: the changing role of intermediaries; (3) electronic commerce: business models and strategies for survival of general lifestyle; (4) implications of "being wired"; and (5) business applications involving collaborative communication, computation and teamwork. The course material is dynamic and Internet-based, reflecting the nature of change in electronic commerce and the IT industry, and the potential implications of electronic business for managers. Students work on a project that requires following developments in the business and IT press, interviewing managers and product developers and simultaneously testing and discussing current developments in the e-commerce market space. Classes use the case method, and a high level of class participation is expected.

MG 7953 Global Innovation *3:0:0:3*

This course focuses on global technology-enabled innovation. Topics covered include accessing global sources of innovation, coordination and organization of activities worldwide, new product development globally, the role of revitalized global R&D, growing prominence of IT and e-Business in global innovation, and the role of alliances and linkages with customers, suppliers and other third parties.

MG 8203 Project Management *3:0:0:3*

This course focuses on managing technology-based projects, ranging from individual research and development to large-scale and complex technological systems. Topics include feasibility and risk analysis; project selection and portfolio optimization; alternative financing methods; functional and administrative structures; coordination and scheduling of activities; personnel planning; negotiations; contracts and computer-based techniques; and cost estimation, capital budgeting, cost controls and effective matrix management. Students use case studies and project-management software.

MG 8653 Managing Technological Change and Innovation *3:0:0:3*

The course focuses on effectively managing technological change and innovation, which is accomplished with a dual perspective. One perspective is based on individual, group and organizational theory, research and practice. This body of literature, viewpoints and experience provide essential guides to manage successfully the introduction of new technologies. Realizing the full potential of new technologies requires effectively managing change to assure the commitment of all stakeholders. The second perspective is based on innovation theory, research and practice. This body of literature, viewpoints and experience provide key insights to for effectively managing the process of innovation and the impact of innovation on all parts of an enterprise.

MG 8783 Managing Cloud Computing *3:0:0:3*

Many corporations and governments around the world are either planning or are in the process of migrating into a "Cloud". Cloud computing as a technology is proliferating at a rapid pace, and as such, there are myriad definitions, architectures, and models that are being developed. Cloud is a significant part of information management, and business managers should become well versed in managing and leading this cutting edge technology. They need to clearly understand how IT components such as virtualization, automation and security fit into and define a Cloud. This course provides a comprehensive overview of managing cloud computing. The course starts by developing a comprehensive technology foundation and then deals with the economics of cloud computing by analyzing its benefits, risks and obstacles. The course then examines Virtualization, Automation, and Security, the three essential components of cloud computing. Specific case studies on private and public clouds are illustrated. The course concludes with the development of specific templates and roadmaps that help an organization migrate from managing traditional IT into a cloud based infrastructure.

MG 9703 Project in Strategy and Innovation Management *3:0:0:3*

This course integrates concepts and theories from several other courses. The course usually considers issues from a holistic and top management perspective; employs case studies and projects to focus on key interrelationships between strategy, technology, innovation, corporate culture, organization structure and human factors; and covers domestic and global corporations, small, medium and large firms; and established and new enterprises.

MG 9683 Technology Management-Internship and Action Learning *3:0:0:3*

This course provides graduate students with the opportunity to work in the field in an action-learning context under faculty supervision. This course exposes graduate students to relevant, state-of-the-art and best practices in modern technology management from the perspective of reflective involvement and interaction in the field. *Prerequisite: Approval of the Program Director.*

MG 9973 Thesis for Degree of Master of Science *variable credits*

Students choose original investigation topics for their theses. While they conduct research and draft their theses, students are required to confer with their advisers and to submit progress reports. A final written report is required at completion. The department may request an oral examination. *Prerequisites: Degree status and approval of the supervising professor, Program Director, and the Technology Management department chair. Note: For other elective MG course descriptions please refer to MS - Management program catalog pages.*

MANUFACTURING ENGINEERING PROGRAM

Program Director: Michael Greenstein

The Department of Manufacturing and Industrial Engineering offers a graduate program leading to a Master of Science in Manufacturing Engineering. In recent years, much has been written about how to improve the productivity, profitability and competitiveness of U.S. manufacturers, which have introduced many new approaches. The first wave of these centered on improving competitiveness by improving quality and reducing inventory and cycle time by focusing on design, introducing product-realization processes, and applying specific new methods such as Total Quality Management, Just-in-Time/Total Quality Control, new production-control systems, lean manufacturing and activity-based costing.

Polytechnic's program emphasizes these methods and supports them through courses in robust design and the design of experiment techniques. As for production, Polytechnic offers courses in computer integrated manufacturing and modern methods of production control such as Goldratt's synchronous manufacturing. Success in applying these new methods depends upon winning acceptance for their use. Thus the program addresses specifically how to overcome cultural barriers through courses in managing the human side of technological change and developing high-performance teams. Currently U.S. industry is focusing attention on reducing variability in production, thereby improving asset use and, hence, profitability and customer satisfaction. Polytechnic offers new courses in production science that specifically address these issues.

The department's comprehensive program in manufacturing engineering concerns this array of new methods, which are applicable generally and thus portable.

This program is interdisciplinary and suitable for full-time students, working professionals with responsibilities in manufacturing, and for those who plan to enter manufacturing after completing the master's program. Because hands-on experience is so important, the program often arranges for full-time students and part-time students who do not work full time to do internships with companies and apply their course work. Full-time students can complete the MS program, including an internship, in one year.

GOALS AND OBJECTIVES

The objectives of the MS program in Manufacturing Engineering include helping its students to:

- Develop expertise in methods used in a wide variety of industries to increase profitability and competitiveness by improving quality, cycle time, design and production in factories and supply chains;
- Develop expertise in computer-based programs used throughout industry to analyze problems and improve performance, including simulation, linear programming, project management, facility planning, and production planning and control;
- Cultivate a broad knowledge base by selecting a concentration of courses in manufacturing engineering and related fields that suit career needs; and
- Obtain hands-on experience through internships in local industry.

GRADUATE PROGRAM

The Master of Science in Manufacturing Engineering can be taken full time or part time. Students are drawn from a wide variety of manufacturing firms, large and small. This program:

- Enables graduates to identify, evaluate and implement production improvements by applying new methods;
- Provides experience in design and production through internships and projects;
- Provides hands-on experience in using software for design and simulation;
- Equips program graduates with a working knowledge of advanced methods and techniques used worldwide in manufacturing;
- Provides graduates with sufficient knowledge and hands-on experience to contribute significantly to productivity improvement and to provide the leadership required, thereby positioning them to advance their careers.

DESIRABLE BACKGROUNDS FOR GRADUATE STUDENTS

Admission to this graduate program is open to those holding an accredited engineering degree (BS or BE), to graduates in physics, chemistry, materials science and the biological sciences, and to those holding an MBA. International students with equivalent backgrounds are eligible for the program.

REQUIREMENTS FOR THE MASTER OF SCIENCE

The degree program requires 30 credits, 9 of which may be granted for up to three relevant graduate-level courses completed elsewhere with a grade of B or better. Issues relating to the transfer of courses are at the discretion of the Program Director.

MANUFACTURING ENGINEERING PROGRAM

Prerequisite Courses (or equivalent knowledge)

- Computer literacy
- Knowledge of engineering economics
- Understanding of probability and statistics

Students lacking the relevant knowledge must complete additional courses to satisfy these prerequisites.

Required Core Courses **12 credits**

MN 7893 Production Science
MN 6113 Quality Control and Improvement
MN 7923 Design for Manufacturability
MN 7993 Supply Chain Engineering

Other Courses **18 credits**

Students are required to take three electives from Manufacturing or Industrial Engineering for a total of 9 credits.

Three electives are taken from any other graduate curriculum with the approval of the Program Director to ensure that they are compatible with the student's professional objectives for a total of 9 credits.

Total **30 credits**

Students are encouraged to organize their electives into "concentrations." These concentrations satisfy the needs of students' careers and, for those who are working, the needs of the firm.

MASTER'S REPORT

MN 9963 MS Report is normally 3 credits and may be expanded to 6 credits by using MN 9973 as an elective. The master's report is done in an industrial lab setting whenever possible. Local industries with plants accessible to campus offer internships in many types of manufacturing.

Part-time students may draw upon their work to provide pertinent master's reports. Full-time students also may work on theoretical or experimental research projects at Polytechnic. In all cases, a faculty adviser is assigned. Written project proposals are

required at the start of the work. A written summary and report are required upon completion of the project.

CERTIFICATE PROGRAMS

The certificate programs are for professionals with work experience. A certificate program requires five courses, which are selected based on individual needs. Applicants for a certificate program must hold a bachelor's degree. Upon completing the sequence with a B average or better, the student receives a certificate. Students who are later admitted to study for a master's degree usually are able to apply all certificate course credits toward the master's degree. If students have taken the equivalent of any required courses as an undergraduate, they must work with their adviser to select substitute courses. Additional information is available from the department. The certificate programs are as follows:

CERTIFICATE IN SUPPLY CHAIN OPERATIONS

Overview

Supply Chain Operations is the most favored technique in today's industrial operations. Supply Chain Operations courses prepare professionals to

- understand how most industries manage their business today;
- know Supply Chain concepts, principles and approaches;
- apply suitable solutions and best practices in a work environment.

Technical professionals who have problem-solving skills and a quantitative aptitude and who seek to expand their knowledge of the field should take these courses.

MN 7953 Introduction to Supply Chain Operations (3 credits)
MN 7963 Supply Chain in Operations (3 credits)
MN 7973 Supply Chain Services and Administration (3 credits)
MN 7983 Supply Chain Infrastructure (3 credits)

CERTIFICATE IN TARGET COSTING

Overview

In today's markets, engineers must design and manufacture products at a cost that meets specified functionality, performance and quality levels while generating the desired profitability at the anticipated selling price over a particular period of time.

Target costing provides the product-realization process with a disciplined, quantitative method to optimize the trade-offs among marketing requirements, product features, company profitability, customer preferences and manufacturing capabilities. Target costing complements engineering technical skills by providing training in a practical application of engineering, design and manufacturing disciplines to a product-realization process. As a result, this process helps firms to meet customer expectations at a price that provides adequate profitability to the producer.

Companies have implemented target costing as a design methodology with great success. Training engineers and managers in target costing will enhance the performance of professionals as the organizations they work for.

MN 7503 Introduction to Target Costing—Customer Driven Product Design
MG 6093 Managerial Accounting and Finance
MN 7523 Quantitative and statistical techniques in Market Driven Design
MN 7533 Advanced case studies in Market Driven Design

CERTIFICATE IN MANUFACTURING EXCELLENCE BY DESIGN: HOLISTIC APPROACH

Required Courses:

MN 6123 Robust Design
MN 6513 Design Strategies
MN 7923 Design for Manufacturability

Elective Courses (choose 2):

MN 7713 Product Realization Process
MN 7883 Manufacturing Systems Engineering
MN 7963 Electronic Systems Manufacturing

CERTIFICATE IN MANUFACTURING ENGINEERING AND PRODUCTION SCIENCE

Required Courses:

MN 7883 Manufacturing Systems Engineering
MN 7893 Production Science
IE 6193 Production Planning and Control

Elective courses (choose 2):

MN 6113 Quality Control and Improvement
MN 6323 Building High Performance Teams

GRADUATE COURSES

The courses with MN designations below are followed by courses from other programs that commonly are taken by manufacturing engineering students.

MN 6113 Quality Control and Improvement *3:0:0:3*

This course provides students with a solid foundation in the cost of quality, quality assurance and quality management. Emphasis is placed on the basic tools of quality control such as control charts and their use, the concept of "out of control," acceptance sampling, variables and attributes charts, and producer's and consumer's risk. This course uniquely demonstrates the power of teams of people with different expertise to improve quality. A course project is required. *Prerequisite: MA 6513 or equivalent. Also listed under IE 6113.*

MN 6123 Quality Engineering Using Robust Design *3:0:0:3*

This course reviews broadly the procedures involved in improving the quality of manufacturing. By employing both Taguchi techniques, such as the use of signal-to-noise ratio representations and other techniques less sensitive to parameter interactions, a full spectrum of robust design methods are presented. Applications of these procedures are reviewed, including online troubleshooting methods to assure quality in manufacturing. *Prerequisite: MN 6113 or IE 6113. Also listed under IE 6123.*

MN 6303 Operations Management *3:0:0:3*

This course examines analytical techniques to design and operate production and service systems, including facility layouts and locations, capacity planning, job sequencing, inventory control and quality control. Topics include introductory linear programming and other formal methods. Students use computers and case studies. *Also listed under MG 6303.*

MN 6323 Building High Performance Teams *3:0:0:3*

Successful manufacturing programs require the teaming of a number of professionals having a variety of types of expertise, such as product design, manufacturing-process design, production engineering, quality control, testing and packaging. In the past, these individual experts were involved only in a serial fashion in the overall product realization process, with not very effective results. Considerable evidence suggests that uniting these experts in a consistent team produces substantial benefits. This course provides students with the skills and knowledge to build work-unit effectiveness. Topics include diagnosing team functioning, understanding group dynamics, and creating a productive team culture, surfacing and resolving critical issues, and implementing strategies for organizational support.

MN 6353 Quality Management *3:0:0:3*

This course examines how quality and overall customer satisfaction—as a primary objective of manufacturing and service operations—is a proven competitive weapon. Students learn the concepts and methods to build

quality into the management process. Total quality management (TQM) and similar approaches are covered through readings, cases and examples. *Also listed under MG 6353.*

MN 6463 Supply Chain Management *3:0:0:3*

This course introduces supply-chain management. Topics cover: Qualitative and quantitative aspects of supply chain management. The course objective is to: (1) introduce students to the standard business concepts (and associated terminology) involved in the retailing and supply-chain management arena; (2) develop student skills in understanding and analyzing retailing, marketing, logistics, operations, channel management and allied issues and the interactions between them; and (3) examine and discuss the important role played by technology and integration at various points in the supply chain. *Also listed under MG 6463.*

MN 6513 Design Strategies *3:0:0:3*

Product design is a major determinant of product cost, quality and customer satisfaction. This course explores the design process, including establishing customer requirements and developing product specifications, conceptual design, detailed design, design for manufacturability, competitive analysis and design for the environment. Computer-aided applications and case studies are reviewed.

MN 7503* Introduction to Target Costing—Customer Driven Product Design *3:0:0:3*

Target Costing is a disciplined process for determining and realizing a total cost at which a product with specified functionality must be produced to generate the desired profitability at its anticipated selling price. This course presents both the theoretical foundation and the practical application of Target Costing methodology to the product-realization process. The topics include basic accounting, principles of Target Costing, the Target Costing Process, quantifying the customer requirements, defining the product feature set, price forecasting, experience curves, cost- functionality tradeoffs and implementation check lists. The course includes a hands-on design project in which teams of students will apply the principles of target costing to design a new product. **Online version available.*

MN 7713 Product Realization Process *3:0:0:3*

Getting new products developed and to market is a major factor in determining global competitiveness. This course uses case studies to illustrate the product-realization process and the successful application of R&D, concurrent engineering, cross-functional teams, continuous improvement, computer applications, target costing and management of new-product development.

MN 7763 Manufacturing Resources Planning *3:0:0:3*

This course discusses computerized systems to run a manufacturing business effectively. Also discussed are the process of software specification, evaluation, selection and implementation. Other topics include manufacturing resources planning logic, enterprise resource planning, manufacturing-execution systems, inventory management and bill of materials. Several software systems and their features are highlighted. *Also listed under IE 7763.*

MN 7853 Computer Integrated Manufacturing Systems (CIMS) *3:0:0:3*

This course introduces the basic concepts of manufacturing products with complex processes that rely heavily on computer and data-processing technologies. All aspects relative to products and processes-planning, design, manufacturing, shipping are addressed from a variety of perspectives. Techniques to manage and optimize manufacturing productivity are explored. *Also listed under IE 7853.*

MN 7873* Lean Manufacturing *3:0:0:3*

This course provides an overview to the basic principles, and theories of lean manufacturing which involves identifying and eliminating non-value-adding activities in design, production, and supply chain management. Students will learn an integrated approach to efficient manufacturing with emphasis on synchronized product, quick changeover, cell design, visual factory, value stream, one-piece flow and understand the metrics used to monitor performance. *Also listed under IE 7873. *Online version available.*

MN 7883 Manufacturing Systems Engineering *3:0:0:3*

This course concentrates on contemporary techniques for product design and manufacture, including financials of the manufacturing firm, quality, reliability, Taguchi methods of product and process design, scale-up and partitioning, production flows, modern manufacturing methods such as Just-In-Time/Total-Quality-Control, pull and synchronized manufacturing. Cultural factors are also discussed. *Also listed under IE 7883.*

MN 7893 Production Science *3:0:0:3*

This course reviews just-in-time and synchronous manufacturing methods. It analyzes the basic dynamics of factories to understand the importance of congestion and bottleneck rates on cycle time and inventories. Analytical models are developed to study variability and randomness introduced by breakdown, setups and batching. Simulation studies are used to provide data on performance of transfer lines.

MN 7923* Design for Manufacturability *3:0:0:3*

This course introduces concepts and techniques for economical, functionally sound and high-quality product design for manufacture. The emphasis is on designing for easy robotic and manual assembly, and on using plastics effectively to reduce manufacturing costs. Managerial and organizational approaches and case studies of successful designs are reviewed. *Also listed under IE 7923. *Online version available.*

MN 7933* Environmental Health and Safety *3:0:0:3*

This course presents an overview of environmental, health and safety management. Students are introduced to management systems within a manufacturing operation. The course explores the motivations and strategies for environmental, health and safety management. Students learn about the mandatory standards along and about the technical and legal rationale for insuring that workers have a safe and healthy workplace. Because workers safety and health are protected by laws, these skills are needed to work effectively in operations; human resources and employee development as well as industrial relations. *Also listed under IE 7933. *Online version available.*

MN 7953 Basics of Supply Chain Operations Management *3:0:0:3*

Supply chain operations seeks to integrate and accelerate the flow of materials, information and cash, throughout the process of supplying goods or services. Supply chain operations optimizes the efforts of suppliers, manufacturers, warehouses, distributors, retailers and customers to create an efficient and robust process. On the service side the same concepts prevail with the suppliers, institutions, providers, administrators and customers. All businesses are part of a supply chain, and understanding and realizing this relationship leads to economies of time, mate-

rial, money and improved customer service.

MN 7963 Electronics Systems Manufacturing *3:0:0:3*

In this course, students understand that the physical design and manufacturability of modern electronics systems results from tradeoffs involving partitioning, electrical performance, cooling and mechanical stresses. Design parameters are derived to study the tradeoffs, along with specific examples from reverse-engineering studies. The current status and future directions of low-cost, high-volume manufacturing technologies are examined.

MN 7983 Supply Chain Infrastructure *3:0:0:3*

Effective supply chain operations require well-designed, quality products, and the echelons of the supply chain must operate as a team. These elements, also termed the infrastructure, are presumed to exist. The objective of this course is to provide detailed information on the infrastructure elements required to operate a competitive supply chain. This infrastructure will cover product design and development, quality, employee involvement and communication, supplier and customer relationships, logistics, warehousing, information technology and e-business. Among the topics covered in detail will be product realization process and product design; house of quality; quality improvement process; six sigma; kaizan; employee motivation; communication and team dynamics; logistics including networks, third and fourth party organizations; warehousing, including optimum location, innovative information technology and e-business models.

MN 7993 Supply Chain Engineering *3:0:0:3*

Students in this course gain an understanding of how companies plan, source, make and deliver their products with a global competitive advantage. The course stresses the engineering components in developing an integrated supply chain that covers the entire manufacturing enterprise. It looks at the supply-chain infrastructure and the velocities of different models. The focus is on understanding and detecting the constraints of the infrastructure and the lowest common denominator of the information system used. Students also gain an understanding of logistical networks and the optimizing of the various traffic and location alternatives. Synchronization of supply and demand is examined in detail, looking at variability in both processes with the objective of maximizing throughput and capacity, emphasizing partnering, e-commerce and the bullwhip effect. Finally, the course establishes global performance measurements that compare companies in different industries. *Also listed under IE 7993.*

MN 8643 New Product Development *3:0:0:3*

This course examines the dynamics of technology and the pressures of competition that drive enterprises to make their product-development and production processes strategically more effective and economically more cost and time efficient. The course covers the state of the art in new product activities for services and manufacturing firms. It also examine in-depth the linkages among marketing, technology and manufacturing technology. *Also listed under MG 8643.*

MN 8653 Managing Technological Change and Innovation *3:0:0:3*

This course focuses on how to manage effectively technological change and innovation by using a dual perspective. One perspective is based on individual, group and organizational theory, research and practice. This body of literature, viewpoints and experience provides essential guides to manage successfully the introduction of new technologies. Realizing the full potential of new technologies requires managing change effectively to assure 100 percent stakeholder commitment. The second perspective is based on innovation theory, research and practice. This body of literature, viewpoints and experience provides key insights to manage effectively the process of innovation and the impact of innovation on all parts of an enterprise. Specifically, explicit consideration is given to a firm's to manage and inspire people so that they can communicate and innovate effectively. *Also listed under MG 8653.*

MN 9113/9123 Selected Topics in Manufacturing Engineering I/II *3:0:0:3*

Areas not covered in other courses. Specific topics vary according to the instructor, who may be a visiting professor. Topics and prerequisites are announced during the term before the offering.

MN 9303/9313 Readings in Manufacturing Engineering I/II *each 3 credits*

In this course, students read selected papers and current literature in specialized area of study and are guided by a faculty member. The topic must be beyond the scope of regularly offered courses. The topic must be agreed upon by the student and adviser before registration. A written report on the topic is required. *Prerequisites: Approval of adviser, instructor and department head.*

MN 9963 MS Report I *3 credits*

This course is an independent project that demonstrates a student's professional maturity and graduate-level knowledge. Students, guided by an adviser, are expected to demonstrate experimental work, software development and extensive analyses. A student's report must include results in one or more of these areas: critical analysis and interpretation of pertinent literature. A required written report (unbound) should represent a worthy contribution. *Prerequisite: Adviser's approval.*

MN 9973 MS Report II *3 credits*

With approval by the graduate adviser, some students may take a 6-credit MS report. This report should be planned during registration for MN 9963. In such cases, MN 9973 is used for the second half of the registration. A grade of S or U is awarded in MN 9963 in these cases, and the letter grade given in MN 9973 applies to all 6 credits. *Prerequisite: Adviser's approval.*

THE FOLLOWING GRADUATE COURSES ARE OFFERED IRREGULARLY IN RESPONSE TO INDUSTRY DEMAND:

MN 7943 Physical Design of Products

MN 8023 Thermal Design of Electronics System for Performance and Reliability

MN 8043 Thermal Issues in Manufacturing Processes

MATHEMATICS PROGRAM

The Department of Mathematics administers the mathematics degree program. More information can be obtained from the department website, www.math.poly.edu, by calling (718) 260-3850 or by e-mailing chair@math.poly.edu.

Mathematics comprises abstraction, logic and quantitative reasoning. It is an indispensable tool for science and engineering. Today, mathematicians are employed by a wide range of companies, including Wall Street investment banks and government agencies, especially the National Security Agency. Polytechnic offers a complete spectrum of mathematics courses leading to bachelor's, master's and doctoral degrees. The degree programs provide not only a solid foundation in mathematics, but also extensive exposure to how mathematics is used in other fields of science and engineering. The department prides itself on providing each mathematics major, undergraduate or graduate, with extensive individual attention and a program tailored to individual needs.

UNDERGRADUATE PROGRAMS

The undergraduate program in mathematics provides a background for advanced study or subsequent research in mathematics and training for those students who expect to end their formal education with a bachelor's degree.

For science and engineering majors, mathematics provides the theory and methods essential to understanding the mathematical aspects of their respective fields.

With these objectives, the Department of Mathematics offers courses in mathematics and, for the mathematics major, specific programs leading to the Bachelor of Science degree. Students wishing to pursue a bachelor's degree in mathematics may elect to follow either of two courses of study. Students wishing to focus their studies within mathematics or to apply mathematics to other fields may elect the program leading to a BS in Mathematics. Students wishing to incorporate extensive physics into their mathematical training may elect the program leading to a BS in Mathematics and Physics. These two programs provide basic grounding in mathematical knowledge.

REQUIREMENTS FOR THE BACHELOR OF SCIENCE

Department	Courses	Credits
MA	1002, 1024/1324, 1124/1424, 2012, 2112, 2122, 2132, 2212, 2222, 2312, 2322, 3022, 3112, 4413, 4423, 4613, 4623	42
CS	1114	4
EG	1001	1
PH	1013, 2023, 2033, 2021, 2031	10
EN	1013W	3
HuSS	1023W	3
CM	1004	4
	Minor Specialties*	18
	Humanities/Social Science electives	18
	Free electives, with adviser's approval	25
	Total	**128**

* Minor specialty: at least 9 credits beyond the required courses in a single area of study other than mathematics. The sequence must be well integrated and consistent, thereby enabling the student to gain knowledge in an area other than mathematics. Students should consult the faculty adviser of the department of interest when selecting electives. This requirement may be satisfied by either two minor specialties or one 18-credit specialty. This work must be in addition to courses taken under other categories of the programs (e.g., required courses in physics do not count toward a minor in physics).

The following are possible specialities:

- Chemical Engineering
- Chemistry
- Computer Engineering
- Computer Science
- Electrical Engineering
- Management
- Mechanical Engineering
- Physics
- Psychology
- Transportation

Advanced placement credits may be given toward the first year of calculus. Students receiving grades of 4 or 5 in Calculus BC on advanced placement examinations in calculus conducted by the College Entrance Examination Board may be granted a maximum of 8 credits to be applied toward the 128-credit requirement for bachelor's degrees in mathematics.

DUAL MAJOR IN MATHEMATICS AND PHYSICS

Polytechnic offers undergraduates a dual major in mathematics and physics, according to the general rules described in the section Degree Requirements. Specific course requirements for this 128-credit degree must be approved by advisers from both the mathematics and physics programs. The dual major allows students to gain competence in two different and substantial fields of science to such an extent that, upon earning a bachelor's degree, they may qualify for industrial positions in two distinct areas or go on to graduate studies in either of the two subjects. The full description of the degree requirements for this program are listed in the Physics program section of the catalog.

MINOR IN MATHEMATICS

Students may obtain a minor in mathematics by taking 15 credits of mathematics courses, 8 credits of which are in addition to the major department's requirement in mathematics and must include two courses in Real Analysis. At least 6 of these 8 credits must be taken by students while enrolled at Polytechnic.

GRADUATE PROGRAMS

The Department of Mathematics offers graduate-level mathematics courses in analysis, geometry, topology, algebra, applied mathematics. These courses form a major portion of the work for advanced degrees in mathematics. They may also be taken by students in other departments to satisfy minor and elective requirements and by qualified pre-degree students who desire further study in graduate-level mathematics.

The department offers master's and doctoral degrees in mathematics. Departmental requirements for these degrees are supplemented by general requirements for advanced degrees set forth elsewhere in this catalog.

Outstanding students are advised to apply for research fellowships, teaching fellowships or partial tuition remission.

REQUIREMENTS FOR THE MASTER OF SCIENCE

Bachelor's degrees in mathematics are required for admission to this program. Students with degrees in other fields may be admitted, possibly with undergraduate deficiencies, at the discretion of departmental advisers. Before beginning graduate studies, students are expected to have completed a one-year course in advanced calculus.

Thirty credits are required. Six credits may be devoted to a thesis.

Required (core) courses, 12 credits, 3 credits each:

Course No	Course Title	Credits
MA 7033	Linear Algebra I	3
MA 7043	Linear Algebra II	3
MA 6213	Elements of Real Analysis I	3
MA 6223	Elements of Real Analysis II	3

All options: Minimum of 15 credits (total) in mathematics courses.

There are three options for incoming MS students of Mathematics:

Thesis Option:
Electives: 12 credits
Master's Thesis: 6 credits

Requires an examination of the thesis material by faculty advisers and certification that the work is satisfactory.

Total: 30 credits

By Examination Option:
Electives: 18 credits, possibly with up to 9 from approved sub-specialties in other departments.

Includes a comprehensive oral examination before the degree is awarded. Examinations cover the student's program of study and are scheduled towards the end of the semester in which the work is completed.

Total: 30 credits

By Examination Option + Designated Sub-specialty Option:
Elective: 18 credits. At least 9 credits in courses approved for specialization by Department.

Includes a comprehensive oral examination before the degree is awarded. Examinations cover the student's program of study and are scheduled towards the end of the semester in which the work is completed.

Total: 30 credits

REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY

Requirements for the doctoral degree are primarily qualitative rather than quantitative. All students' programs require the approval of the guidance committee.

The number of graduate credits usually associated with the PhD in mathematics is 60 credits (course = 3 credits). The courses are to be selected from a well-balanced program in one major and two minor fields. The minor fields are encouraged to be chosen outside the Department of Mathematics, selected from such fields as applied mechanics, financial engineering, control theory, computer science, traffic engineering and electrical engineering. 39 credits of course work and at least 21 credits of thesis are required.

Required (core) courses, 12 credits, 3 credits each:

Course No	Course Title	Credits
MA 7033	Linear Algebra I	3
MA 7043	Linear Algebra II	3
MA 6213	Elements of Real Analysis I	3
MA 6223	Elements of Real Analysis II	3

A grade of A is necessary in these required courses for PhD credit (they may be repeated).

Only courses with grades of B or better can be used to satisfy the PhD requirements.

Students are required to pass a Part 0 written examination covering fundamental topics; a Part 1 written examination covering real and complex analysis and linear and abstract algebra and a Part 2 oral examination on topics chosen by the student and thesis adviser.

After passing the Part 2 examination, the student writes a dissertation under the supervision of a faculty adviser.

The final requirement for the PhD degree is a public oral exam on the student's dissertation.

Students must demonstrate the ability to read mathematical text written in French, German, or Russian.

UNDERGRADUATE COURSES

MA 0902 Introduction to Precalculus *6:0:0:2*

This course covers foundations of Algebra: exponents, multiplication of algebraic expressions, factoring algebraic expressions, working with algebraic fractions, proportionality, rates of change, equation of a line, completing squares, the quadratic formula, solving equations, system of linear equations, inequalities, domain and range of functions. *Prerequisite: placement exam. Note: credit for this course may not be used to satisfy the minimum credit requirement for graduation.*

MA 0912 Precalculus A *6:0:0:2*

This course covers exponential and logarithmic functions, transformations of functions; trigonometric functions. *Prerequisite: MA 0902. Note: credit for this course may not be used to satisfy the minimum credit requirement for graduation.*

MA 0922 Precalculus B *6:0:0:2*

Continuation of Precalculus: trigonometric functions, compositions, inverses and combinations of functions, polynomial and rational functions. *Prerequisite: MA 0912. Note: credit for this course may not be used to satisfy the minimum credit requirement for graduation.*

MA 0914 Precalculus *6:0:0:4*

This course covers foundations of algebra: exponents, multiplication of algebraic expressions, factoring algebraic expressions, working with algebraic fractions, proportionality, rates of change, equation of a line, completing squares, the quadratic formula, solving equations, systems of linear equations, inequalities, domain and range of functions, exponential and logarithmic functions, compositions, transformations of functions, right triangles, trigonometry of triangles. *Prerequisite: placement exam. Note: credit for this course may not be used to satisfy the minimum credit requirement for graduation.*

MA 0954 Calculus for Business and Life Sciences IA *6:0:0:4*

This course covers the fundamentals of algebra with a focus on Management and the Life Sciences. The topics include: foundations of algebra, solving equations, exponents, working with algebraic expressions, working with algebraic fractions, proportionality, rates of change, lines in the plane, completing squares, the quadratic formula, systems of linear equations, inequalities, graphs, exponentials, logarithms, inverses, compositions, transformations of functions and right angle trigonometry. *Prerequisite: placement exam. Note: course required only for specific Majors in place of MA 0914. Credit for this course may not be used to satisfy the minimum credit requirement for graduation.*

MA 1002 The Art of Mathematics *2:0:0:2*

This is an introductory course about Mathematics. Areas of Mathematics. History of Mathematics. Mathematical Methods. Great Mathematicians. Famous open and solved mathematical problems. The study of Mathematics. Mathematical Software.

MA 1024 Calculus I / MA 1324 Integrated Calculus I *4:0:0:4 / 6:0:0:4*

This course covers: Library of functions, functions of one variable. Limits, derivatives of functions defined by graphs, tables and formulas, differentiation rules for power, polynomial, exponential and logarithmic functions, derivatives of trigonometric functions, the product and quotient rule, the chain rule, applications of the chain rule, maxima and minima, optimization. MA 1324 is for students who wish to take MA 1024 but need more review of precalculus. MA 1324 covers the same material as MA 1024 but with more contact hours a week, incorporating a

full discussion of the required precalculus topics. *Prerequisite: Placement exam or MA 0912 or MA 0914.*

MA 1054 Calculus I with Precalculus *6:0:0:4*

This course covers limits, definition of the derivative, differentiation rules for polynomial and trigonometric functions, applications of the chain rule and introduction to optimization. This Calculus I course provides an in-depth review of precalculus. *Prerequisite: Placement exam, MA 0954, or MA 0912 or equivalent. Note: course required only for specific majors in place of MA 1024/1324.*

MA 1124 Calculus II/MA 1424 Integrated Calculus II *4:0:0:4 / 6:0:0:4*

This course covers definite integrals, theorems about integrals, anti-derivatives, second fundamental theorem of calculus, techniques of integration, introduction to ordinary differential equations, improper integrals, numerical methods of integration, applications of integration, sequences, series, power series, approximations of functions via Taylor polynomials, Taylor series. MA 1424 is for students who wish to take MA 1124 but need more review of precalculus. MA 1424 covers the same material as MA 1124 but with more contact hours a week, incorporating a full discussion of the required precalculus topics. *Prerequisites: MA 1024 or MA 1324. Note: credit for this course may be used to satisfy the minimum credit requirement for graduation.*

MA 1132 Numerical Methods for Calculus *4:0:0:2*

Parametrized curves. Elementary Numerical Analysis. Introduction to differential equations. Solution of first and second order linear differential equations with constant coefficients. Use of mathematical software to solve differential equations. Fourier series. *Prerequisite: AP credit or transfer credit for Calculus I and II.*

MA 1154 Calculus II with Precalculus *6:0:0:4*

This course covers the first and second derivative, optimization problems, antiderivatives, fundamental theorem of calculus, techniques of integration, logarithmic and exponential functions, numerical methods of integration, applications of integration, introduction to differential equations, introduction to series. This Calculus II course provides an in-depth review of precalculus. *Prerequisite: MA 1054. Note: course required only for specific majors in place of MA 1124/1424.*

MA 1252 Calculus for Business and Life Sciences IIA *6:0:0:2*

This course covers antidifferentiation, the definite integral, integration by substitution, the Fundamental Theorem of Calculus, area enclosed between curves, average value, integration by parts, introduction to differential equations, improper integrals, numerical integration. *Prerequisite: MA 1054. Note: course required only for specific majors.*

MA 2012 Elements of Linear Algebra I *4:0:0:2*

This course introduces vector concepts. Linear transformations. Matrices and Determinants. Characteristic roots and eigenfunctions. *Prerequisite: MA 1124 or equivalent.*

MA 2054 Applied Business Data Analysis I *4:0:0:4*

This course covers applications of theories of random phenomena to problems in business management. Topics include probability theory, discrete and continuous probability distributions, sampling, measures of central value and dispersion, sampling distributions, statistical estimation and introduction to hypothesis testing. Use of statistical software is integrated with the previous topics; examples are drawn from problems in business decision-making. Applications to advanced statistical applications in business management. Emphasis is on application of concepts. Use of statistical software integrated with the previous topics. *Prerequisite: MA 1054 or equivalent. Note: Course required only for Management Majors. Credit for this course may not be used to satisfy the requirements for other majors.*

MA 2112 Multivariable Calculus A *4:0:0:2*

This course introduces Multivariable Calculus. Analysis of functions of several variables, vector valued functions, partial derivatives, optimization techniques. *Prerequisite: MA 2012.*

MA 2122 Multivariable Calculus B *4:0:0:2*

This course continues Multivariable Calculus. Multiple integrals, parametric equations, vector fields, line integrals, surface integrals and major theorems concerning their applications. *Prerequisite: MA 2112.*

MA 2132 Ordinary Differential Equations *4:0:0:2*

This course covers first order differential equations: modeling and solving. Stability of autonomous equations. Higher order linear ordinary differential equations: Solution bases, Wronskian and initial value problems. Linear systems of first-order differential equations with constant coefficients: Elimination and eigenvalue method of solution. Elementary concepts of numerical analysis. Numerical solution of initial value problems for ordinary differential equations. *Prerequisite: MA 2012.*

MA 2212 Data Analysis I *4:0:0:2*

This course covers basic theory of probability. Random variables. Distributions. Expectation. Functions of a random variable. Descriptive statistics. Data description. Sampling distributions. Use of statistical software is integrated with previous topics. *Prerequisite: MA 1124 or equivalent.*

MA 2222 Data Analysis II *4:0:0:2*

This course covers point and interval estimation. Hypothesis testing. Linear regression. One-way analysis of variance. Use of statistical software is integrated with the previous topics. *Prerequisite: MA 2212.*

MA 2312 Discrete Mathematics I *4:0:0:2*

This course covers logic and induction. Sets and functions. Recursive definitions. Counting techniques. Inclusion-exclusion principle. *Prerequisite: MA 1124 or equivalent.*

MA 2322 Discrete Mathematics II *4:0:0:2*

This course covers recurrence relations and generating functions. Equivalence relations and partial orderings. Graphs and connectivity of graphs. Trees and sorting. Boolean algebra, languages and finite state machines. *Prerequisite: MA 2312.*

MA 3012 Introduction to Probability I *4:0:0:2*

This course covers probability of events. Random variables. Discrete and continuous distributions. Joint distributions. Expectation. Functions of a random variable. *Prerequisite: MA 2112 or equivalent. Note: Not open to students who have taken MA 2212.*

MA 3022 Probability Theory II *4:0:0:2*

This course covers multivariate random variables, moment generating functions, properties of expectation, limit theorems and gives an introduction to random processes and their applications. *Prerequisite: MA 2212 or MA 3012.*

MA 3112 Complex Variables I *4:0:0:2*

This course covers functions of a complex variable. Derivatives and Cauchy-Riemann equations. Integrals and Cauchy integral theorem. Power and Laurent Series. Residue theory. *Prerequisite: MA 2122 or equivalent.*

MA 3103 Problem Solving and Proofs *3:0:0:3*

This course covers mathematical problem-solving, proofs and innovative reasoning. Discussion of independent challenging problems from Analysis, Complex Analysis, Probability, Combinatorics, Linear Algebra, Number Theory and Graph Theory. *Prerequisites: MA 2312 and MA 2012.*

MA 3203 Linear Optimization *3:0:0:3*

This course examines linear optimization problems with constraints; optimality conditions and duality theory, the simplex method, complexity of the simplex method, interior point methods, selected applications, network flow problems and the network simplex method. *Prerequisites: MA 2312 and MA 2112.*

MA 3303 Differential Geometry *3:0:0:3*

This course covers curves and surfaces. Curvature. First and second fundamental form. Gaussian curvature. Geodesics, Minimal Surfaces. Gauss-Bonnet Theorem. *Prerequisite: MA 2122.*

MA 3914 Project in Mathematics I *4:0:0:4*

In this course, students read, study and investigate selected topics in mathematics. Problems are discussed and presented by participating students. *Prerequisite: approval of departmental adviser.*

MA 4013 Introduction to Number Theory *3:0:0:3*

This course covers properties of integers and prime numbers. Congruences. Theorems of Fermat, Euler and Wilson. Quadratic residues. Diophantine equations. *Prerequisite: MA 1124 or equivalent.*

MA 4023 Elements of Abstract Algebra *3:0:0:3*

This course covers basic properties of groups, rings, fields, Euclidean rings and modules. Field extensions and Galois theory. Finite fields. *Prerequisite: MA 2012.*

MA 4113 Introduction to Mathematical Statistics *3:0:0:3*

This is a standard first course in mathematical statistics, recommended for those who will take advanced courses in statistics. Topics covered: Sampling distributions, tests of hypotheses, significance tests, point and interval estimation, regression and analysis of variance. *Prerequisite: MA 3012 or MA 2222.*

MA 4123 Statistical Methods *3:0:0:3*

This course covers analysis of variance with simple experimental designs. Topics covered: Sampling procedures, including sequential analysis. Nonparametric statistical methods. Statistical decisions. *Prerequisite: MA 4113.*

MA 4133 Time Series *3:0:0:3*

This course examines properties of time series, regression methods, linear processes, moving average processes, autoregressive processes, ARIMA models, autocorrelation, nonstationarity, parameter estimation, forecasting, regression models, ARCH, GARCH models, applications. *Prerequisite: MA 2222.*

MA 4413 Applied Partial Differential Equations *3:0:0:3*

This course looks at the heat equation, homogeneous and non-homogeneous boundary conditions, Green's function, separation of variables, Fourier series and Fourier transform, Maximum principle, existence and uniqueness, Poisson integral formula, the wave equation. Shock waves, conservation laws. *Prerequisites: MA 2132 and MA 3112.*

MA 4423 Introductory Numerical Analysis *3:0:0:3*

This course covers: Polynomial interpolation and approximation of functions. Divided differences. Least-squares data fitting, orthogonal polynomials. Numerical differentiation and integration. Solution of nonlinear equations. Gaussian elimination, pivoting, iterative refinement, conditioning of matrices. Numerical solution of ordinary differential equations. *Prerequisites: MA 2132 and some experience in computer programming.*

MA 4433 Complex Variables *3:0:0:3*

This course covers: Functions of a complex variable. Derivatives and Cauchy-Riemann equations. Integrals and Cauchy integral theory. Power and Laurent series. Residue theory. Conformal mappings. Schwarz-Christoffel transformations. *Prerequisites: MA 2132 and MA 3112.*

MA 4613/4623 Analysis I/II *each 3:0:0:3*

This course covers the study of basic topics in analysis with emphasis on methods. Sequences, series, functions, uniform convergence, continuity, partial differentiation, extreme value problems with constraints, Riemann integrals, line integrals, improper integrals, integrals with parameters, transformations, Riemann-Stieltjes integral, uniform and absolute convergence of integrals. Beta and Gamma functions. *Prerequisites for MA 4613: MA 2122 and MA 2132. Prerequisite for MA 4623: MA 4613. Note: This course is required for MA minors.*

MA 4924 Project in Mathematics II *4:0:0:4*

In this course, students read, study and investigate selected topics in mathematics. Students discuss and present problems. *Prerequisite: Departmental adviser's approval.*

MA4993 Thesis for Bachelor of Science Degree *3:0:0:3*

The course provides the framework for a Bachelor's thesis. In the Bachelor's thesis, a student reports on an independent investigation of a topic in Mathematics that demonstrates an in-depth knowledge of that area of Mathematics and proficiency in using its specific methods. *Prerequisite: Departmental adviser's approval.*

GRADUATE COURSES

MA 5313 Applied Mathematics in Engineering and Science I *3:0:0:3*

This course covers: Use of matrix algebra techniques in applications. Vector spaces. Solutions of linear algebraic equations. Linear independence. Rank of matrix. Linear transformations. Orthogonality. Gram-Schmidt procedure. Orthogonal matrices. Eigenvalues and eigenvectors. Spectral decomposition. Similarity transformations. Pseudoinverses. Singular value decomposition. Jordan form. Condition numbers of matrices. Iterative methods for eigenvalues of symmetric matrices. *Prerequisites: MA 2122 and MA 2132 or equivalent. Note: Not acceptable for graduate credit in the Department of Mathematics.*

MA 5323 Applied Mathematics in Engineering and Science II *3:0:0:3*

This course covers: Some common partial differential equations, boundary conditions, separation of variables. Wave equation, dif-

fusion equation, Laplace equation. Axial symmetry and spherical symmetry. Adjoint operators and Sturm-Liouville problems. Expansions in orthogonal eigenfunctions. Method of Frobenius. Bessel functions. Integral representations. Asymptotic expansions. Legendre polynomials. Spherical harmonics. Spherical Bessel functions. *Prerequisite: MA 5313. Note: Not acceptable for graduate credit in the Department of Mathematics.*

MA 5413 Stringology: Mathematics of String Comparisons in Computational Biology *3:0:0:3*

The course addresses basic combinatorial problems of string manipulation, string matching, string editing, string distance computations, arising from areas of text processing, computational biology and genomics. Classical, modern and entirely new approaches to these problems are presented with all necessary mathematical and computer science backgrounds (including coding theory and symbolic manipulation). Emphasis is on practical and effective algorithm implementations.

MA 6003 Elements of Discrete Mathematics *3:0:0:3*

This course covers logic, sets and functions, algorithms, analysis of algorithms. Mathematical models, primitives of naïve set theory. Covered topics: Mathematical reasoning, methods of proof, mathematical induction, recursive definitions, recursive algorithms, Counting, the Pigeonhole principle, discrete probability, recurrence relations, generating functions, inclusion-exclusion. Introduction to graph theory, counting and algorithm analysis, relations, graphs, Boolean algebras, circuits. Turing Machines, algorithm complexity. Introduction to algebraic structures. *Prerequisite: Adviser's approval.*

MA 6013 Applied Matrix Theory I *3:0:0:3*

This course covers the basics of linear algebra and matrix theory. Topics included: Vector Spaces, linear combinations, affine combinations, linear dependence, affine dependence, bases, dimension, isomorphism, subspaces, calculus of subspaces, dimension of subspaces, dual vector spaces and dual bases, direct sums of vector spaces, quotient spaces, bilinear forms, tensor products, permutations, cycles, parity, linear transformations, transformations as vectors, polynomials, inverses, matrices, matrices associated with linear transformations, invariance, reducibility, projections, adjoints, change of basis, similarity. *Prerequisites: MA 2012 and MA 2122 or equivalent.*

MA 6023 Applied Matrix Theory II *3:0:0:3*

This course is the sequel to MA 6013, basics concepts of linear algebra and matrix theory. Topics covered: Linear mappings, their range and null spaces, tensor product of transformations, determinants, eigenvalues, multiplicities, triangular form, nilpotence, Jordan form, inner products, inner product spaces, orthogonality, completeness Schwarz's inequality, complete orthonormal sets, the projection theorem, linear functionals, self-adjoint transformations, polarization, positive transformations, isometries, change of orthonormal basis, characterization of spectra, the spectral theorem, normal transformations orthogonal transformations, functions of transformations, polar decomposition, commutativity. Applications for matrices and for differential equations. *Prerequisite: MA 6013.*

MA 6103 Graph Theory *3:0:0:3*

This course covers: Graphs and digraphs, subgraphs, paths, cycles, trees and forests. Contraction and minors. Vertex-connectivity and edge-connectivity. Structure of k-connected graphs. Menger's theorem. Planar graphs, drawings and embeddings. Graph colorings: vertex-coloring, edge-coloring, list-coloring. Perfect graphs. Network flows, Ford-Fulkerson Theorem. Matching, Packing and Covering. Ramsey theory. Extremal graph theory, Szemeredi's regularity lemma. Hamilton cycles. Random graphs. The probabilistic method. Tree-decompositions, tree-width. The graph minor theorem. *Prerequisite: MA 6003 or adviser's approval.*

MA 6123 Queueing Theory *3:0:0:3*

This course covers: Steady-state solutions for single and multiple channels. Various arrival and service distributions and queuing disciplines. Transient solutions. Emphasis on theory, with solution techniques given for specific classes of queues. *Prerequisite: MA 6003 or adviser's approval.*

MA 6133 Elements of Number Theory *3:0:0:3*

This course covers: Prime numbers, the fundamental theorem of arithmetic, linear Diophantine equations. Fermat's Little Theorem, Wilson's Theorem, Euler's theorem. Linear congruences, Chinese Remainder Theorem, Euler phi function, Moebius inversion. Primitive roots and indices, quadratic congruences, Quadratic reciprocity law. Perfect numbers, sums of squares, Siegel's theorem. The prime number theorem. Computational number theory, primality testing, Cryptography. Elliptic curves. *Prerequisite: MA 6003 or adviser's approval.*

MA 6143 Optimization: Linear and Nonlinear Programming *3:0:0:3*

This course covers: Theory and application of linear programming techniques. Simplex and revised simplex algorithms. Duality theory, dual simplex method, post-optimality analysis. Degeneracy. Transportation and assignment problems. Quadratic programming, Kuhn-Tucker conditions. Wolfe's method. *Prerequisite: MA 6003 or adviser's approval.*

MA 6213 Elements of Real Analysis I *3:0:0:3*

This course and its sequel MA6223 rigorously treat the basic concepts and results in real analysis. Course topics include limits of sequences, topological concepts of sets for real numbers, properties of continuous functions and differentiable functions. Important concepts and theorems include supremum and infimum, Bolzano-Weierstrass theorem, Cauchy sequences, open sets, closed sets, compact sets, topological characterization of continuity, intermediate value theorem, uniform continuity, mean value theorems and inverse function theorem. *Prerequisite: MA 2122 or permission of adviser.*

MA 6223 Elements of Real Analysis II *3:0:0:3*

This course continues MA 6213. The topics are integration, series of real numbers, sequences and series of functions and Fourier series. Important concepts and theorems include Riemann and Riemann-Stieltjes integral, fundamental theorem of calculus, the mean value theorem of integrals, Dirichlet test, absolute and conditional convergence, uniform convergence, Weierstrass test, power series, orthogonal functions and Fourier series. *Prerequisite: MA 6213.*

MA 6233/ MA 6243 Theory of Ordinary Differential Equations I/II *each 3:0:0:3*

This course covers: Ordinary differential equations. Existence and uniqueness theorems. Linear systems. Isolated singularities. Self-adjoint eigenvalue problems. Geometric theory of differential equations in the plane. *Prerequisites: MA 6213 and MA 6223, MA 6233 for MA 6243.*

MA 6253/ MA 6263 Theory of Partial Differential Equations I/II *each 3:0:0:3*

This course covers: Partial differential equations. Cauchy-Kowalewski theorem. First-order differential equations, systems of differential equations in two variables, characteristics and classification, hyperbolic, parabolic and elliptic systems. Well-posedness. *Prerequisites: MA 6213 and MA 6223, MA 6253 for MA 6263.*

MA 6283 Mathematical Modeling in Biology *3:0:0:3*

This course covers: Linear and nonlinear difference equations for population growth and propagation. Stability. Competitive systems. Growth of microorganisms. Steady states in chemostats. Predator-prey models. Populations of infectious diseases. Michaelis-Menten kinetics. Cooperative reactions. Hodgkin-Huxlley equations. Fitzhugh-Nagumo model of nerve impulses. Conservation equations. Convection and diffusion of species. Transport in axon. Slime molds. Aggregation. Morphogenesis. *Prerequisite: MA 2122 and MA 2132.*

MA 6303 Elements of Complex Analysis *3:0:0:3*

This course covers: Complex numbers, analytic functions, Cauchy's theorem and consequences, isolated singularities, analytic continuation, open mapping theorem, infinite series and products, harmonic and subharmonic functions, maximum principle, fractional linear transformations, geometric and local properties of analytic functions, Weierstrass Theorem, normal families, residues, conformal mapping, Riemann mapping theorem, branch points, second order linear O.D.E.'s. *Prerequisites: MA 2122 and MA 2132 or equivalent. Note: Not open to students who have taken MA 3112 or MA 4433.*

MA 6313 Applications of Complex Analysis *3:0:0:3*

This course continues MA 6303. Topics covered: Residues, complex integration, Laplace transforms, Harmonic functions and classical examples from thermodynamics, electricity and magnetism, fluid flow, The Schwarz-Christoffel transformation. *Prerequisite: MA 6303.*

MA 6403 Elements of Geometry and Topology *3:0:0:3*

This course covers: Differential geometry in the plane. Introduction to transformation groups. Space curves and ruled surfaces. Tensors and exterior forms. Manifolds and tensor fields. Theory of surfaces. Introduction to Riemannian geometry. *Prerequisites: MA 2122 and MA 2132 or equivalent.*

MA 6513 Applied Statistics I (Data Analysis) *3:0:0:3*

This course covers: Treatment of statistical methods and application to analysis of data, fitting of functions to data. Estimation of population parameters, t-tests, chi square tests, rank tests. *Prerequisite: MA 1124 or equivalent.*

MA 6523 Regression-Analysis of Variance-Time Series Analysis *3:0:0:3*

This course discusses models and computational schemes associated with correlation, regression coefficients, analysis of variance and time series models. *Prerequisite: MA 4113 or MA 6513.*

MA 6583 Calculus of Variations *3:0:0:3*

This course covers: Classical problems, such as geodesics, brachistochrones, isoperimetric problems. Euler equations. Geodesic coverings. Weierstrass condition. Hamilton-Jacobi equation. First and second variations. Transversality. Convex sets and functions. Duality. Existence theorems. Generalized curves. Control theory. Time-optimal problems. Optimal processes. Extension of elementary theory of maxima and minima. Euler equations, conditions of Weierstrass, Legendre and Jacobi; Mayer fields; Hamilton-Jacobi equations; transversality; conjugate and focal points. Applications to geodesics, minimal surfaces, isoperimetric problems, Hamilton's principle, Fermat's principle, brachistochrones. *Prerequisite: MA 4623 or MA 6223.*

MA 6653 Numerical Analysis *3:0:0:3*

This course covers: Interpolation. Approximation of functions by polynomials. Fast Fourier transform. Numerical integration. Solution of nonlinear equations. Iterative improvement of solutions of linear equations. Eigenvalues of matrices. Numerical solution of ordinary differential equations. *Prerequisites: MA 2122, MA 2132 and some experience in computer programming.*

MA 6663 Numerical Solution of Partial Differential Equations *3:0:0:3*

This course covers: Stability, consistency and convergence of finite-difference methods for initial-value problems. Explicit and implicit schemes. Alternating direction methods and fractional-step methods. Iterative solutions of finite-difference equations for elliptic boundary value problems. Finite elements. Integral equation methods. Nonlinear semigroups, conservation laws and level set methods. *Prerequisites: MA 6013, MA 6653 and some experience in computer programming.*

MA 6683 Partial Differential Equations of Mathematical Physics *3:0:0:3*

This course covers: First and second order partial differential equations and systems of equations. Initial and boundary value problems. Fundamental solutions and Green's functions. Theory of characteristics. Eigenvalue problems. Rayleigh-Ritz and Ritz-Galerkin methods. Approximate and asymptotic methods. Nonlinear equations. Applications. *Prerequisite: MA 4623 or equivalent.*

MA 6813 Elements of Probability *3:0:0:3*
This course covers: Probability of events, distribution of random variables, joint distribution, transformations. *Prerequisites: MA 2122 and MA 3012 or equivalent.*

MA 6823 Stochastic Processes *3:0:0:3*

This course covers: Normal and stationary processes, Wiener processes, Poisson and renewal processes, Markov processes. *Prerequisite: MA 6813 or equivalent.*

MA 6833/6843 Statistical Inference I/II *each 3:0:0:3*

This course covers: Point and interval estimation of statistical parameters. Theory of statistical estimators. Fundamentals of statistical tests of hypotheses. Second semester: extended theory of hypothesis testing, including sequential tests. Nonparametric methods in statistics. *Prerequisite for MA 6833: MA 6813 or equivalent. Prerequisite for MA 6843: MA 6833.*

MA 6853 Multivariate Analysis *3:0:0:3*

This course covers: Multivariate normal distribution. Simple, partial and multiple correlation. Generalization of student's ratio. Tests of significance of sets of means. Tests of general linear hypothesis. Some generalizations of analysis of variance. *Prerequisite: MA 6843.*

MA 6863 Regression and Analysis of Variance *3:0:0:3*

This course covers: Linear regression of one or more independent variables. Least square estimates regression coefficients. Gauss-Markov theorem. Confidence regions for and tests of hypotheses about regression coefficients. Tests

of general linear hypothesis. Multiple classification in analysis of variance. Power of F-test. Alternative models: I and II, mixed models, analysis of covariance and components of variance. *Prerequisite: MA 6843.*

MA 6873 Nonparametric Methods in Statistics *3:0:0:3*

This course covers: Statistical methods not bound by assumption of known parametric form of the distribution of observations. Applications to engineering and scientific research in which observations are not ordered on a numerical scale. Order statistics, tolerance regions, permutation tests, goodness of fit tests, limiting distributions and large-sample properties of tests. *Prerequisite: MA 6813.*

MA 6913 / MA 6923 Time Series Analysis I/II *each 3:0:0:3*

In this course, students carefully study tractable models for statistical analysis of scalar time series. Models treated: (l) "error plus trend" models, (2) stationary stochastic process models with special emphasis on autoregressive models. Estimation, tests of hypotheses and multiple-decision procedures for these models. Spectral representation and filtering, estimation of spectral density. *Prerequisites for MA 6913: MA 6813 and MA 6843. Prerequisite for MA 6923: MA 6913.*

MA 7013 Abstract Algebra *3:0:0:3*

This course covers: Basic algebraic structures, groups, rings, fields, integral domains and modules. Field extensions and Galois theory. *Prerequisite: MA 6013 or equivalent.*

MA 7033 Linear Algebra I *3:0:0:3*

This course covers: Basic ideas of linear algebra: Fields, vector spaces, basis, dependence, independence, dimension. Relation to solving systems of linear equations and matrices. Homomorphisms, duality, inner products, adjoints and similarity. *Prerequisites: MA 2012 and MA 2122 or equivalent.*

MA 7043 Linear Algebra II *3:0:0:3*

This course continues MA 7033. Topics covered: Basic concepts of linear algebra continuing with: Range, nullity, determinants and eigenvalues of matrices and linear homomorphisms, the polar decomposition and spectral properties of linear maps, orthogonality, adjointness and its applications. *Prerequisite: MA 7033.*

MA 7213 Real and Complex Analysis I *3:0:0:3*

This course provides rigorously and comprehensively treats real analysis. Topics covered: Outer measure, Lebesgue measure, Lebesgue integral, convergence theorems, functions of bounded variation, integration in measure spaces, the Radon- Nikodyn Theorem and Fubini's theorm. *Prerequisites: MA 6213 and MA 6223 or equivalent.*

MA 7223 Real and Complex Analysis II *3:0:0:3*

This course continues MA 7213 and provides a rigorous and comprehensive treatment of complex analysis. Topics covered: Analytic and meromorphic functions, differentiation and integration, Cauchy's theorem, Morera's theorem, Power and Laurent series, residue theory, Rouche's theorem, conformal mappings, the Riemann mapping theorem and Riemann surfaces. *Prerequisite: MA 7213.*

MA 7313 / MA 7323 Functional Analysis I/II *each 3:0:0:3*

This course, together with its sequel MA 7323, introduces the language and methods of functional analysis. It covers normed spaces, Hilbert spaces, bounded linear functionals, Hahn-Banach theorem, the dual space, bounded operators, Fredholm theory of compact operators, self-adjoint operators and applications to classical analysis. *Prerequisites for MA 7313: MA 6013 and MA 7213. Prerequisite for MA 7323: MA 7313.*

MA 7333 Measure Theory I *3:0:0:3*

This course presents a unified treatment of that part of measure theory that is most useful for its application in modern analysis. Topics covered: Sets and classes, measures and outer measures, measurable functions, integration, general set functions, product spaces, transformations, probability. The dominated convergence theorem, Riesz Representation Theorem, Vitali-Caratheodory theorem, etc. are covered in conjunction with many examples. *Prerequisite: Graduate status.*

MA 7343 Measure Theory II *3:0:0:3*

This course continues MA 7333 and presents a unified treatment of that part of measure theory that is most useful for applications in modern analysis. Topics covered: Fubini's theorem, convolutions and distributions are applied to explicit examples. In this part, Baire's theorem,the Banach-Steinhaus theorem, the Open Mapping theorem, the Hahn-Banach Theorem are derived with the properties of the Radon-Nikodym derivatives to naturally generalize calculus both differential and integral. *Prerequisite: MA 7333.*

MA 7353 Fourier and Laplace Transforms *3:0:0:3*

This course presents in a unified manner the fundamentals of both continuous and discrete versions of the Fourier and Laplace transforms. Topics covered: Application of transform methods to partial differential equations of mathematical physics. Includes introduction to the Wiener- Hopf technique. *Prerequisite: Graduate status or permission of adviser.*

MA 7403 Topology *3:0:0:3*

This course covers: Topological spaces. Compactness, connectedness, continua, extension theorems and metrization theorems. Simplexes, simplicial topology and applications. Fixed point theorems. Graphs and networks. Homology and cohomology theory. Introduction to Morse theory. *Prerequisites: MA 6213 and MA 6223 or equivalent.*

MA 7503 Manifolds and Lie Groups *3:0:0:3*

This course covers: Elementary theory of manifolds. Tangent space, mappings, submanifolds, fields, fiber bundles, Lie groups, homogeneous spaces. Elements of the theory of connections, Riemannian geometry. Imbedded manifolds. Calculus of variations. Harmonic forms, complex manifolds and Morse theory. *Prerequisites: MA 6213 and MA 6223.*

MA 7543 Topological Methods in Analysis *3:0:0:3*

This course covers: Aspects of topological methods and applications to existence theorems in analysis. Use of fixed-point theorems and topological degree to study properties of solutions to ordinary and partial differential equations. No previous courses in topology are required. *Prerequisite: MA 4623 or MA 6223.*

MA 7603 / MA 7613 Topics in Algebra I/II *each 3:0:0:3*

Course content varies. In spring of the year before the course offering, a detailed description is posted and mailed to all graduate mathematics students. *Prerequisite for MA 7603: MA 7013. For MA 7613: MA 7603.*

MA 7623 / MA 7633 Topics in Linear Algebra I/II *each 3:0:0:3*

Course content varies. *Prerequisites for MA 7623: MA 7033 and MA 7043. For MA 7633: MA 7623.*

MA 7643 / MA 7653 Topics in Real Analysis I/II *each 3:0:0:3*

Course content varies. *Prerequisites for MA 7643: MA 6213 and MA 6223. For MA 7653: MA 7643.*

MA 7663 / MA 7673 Topics in Complex Analysis I/II *each 3:0:0:3*

Course content varies. *Prerequisites for MA 7663: MA 6303 and MA 6313. For MA 7673: MA 7663.*

MA 7683 / MA 7693 Topics in Geometry I/II *each 3:0:0:3*

Course content varies. *Prerequisite for MA 7683: MA 6403. For MA 7693: MA 7683.*

MA 7703 / MA 7713 Topics in Topology I/II *each 3:0:0:3*

Course content varies. *Prerequisite for MA 7703: MA 6403. For MA 7713: MA 7703.*

MA 7723 / MA 7733 Topics in Applied Mathematics I/II *each 3:0:0:3*

Course content varies. *Prerequisite for MA 7723: Graduate status or permission of adviser. For MA 7733: MA 7723.*

MA 7743 / MA 7753 Topics in Probability I/II *each 3:0:0:3*

Course content varies. *Prerequisite for MA 7743: MA 6813. For MA 7753: MA 7743.*

MA 7763 / MA 7773 Topics in Statistics I/II *each 3:0:0:3*

Course content varies. *Prerequisites for MA 7763:MA 6833 and MA 6843. For MA 7773: MA 7763.*

MA 7813 Probability *3:0:0:3*

This course covers: Measure-theoretic foundations of probability. Expectations, distribution functions, characteristic functions. Modes of convergence of random variables and distribution functions. Laws of large numbers. The multidimensional central-limit theorems and related asymptotic expansions. Infinitely divisible distributions. *Prerequisite: MA 7213.*

MA 7833 / MA 7843 Stochastic Processes I/II *each 3:0:0:3*

This course covers: Foundations of stochastic processes. Kolmogorov's extension theorem. Properties of sample paths. Conditional expectation. Martingales. Classes of stochastic processes. Gaussian processes, Markov processes and others. Second order properties. Stationary processes. Applications. *Prerequisite for MA 7833: MA 7813. For MA 7843: MA 7833.*

MA 8003 / MA 8013 Advanced Topics in Discrete Mathematics I/II *each 3:0:0:3*

Course content varies. In spring of year before course offering, a detailed description is posted and mailed to all graduate mathematics students. *Prerequisite for MA 8003: MA 6003. For MA 8013: MA 8003.*

MA 8023 / MA 8033 Advanced Topics in Algebra I/II *each 3:0:0:3*

Course content varies. *Prerequisites for MA 8023: MA 7033 and MA 7043. For MA 8033: MA 8023.*

MA 8043 / MA 8053 Advanced Topics in Real Analysis I/II *each 3:0:0:3*

Course content varies. *Prerequisites for MA 8043: MA 6213 and MA 6223. For MA 8053: MA 8043.*

MA 8063 / MA 8073 Advanced Topics in Linear Algebra I/II *each 3:0:0:3*

Course content varies. *Prerequisites for MA 8063: MA 6303 and MA 6313. For MA 8073: MA 8063.*

MA 8103 / MA 8113 Advanced Topics in Complex Analysis I/II *each 3:0:0:3*

Course content varies. *Prerequisites: MA 7213 and MA 7223.*

MA 8123 / MA 8133 Advanced Topics in Geometry I/II *each 3:0:0:3*

Course content varies. *Prerequisite: MA 6403.*

MA 8143 / MA 8153 Advanced Topics in Topology I/II *each 3:0:0:3*

Course content varies. *Prerequisite: MA 7403.*

MA 8163 / MA 8173 Advanced Topics in Applied Mathematics I/II *each 3:0:0:3*

Course content varies. *Prerequisite: MA 6003.*

MA 8183 / MA 8193 Advanced Topics in Probability I/II *each 3:0:0:3*

Course content varies. *Prerequisite: MA 6813.*

MA 8203 / MA 8213 Advanced Topics in Statistics I/II *each 3:0:0:3*

Course content varies. *Prerequisites: MA 6833 and MA 6843.*

MA 8383 Advanced Topics in Differential Equations *3:0:0:3*

Course content varies. *Prerequisites: MA 6233 and MA 6243.*

MA 8583 Advanced Topics in Differential Geometry *3:0:0:3*

Course content varies. *Prerequisite: MA 6403.*

MA 9413-9463 Reading in Mathematics I-VI *3:0:0:3*

In this course, reading is guided by faculty members and devoted mainly to scholarly papers. *Prerequisite: Department's permission.*

MA 9583/9593 Selected Topics in Advanced Mathematics I/II *each 3:0:0:3*

This course reviews current mathematics research. Specific topics vary, depending on instructor. *Prerequisite: Department's permission.*

Typical Course of Study for the Bachelor of Science in Mathematics

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Class	Lab.	Rec.	Cr.
		Hours/Week			
MA 1024	Calculus I[1]	4	0	0	4
MA 1002	The Art of Mathematics	2	0	0	2
CM 1004	General Chemistry	3	2	1	4
EN 1013W	College Writing Workshop	3	0	0	3
EG 1001	Engineering and Technology Forum	1	0	0	1
					14

Spring Semester

Course No.	Course Title	Class	Lab.	Rec.	Cr.
		Hours/Week			
MA 1124	Calculus II	4	0	0	4
PH 1013	Mechanics	3	0	1	3
HuSS 1023W	First-Year Writing Seminar	3	0	0	3
CS 1114	Introduction to Programming and Problem Solving	3	3	0	4
					14

SOPHOMORE YEAR

Fall Semester

MA 2012	Linear Algebra I (½ semester)	4	0	0	2
MA 2132	Ordinary Diff. Equations (½ semester)	4	0	0	2
MA 2212	Data Analysis I (½ semester)	4	0	0	2
MA 2222	Data Analysis II (½ semester)	4	0	0	2
PH 2023	Electricity, Magnetism and Fluids	4	0	1	3
PH 2021	Introductory Physics Lab I	0	1.5	0	.5
	Minor Specialty	3	0	0	3
Humanities and Social Sciences Elective		3	0	0	3
					17.5

Spring Semester

MA 2112	Multi. Calculus A (½ semester)	4	0	0	2
MA 2122	Multi Calculus B (½ semester)	4	0	0	2
MA 2312	Discrete Math. I (½ semester)	4	0	0	2
MA 2322	Discrete Math. II (½ semester)	4	0	0	2
PH 2033	Waves, Optics and Thermodynamics	3	0	1	3
PH 2031	Introductory Physics Lab II	0	1.5	0	.5
	Minor Specialty	3			3
Humanities and Social Sciences Elective		3	0	0	3
					17.5

JUNIOR YEAR

Fall Semester

MA 3022	Probability Theory II (½ semester)	4	0	0	2
MA 3112	Complex Variables I (½ semester)	4	0	0	2
MA 3103	Problem Solving and Proofs[3]	3	0	0	3
	Free Elective[2]	3	0	0	3
	Minor Specialty	3	0	0	3
Humanities and Social Sciences Elective		3	0	0	3
					16

Spring Semester

MA 3203	Linear Optimization[3]	3	0	0	3
MA 3303	Differential Geometry[3]	3	0	0	3
	Free Elective[2]	3	0	0	3
	Minor Specialty	3	0	0	3
	Minor Specialty	3	0	0	3
Humanities and Social Sciences Elective		3	0	0	3
					18

SENIOR YEAR

Fall Semester

MA 4413	Applied Partial Differential Equations[3]	3	0	0	3
MA 4613	Introduction to Real Analysis I	3	0	0	3
	Free Elective[2]	3	0	0	3
	Minor Specialty	3	0	0	3
Humanities and Social Sciences Elective		3	0	0	3
					15

Spring Semester

MA 4423	Intro. Numerical Analysis[3]	3	0	0	3
MA 4623	Introduction to Real Analysis II	3	0	0	3
MA 3914	Project in Mathematics I[3]	0	0	4	4
	Free Elective[2]	3	0	0	3
Humanities and Social Sciences Elective		3	0	0	3
					16

Total credits required for the degree: 128

1. Students placed by examination or by an adviser into MA 0902, MA 0912 or MA 0914 must defer registration for MA 1024.
2. The Free Elective can be a course offered by any department, provided it does not duplicate material studied in other courses. Students must meet the prerequisites for the courses.
3. May be substituted by another course with adviser's approval.

MECHANICAL AND AEROPSPACE ENGINEERING PROGRAM

Program Director: George Vradis

The Mechanical Engineering Program offers degrees of Bachelor of Science, Master of Science and Doctor of Philosophy in Mechanical Engineering. A Minor in Aerospace Engineering is offered as well as an Interdisciplinary Minor in Nuclear Sciences and Engineering (offered in collaboration with the Department of Applied Physics). Both minors can be integrated seamlessly into the BS in Mechanical Engineering program. The BS in Mechanical Engineering can be completed full-time or part-time. Students who choose the Co-Op Program work with their undergraduate advisers to design a study program. There is no evening program, so part-time students take the same classes as full-time students. Transfer students, all of whom must meet minimum residence requirements set by the Institute, are welcomed. A number of articulation agreements with several colleges provide a smooth transfer to the Institute. The Office of Undergraduate Admissions, which provides comprehensive support to prospective transfer students, should be consulted for details.

The Mechanical Engineering Program also offers two graduate degrees, Master of Science and Doctor of Philosophy in Mechanical Engineering. For each level, the student must choose one of the following specialty areas:

- Aerospace engineering (PhD only)
- Controls and dynamic systems
- Fluid dynamics and thermal systems
- Materials engineering (PhD only)
- Mechanics and structural systems

All mechanical engineering degrees are offered to full- and part-time students at the Brooklyn campus.

MECHANICAL ENGINEERING PROFESSION

Mechanical engineering is a dynamic, evolving profession and the most diverse of the engineering disciplines. Mechanical engineers invent, innovate and create the physical systems and devices that define modern society. These systems and devices include automobiles and aircrafts, robots and power plants, medical devices and artificial limbs, and advanced nanomaterials and smart structures. The breadth and depth of mechanical engineering contribute significantly to the development of three technologies that are expected to define the 21st century: bioengineering, nanotechnology and green energy. Undergraduate and graduate mechanical-engineering programs prepare Polytechnic graduates for practice in diverse technical industries as well as in corporate management, law, medicine and entrepreneurial endeavors.

AEROSPACE ENGINEERING PROFESSION

Aerospace engineering is the art and science associated with the design and performance of aircraft, spacecraft and other airborne and space-related devices and systems. The scientific aspects of aircraft and spacecraft design are rooted in mechanical engineering and, in particular, in the broad areas of low- and high-speed flows, strength and stability of extremely lightweight structures, aero-thermochemistry and propulsion, guidance and control, materials engineering, and thermodynamics and heat transfer.

Moon and planetary vehicles, deep-space probes and space habitats, once confined to the realm of science fiction, are now realities. Vehicles now under design or projected for the future challenge the imagination. They also challenge the current knowledge base and state of the art of the technologies involved.

To meet these extraordinary challenges, aerospace engineers must understand the scientific principles that give them the greatest possible potential, flexibility and adaptability. Conflicting requirements imposed by such considerations as safety, reliability, cost, maintenance, and production and handling often demand compromises to attain optimum design. Aerospace engineers are responsible to resolve such issues. The hallmark of aerospace engineers is an ability to push the boundaries of knowledge and lead teams of specialists to achieve mission-specific goals. The Minor in Aerospace Engineering prepares students to meet these challenges and follow successful careers in aerospace related industries.

NUCLEAR ENGINEERING PROFESSION

The Nuclear Engineering field is experiencing a major resurgence from the skeptical public attitude of the 1970s and 1980s that resulted in a stagnated nuclear power industry for more than two decades. At the same time nuclear technologies have emerged in many fields to provide advanced solutions to challenging problems, such as food processing, Instrumentation, diagnostics and perhaps most importantly in the medical industry where many nuclear-based diagnostic and therapeutic procedures have saved and improved the lives of millions. In addition, growing concerns regarding global warming have again shifted the attitude of the public to amore favorable view of the potential benefits of nuclear power, which is inherently carbon free and thus can play a substantial role in curbing carbon dioxide and methane emissions.

To meet the demands of this resurgent industry, engineers proficient in the fundamentals of the nuclear sciences and engineering are needed. Developing new nuclear based medical diagnostic technologies, new electric power reactor systems, inherently safe reactors, nuclear-based sensors, and instruments for non destructive testing of structures and materials are some of the many fields where engineers with knowledge of the fundamentals of this fascinating field can get engaged. The Interdisciplinary Minor in Nuclear Sciences and Engineering prepares graduates for rewarding and successful careers in these nuclear sciences and engineering related fields.

UNDERGRADUATE PROGRAM

GOALS AND OBJECTIVES

The objectives of the undergraduate BS in Mechanical Engineering program at the Polytechnic Institute of New York University is for its graduates to:

- engage and advance in professional careers in mechanical or related engineering, or other career paths that include industry, academia and governmental or non-governmental organizations; and
- seek continuous professional development and lifelong learning through graduate studies, continuing education credits and professional registration.

THE PROGRAM

To support program goals, the undergraduate mechanical engineering curriculum balances basic scientific and engineering principles and practice. Emphasis in the basic sciences (mathematics, physics, chemistry and materials) as well as basic engineering sciences (mechanics of materials, thermodynamics, fluid mechanics and heat transfer, measurement systems and controls) is balanced by a parallel emphasis in engineering practice: laboratory experience, engineering design and computer-based analysis and design.

During the program's first two years a series of courses in mathematics, from calculus to multivariable calculus and differential equations, provides students with the background

to understand and to solve complex equations of engineering physics. A series of courses in physics introduces the fundamentals of the physical world in all areas, including modern physics. Finally, a series of courses in chemistry, materials science and computer science introduce these fields, which are at the core of modern engineering research and practice, to the students.

A series of courses in the basic engineering sciences build on the knowledge acquired in mathematics, physics and materials sciences to provide the fundamental knowledge at the core of modern mechanical engineering. Engineering mechanics (statics and dynamics), mechanics of materials, thermodynamics, fluid mechanics, heat transfer, measurement systems and control systems form the basis of modern mechanical engineering. They also provide the needed foundation for students to excel in any major subdiscipline in mechanical engineering. Another series of courses that includes computer-aided design, finite elements method and machine design, introduces students to the tools of modern mechanical-engineering practice. Computer-based tools have emerged over the last 20 years to revolutionize the practice of mechanical engineering, offering unsurpassed capabilities in analyzing and simulating complex engineering systems, as well as increasing dramatically engineering-enterprise productivity. In dedicated classes, students learn to use the latest, state-of-the-art computer tools.

This required course work is complemented by a series of seven mechanical-engineering laboratory courses in materials science, statics, mechanics of materials, measurement systems, automatic controls, fluid mechanics and heat transfer. Finally, the students are given the opportunity to select from a broad range of elective courses to complement their education by building breadth and depth in one or more mechanical engineering sub-disciplines. Popular offerings over the last few years have been courses in energy systems, heating, ventilation and air-conditioning systems, nanomaterials and composites, mechatronics, microelectromechanical systems and in intellectual-property strategies for engineers.

Throughout the curriculum, a series of courses introduces the concepts, methods and tools of engineering design. Emphasis is on the systematic process of design and the related innovation and creative content. Three aspects of design addressed through the course content are:

- the concept of design and the corresponding concept of multiple solutions;
- the process of design; and
- the tools and skills for design.

The first aspect of design includes both the creative element, since the problem most likely lacks a unique solution, and project work. The second includes introduction to the systematic process of design, represented by concurrent engineering, quality management and the product-realization process, as well as other emerging concepts that set the framework for modern design. The third includes design tools, such as Computer Aided Design (CAD), Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA), as well as the underlying engineering theory for designing and analyzing components and systems.

The curriculum of integrated design exposure and experience evolves over the four years of the program. In the freshman year, students take EG 1001, Engineering and Technology Forum, EG 1003, Introduction to Engineering and Design, and ME 1012, Introduction to Mechanical Engineering, to gain an initial comprehensive exposure to how things are designed and built. These courses also introduce students to ethical issues in engineering research and practice. Students work in team projects and learn the basics of effective, professional report writing and presentations. Sophomore students take ME 2112, Computer Aided Design, where they are introduced to state-of-the-art computer-aided drafting tools, ME 2213, Statics, and ME 2211, Statics Laboratory, to enhance their understanding of static equilibrium of rigid bodies, and MT 2813, Introduction to Materials Science, and MT 2811, Materials Science Laboratory, to study the structure of engineering materials and examine the impact of material properties on design.

In the junior year, students take ME 3513, Measurement Systems, to learn how to design experiments; ME 3323, Thermodynamics, to understand the design of thermodynamic systems; ME 3313, Fluid Mechanics, to understand design of fluid and thermal systems; ME 3233, Machine Design, to consider the design aspects of machines and mechanical systems; ME 3223, Dynamics, to consider the design of systems where motion is involved; and ME 3413, Automatic Control, to explore the control of mechanical, aerospace, robotic, thermofluid, and vibrating systems and processes.

Finally, the design experience culminates with the Capstone ME 4112 and ME 4113 Senior Design I and II courses, during which students work in teams of three to four to conceptualize, design, fabricate and test an engineering product or system. In addition to the systematic and creative processes of design, the capstone design experience includes engineering consideration of safety, ethics, economic analysis, project planning, and budgeting and quality. These courses focus heavily on communications aspects, including report writing and oral presentations. Finally, many mechanical engineering elective courses offered contain significant design experience.

PLACEMENT

Graduates of the Mechanical Engineering Bachelor of Science program are employed in a wide range of industries, including primarily:

- National defense
- Aerospace
- Energy generation and distribution
- Telecommunications
- Consulting firms (mostly infrastructure related)
- Petrochemical, Pharmaceutical and other process industries
- Government
- A variety of small and medium size engineering firms

At the same time, Polytechnic graduates find opportunities in emerging fields, such as in biomedical systems and devices, nanotechnology and mechatronics. Alumni have used their basic mechanical engineering education as a springboard to law, medicine, corporate management and entrepreneurial ventures.

Finally, a substantial number of graduates continue their studies toward a Master of Science (MS) or Doctor of Philosophy (PhD) degree in mechanical or related disciplines. Some of those obtaining a PhD degree pursue rewarding careers in academia and research organizations.

SPECIAL DEPARTMENTAL REQUIREMENTS

Students must meet the Institute requirement of a 2.0 GPA or better for graduation. For graduation, the students also must earn an average of 2.0 GPA or better in the ME required courses at the Institute. Seniors with GPAs of 3.5 or better may take certain graduate courses as electives with approval from the departmental adviser. Students on academic probation usually are permitted to preregister for the next semester, but are obliged to consult with their adviser after grades are posted and before classes begin.

TRANSFER STUDENTS

All transfer students must meet the Institute's minimum residency requirement of 64 credits. In addition, transfer students in the Mechanical Engineering Program are required to take all junior and senior mechanical engineering courses and technical electives at Polytechnic. Qualified graduates of two-year pre-engineering programs, such as those offered at several community colleges and four-year liberal-arts colleges, often may fulfill the requirements for BS in Mechanical Engi-

neering in two additional years. Since such programs vary from college to college, students should meet with the mechanical engineering undergraduate adviser for guidance. The Institute has formal articulation agreements with some colleges; as a result, students from these schools have a series of transfer courses preapproved. Students with some course work toward a degree also may apply for transfer credit upon application to Polytechnic. In all cases, transfer credit is granted based upon equivalence to Polytechnic courses.

The process is expedited by previous decisions. Past transfer credit granted to students from the same college is a good indicator for prospective students. However, the adviser must be consulted in all cases for a current decision. Course content changes over the years at Polytechnic and other colleges, and content comparison determines decisions in each case. Transfer students are strongly encouraged to meet with the undergraduate adviser apart from the registration process to achieve a proper evaluation. The Office of Undergraduate Admissions offers information on past decisions for a given college and can arrange a meeting with the departmental undergraduate adviser. Graduates of technology programs may be able to fulfill the requirements for a BS in Mechanical Engineering in two to three-and-one-half years depending upon the scope and level of their previous education. The same is true for graduates of practical engineering and other such programs in various countries. Consult with the undergraduate adviser for details.

TYPICAL PROGRAM OF STUDY FOR THE BACHELOR OF SCIENCE DEGREE

The program consists of five components:

- Engineering core, 50 credits
- Mechanical engineering electives, 9 credits
- Mathematics, sciences and introduction to engineering, 39 credits
- Humanities and social sciences, 24 credits
- Non-technical and technical electives, 6 credits

AEROSPACE ENGINEERING MINOR

The Department of Mechanical and Aerospace Engineering offers a minor in Aerospace Engineering that consists of the following five courses, totaling 15 credits, which provide students with the foundation needed to pursue a career in the aerospace industry or graduate studies in the field:

- ME 3213 Mechanics of Materials
- AE 4603 Compressible Flow
- AE 4613 Aerodynamics
- AE 4633 Aerospace Propulsion
- AE 4653 Aircraft Flight Mechanics

Students pursuing the BS in Mechanical engineering degree may complete the aerospace engineering minor by taking the four AE designated course in place of the ME and Technical Electives available in the program.

INTERDISCIPLINARY MINOR IN NUCLEAR SCIENCES AND ENGINEERING

The Department of Mechanical and Aerospace Engineering, in collaboration with the Department of Applied Physics, offers a minor an Interdisciplinary Minor in Nuclear Sciences and Engineering that consists of the following five courses, totaling 15 credits, that provide students with the foundation needed to pursue a career in the nuclear sciences and engineering industries or graduate studies in the field:

- PH 3103 Fundamentals of Applied Nuclear Physics
- ME 4383 Introduction to Radiation Physics and Dosimetry
- ME 4373 Introduction to Nuclear Engineering
- Two elective courses to be chosen from the following list of four:
  ME 4863 Corrosion and Non-Destructive Evaluation of Materials
  EE 2613 Fundaments of Electric Power Engineering (for Nonelectrical Students)
  FIN 3593 Probabilistic Risk Assessment
  PS 2723 Human Factors in Engineering Design

Students pursuing the BS in Mechanical Engineering degree may complete the Interdisciplinary Minor in Nuclear Sciences and Engineering by taking the five courses in place of the ME, Technical, and Non-Technical electives available in the program.

GRADUATE PROGRAM

Programs of study that lead to the MS and PhD degrees in Mechanical Engineering are available in each of five specialty areas:

- Aerospace engineering (PhD only)
- Controls and dynamic systems (MS and PhD)
- Fluid dynamics and thermal systems (MS and PhD)
- Materials engineering (PhD only)
- Mechanics and structural systems (MS and PhD)

A bachelor's degree and a good academic record in mechanical engineering from a reputable college or university are generally required for admission to the graduate program. Students with exceptional undergraduate performance (typically with a GPA of 3.5 or better) can be admitted directly to the PhD program. Applicants with degrees from fields other than mechanical engineering may be admitted, but may have to complete additional studies to achieve a comparable background. Courses required to achieve this status are specified as part of the admission evaluation. Undergraduate courses specified for this purpose cannot count toward credits for the graduate degree. Graduate programs are subject to prior approval of a graduate adviser designated by the department.

To graduate, all students are required to have a 3.0 GPA or better in each of the following: in the average of all graduate courses taken at Polytechnic (whether or not some of these courses are being used to satisfy specific degree requirements); in the average of all courses submitted for the graduate degree sought (MS or PhD); in each guided studies, readings, projects, thesis and dissertation courses or credits enrolled.

GOALS AND OBJECTIVES

The objectives of the MS in Mechanical Engineering are for its students to acquire the skills necessary to:

- develop in-depth expertise in at least one subdiscipline of mechanical engineering (e.g., Fluid Dynamics and Thermal Systems; Mechanics and Structural Systems; and Controls and Dynamic Systems) to prepare for a rewarding professional career or for studies toward a PhD or other degrees;
- diversify their knowledge by taking advanced courses in other disciplines; and
- enhance their professional careers by acquiring knowledge of how to formulate, analyze and design components and systems by using modern advanced analytical and computational-engineering tools.

The objectives of the PhD in Mechanical Engineering are for its students to master the skills necessary to:

- obtain deep knowledge in one of the areas of mechanical engineering (e.g., materials, aerospace, fluid dynamics and thermal systems, mechanics and structural systems and controls and dynamic systems) through advanced courses and research;
- obtain a broad understanding of other engineering and science disciplines so they can participate in interdisciplinary research;
- identify problems, formulate research programs to address them, conduct research and produce results that advance the fundamental understanding of a certain subdiscipline by completing a dissertation in the chosen subdiscipline; and
- communicate results of their research and other work effectively through conference presentations and refereed journal publication.

REQUIREMENTS FOR THE MASTER OF SCIENCE

Course requirements for the MS in Mechanical Engineering are suited to the applicant's specialty, which is specified by the student in the admissions process or during the first advising session. Students must take at least 21credits out of the 30 credits needed for the degree at Polytechnic. No more than 6 credits in "Guided Reading" courses are allowed. Validation credit is not allowed, but the graduate adviser may waive specific requirements (and substitute designated ones), based upon the student's prior studies or experience. Transfer credits are not granted for:

- undergraduate courses;
- courses counted toward satisfying undergraduate degree requirements;
- courses not related to the graduate program as stated in this catalog;
- courses that received a grade lower than B.

Studies for the MS must be completed in five years, unless a formal leave of absence is approved before the period for which studies are interrupted. The degree requirements are:

Course No.	Course Title	Credits
ME 6003	Applied Mathematics in Mechanical Engineering	3
ME 6043	Transport Phenomena	3
ME 6213	Introduction to Solid Mechanics	3
ME 6603	Digital Control Systems (or ME 6703 Linear Systems)	3
ME xxxx	Required for Specialty Area (see below)	6
ME xxxx	Electives, approved by graduate adviser	6
	Free Electives	6
Total		**30**

If students decide to do a ME 9973 Master Thesis (9 credits) as part of their work for the degree, these 9 credits will be counted against 3 credits out of the 6 credits in ME electives, 3 credits out of the 6 credits in ME Required for the Specialty Area credits and 3 credits out of the 6 credits of Free Electives. Students are not allowed to submit more than three courses (9 credits) starting with a 5 for MS degree requirements satisfaction. Departmental electives include courses with a mechanical (ME), aerospace (AE) or materials (MT) prefix, plus departmental thesis or project credits. All courses and program details are subject to adviser approval.

Mechanics and Structural Systems Specialty

In the Mechanics and Structural Systems area, at least three graduate courses come from the list of courses under this heading. See courses below.

Controls and Dynamic Systems Specialty

In the Controls and Dynamic Systems area, at least three graduate courses come from the list of courses under this heading. See courses below.

Fluid Dynamics and Thermal Systems Specialty

In the Fluid Dynamics and Thermal Systems area, at least three graduate courses come from the list of courses under this heading. See courses below.

REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY

The PhD is a terminal degree beyond the MS and focuses on engineering research. Students are expected to advance the state of the art in their specialty by original and creative work. A MS in Mechanical or Aerospace Engineering or other closely related engineering or applied sciences fields is required for admission to the PhD degree program. A 3.5 GPA or better in the MS work is generally required for admission. In cases where it is unclear that the required MS specialization has been satisfied, the MS degree requirements of the preceding section will define the necessary reparation. The same criterion is used when the MS degree is in other engineering disciplines. Students with a BS degree in Mechanical or Aerospace Engineering and a GPA of 3.5 or better may apply directly for admission to the PhD program. Students have to take a written and oral departmental qualifying examination within the first two offerings of the exam after the date they join the doctoral program.

The general credit requirements for the PhD degree (beyond the BS degree and including MS degree credits) are:

	Credits
Transfer from MS degree	30
Approved course work beyond the MS degree	21(minimum)
PhD Dissertation (ME 9999)	24 (minimum)
Minimum total required	75 (minimum)

Studies for the PhD degree must be completed in five years after the MS degree or the date of admission, whichever is later, unless a formal leave of absence is approved before the period for which the studies are interrupted.

Once the dissertation is begun (after the student passes the PhD Qualifying Exam and forms a PhD Guidance Committee), the student must register for at least 3 credits of ME 9999 PhD Dissertation each fall and spring semester. Actual registration should reflect the pace of the work and the activity of the student. An exception to the minimum registration requirement may be made in the last semester of registration if that semester is devoted primarily to complete the work and dissertation. A dissertation grade of U for two consecutive terms affects whether a student will be permitted to continue doctoral work. Students are required to present the progress in their dissertation work to their guidance committees at least once a year.

Details on the PhD degree requirements and additional requirements can be found in the departmental pamphlet on the topic.

UNDERGRADUATE COURSES

AE 4603 Compressible Flow *3:0:0:3*
This course covers conservation equations for inviscid flows, one-dimensional flows, normal shock waves, one-dimensional flow with friction, one-dimensional flow with heat addition, oblique shock waves and Prandtl-Meyer expansion waves. *Prerequisites: ME 3333 and ME 3313.*

AE 4613 Aerodynamics *3:0:0:3*
The course explores incompressible inviscid flow, rotational and irrotational flow, elementary flows and their superposition, airfoil and wing geometry, aerodynamic forces and moments, thin airfoil theory, camber effects, incompressible laminar and turbulent boundary layer, vortex system, incompressible flow about wings, wing/body configurations, compressible flows past airfoils and wings and high-lift devices. *Prerequisite: AE 4603.*

AE 4633 Aerospace Propulsion *3:0:0:3*

This course looks at operation, performance and design methods for flight-vehicle propulsion, air-breathing engines, ramjets, turbojets, turbofans and their components, elements of solid and liquid rocket-propulsion systems. *Prerequisite: AE 4603.*

AE 4653 Aircraft Flight Mechanics *3:0:0:3*

The course examines development of equations of motion. Topics: Characteristics of aircraft-propulsion systems; Level flight performance of turbojet and propeller-driven aircraft; Unaccelerated climbing flight and aircraft ceiling; Takeoff and landing performance; Longitudinal and lateral static stability; Linearized equations of motion; Longitudinal and lateral modes of motion. *Prerequisite: ME 3223.*

ME 1012 Introduction to Mechanical Engineering *2:0:0:2*

This course introduces students to the range of mechanical engineering and emphasizes the basic principles and devices for storing and using energy, directing motion and satisfying needs. Case studies look at design issues and related ethical and professional practice issues. Emphasis is on a mindset of exploration. Engineering standards and standard parts. Teams work on and present two design challenges.

ME 2112 Computer Aided Design *1:0:3:2*

The course covers sketching, drawing and computer-aided drafting. Topics: Projection theory—multiview, axonometric, oblique. Auxiliaries, sections, isometrics, dimensions, fasteners, detail and assembly drawings. Introduction to blueprint reading. Overview of CIM and CAD integration with other CIM concepts. A design project incorporates developed skills in visualization, drawing techniques, standards and CAD.

ME 2211 Statics Laboratory *.5:0:1.5:1*

The course deals with measurement and calculations of bending stress, bending moment, shear forces and deflections in beams, buckling of struts and equilibrium analysis of structures. *Co-requisite: ME 2213.*

ME 2213 Statics *3:0:0:3*

The course covers three-dimensional vector treatment of the static equilibrium of particles and rigid bodies. Topics: Equivalent force and couple systems. Distributed force systems. Static analysis of trusses, frames and machines. Friction, impending motion. Methods of virtual work. *Prerequisites: PH 1013 and MA 1024. Co-requisite: ME 2211.*

ME 3211 Mechanics of Materials Laboratory *.5:0:1.5:1*

The course covers measurement of elastic constants for isotropic and anisotropic materials, verification of stress and strain transformation equations, stress concentration concept, unsymmetric bending of beams and torsion of shafts. *Co-requisite: ME 3213.*

ME 3213 Mechanics of Materials *3:0:0:3*

The course examines the Concept of Stresses and Strains in two and three dimensions, Stress-strain relationships, Stress transformation, Strain transformation, Axial members, Torsion of shafts, Bending of beams. *Prerequisites: ME 2213, MT 2813 and MA 2132. Co-requisite: ME 3211.*

ME 3223 Dynamics *3:0:0:3*

The course explores three-dimensional treatment of the kinematics of particles and rigid bodies using various coordinate systems, Newton's laws, work, energy, impulse, momentum, conservative force fields, impact and rotation and plane motion of rigid bodies. *Prerequisites: MA 2132 and ME 2213.*

ME 3233 Machine Design *3:0:0:3*

This course introduces students to fundamentals of machine elements, enabling them to employ this knowledge to design machines for various practical applications. The course begins with a brief review of stress, deformation and failure, followed by friction and wear. Subsequently, loaded columns, pressurized cylinders and shafts are presented. Bearings, gears, screws, springs, brakes, clutches and belts are discussed. The course ends with an introduction to MEMS, Micro-Electro Mechanical Systems. *Prerequisite: ME 3213.*

ME 3311 Fluid Mechanics Laboratory *.5:0:1.5:1*

The course covers fluid mechanics instrumentation and principles, and consists of a set of laboratory experiments designed to reinforce concepts presented in ME 3313 Fluid Mechanics. In addition, this course involves team work, report writing and oral presentations. *Co-requisite: ME 3313.*

ME 3313 Fluid Mechanics *3:0:0:3*

This course introduces fluid kinematics, hydrostatics and thermodynamics. Topics: Basic conservation laws in integral form for a control volume. Conservation of mass, momentum, angular momentum and energy for flow. Inviscid flow: Bernoulli's and Euler's equations. Viscous flow: flows in pipes and ducts, head loss and friction factor. *Prerequisites: ME 3333, MA 2132 and MA 2122. Co-requisite: ME 3311.*

ME 3333 Thermodynamics *3:0:0:3*

The course centers on properties of pure substances; concepts of work and heat; closed and open systems. Topics: Fundamental laws of thermodynamics. Carnot and Clasius statements of the 2nd law; entropy and entropy production; heat engines, refrigerators, heat pumps; efficiencies, coefficients of performance. *Prerequisites: PH 2033, MA 1124 and MA 2132.*

ME 3323 Energy Systems *3:0:0:3*

This first course in power generation focuses on the analysis and design of energy-conversion systems. It will introduce students to fossil, nuclear and renewable-energy (including wind and solar) power plants with equal emphasis. Students gain a comprehensive and detailed understanding of the fundamentals of such systems and the issues related to their operation from economic, environmental and safety points of view. *Prerequisite: ME 3333.*

ME 3411 Automatic Control Laboratory *.5:0:1.5:1*

The course covers system ID, modeling, identification and control of RC electrical network and a DC servo motor, modeling and control of a maglev system, rotary inverted pendulum and a coupled water tank system. *Prerequisite: ME 3511. Co-requisite: ME 3413.*

ME 3413 Automatic Control *3:0:0:3*

The course examines dynamic system modeling, analysis and feedback control design with extensive, hands-on computer simulation. Topics: Modeling and analysis of dynamic systems. Description of interconnected systems via transfer functions and block/signal flow diagrams. System response characterization as transient and steady-state responses and error considerations. Stability of dynamical systems: Routh- Hurwitz criterion and Nyquist criterion. Graphical methods for dynamical system analysis and design: root locus and Bode plot. Computer-aided feedback control design for mechanical, aerospace, robotic, thermo-fluid and vibratory systems. *Prerequisites: ME 3513 and ME 3223. Co-requisite: ME 3411.*

ME 3511 Measurement Systems Laboratory *.5:0:1.5:1*

The course covers electric measurements, data acquisition, passive and active filters for signal conditioning, temperature, position, velocity and acceleration measurements. *Co-requisite: ME 3513.*

ME 3513 Measurement Systems *3:0:0:3*

The course focuses on electrical circuits and components, filtering, dynamic measurement system response characteristics, analog signal processing, digital representation, data acquisition, sensors. Study of measurement systems via computer simulation. *Prerequisites: MA 2132 and PH 2023. Co-requisite: ME 3511.*

ME 3713 Manufacturing Systems I *3:0:0:3*

To be successful in the marketplace, a product must meet both customer needs and goals of performance, cost, quality, reliability, safety and the environment. The course addresses issues critical to the design of a product for manufacture and the methods that have been found to be successful in addressing these issues. The design process is studied and illustrated through class exercises and a term project. Selected manufacturing processes are studied. Economic feasibility, entrepreneur-

ship and bringing products (and services) to the market are emphasized. *Prerequisites: PH 1013 and MA 1024.*

ME 4112 Senior Design I *2:0:0:2*

This is the first of two courses dedicated to the capstone design experience in mechanical engineering. In this first course, the students identify and define a project to design, build and test an engineering product or system and complete the preliminary design of their chosen system. The product-realization process, building effective teams and teamwork and communication skills are emphasized. *Prerequisites: ME 2112, ME 3233 and ME 3313. Co-requisites: ME 4214, ME 4313 and ME 3413.*

ME 4113 Senior Design II *3:0:0:3*

This is the second of two courses dedicated to the capstone design experience in mechanical engineering and based on knowledge and skills acquired in earlier course work. Topics: Product design, development, building and testing prototype hardware, with an emphasis on teamwork. The Product Realization Process emphasizes incorporation of engineering standards and realistic constraints. The course concentrates on communication skills. *Prerequisite: ME 4112.*

ME 4213 Design and Fabrication of Composite Materials *3:0:0:3*

The course introduces composite materials. Topics: Introduction to types of reinforcements and matrix materials. Various applications in mechanical engineering. Manufacturing of polymer, metal and ceramic matrix materials. Analysis of laminated composites for mechanical properties. *Prerequisites: MT 2813, MT 2811 and ME 3213.*

ME 4214 Finite Element Modeling, Design and Analysis *3:3:0:4*

The analysis of complex static and dynamic problems involves three steps: selection of a mathematical model; analysis of the model; interpretation of the predicted response. The course deals with deriving analytical solutions and comparing them with Finite Element Analysis results. Students are required to use state-of-the-art commercial software. *Prerequisites: ME 3213, ME 3313, MA 2122 and MA 2132.*

ME 4311 Heat Transfer Laboratory *.5:0:1.5:1*

The course covers heat-transfer instrumentation and principles and consists of a set of laboratory experiments designed to reinforce the concepts presented in ME 4313 Heat Transfer. In addition, this course involves team work, report writing and oral presentation. *Prerequisite: ME 3311. Co-requisite: ME 4313.*

ME 4313 Heat Transfer *3:0:0:3*

The course introduces modes of conduction, convection and radiation heat transfer. Topics: Analysis of multidimensional geometries for the conduction mode. Unsteady conduction. Numerical methods of analysis. Introduction to convection. Internal and external convection. Natural convection and boiling and condensation. Principles of radiative heat transfer. *Prerequisite: ME 3313. Co-requisite: ME 4311.*

ME 4353 Internal Combustion Engines *3:0:0:3*

The course covers introduction and definitions, engine-operating characteristics. Topics: Thermodynamics of internal combustion engines. Thermodynamics of combustion. Combustion in spark ignition engines. Design for performance and efficiency. Pollutant formation and controls, emissions tests. *Prerequisites: ME 3313 and ME 3333. Co-requisite: ME 4313.*

ME 4363 Heating, Ventilation and Air Conditioning *3:0:0:3*

This course reviews thermodynamic principles, psychometric chart and psychometric analysis, comfort air conditioning and indoor air quality, heating and cooling system, HVAC system design and equipment selection. *Prerequisite: ME 4313.*

ME 4373 Introduction to Nuclear Engineering *3:0:0:3*

This is intended to be a required course for the Nuclear Engineering Concentration. It covers three basic areas: (a) reactor kinetics, as it pertains to neutron reaction associated with fissile materials, (b) power reactor systems, i.e. the various types of nuclear reactors in use and their basic operating principles, and (c) design principles for reactors and reactor systems. *Prerequisite: PH 3103.*

ME 4383 Introduction to Radiation Physics and Dosimetry *3:0:0:3*

Theory and practice of Radiation and Health Physics. Atomic and nuclear structure, X-ray and gamma radiation, interaction of ionizing radiation with matter, and effects of ionizing radiation on living tissue. The course also introduces the principles of radiation detection, radiation measurement, and external and internal dosimetry. *Prerequisite: PH 3103. Also listed under PH 3503.*

ME 4713 Manufacturing Systems II *3:0:0:3*

This course continues MN 3713. It addresses techniques of manufacturing systems that can be applied to business processes in a variety of industries to address bottlenecks, simulation, economic computations, design process and applications. This course builds from the readings and emphasizes project work. The course depends on effective teamwork and focuses on project work and presentations. *Prerequisite: ME 3713.*

ME 498x Special Topics in Mechanical Engineering *variable credit*

The course covers topics of special interest in mechanical engineering to promote exposure to traditional and emerging issues in mechanical engineering not covered in the program's mainstay courses. *Prerequisite: Adviser's approval.*

ME 4993 BS Thesis in Mechanical Engineering *3:0:0:3*

Honors Program students can produce a BS Thesis on a topic of interest to them under faculty advisement. A research project is carried out in traditional and emerging areas of mechanical engineering. The course can be repeated for no more than 6 credits. *Prerequisites: Honors Program status and adviser approval.*

MT 2811 Materials Science Laboratory *.5:0:1.5:1*

Students learn to characterize the microstructure and crystal structure of a material by optical and scanning electron microscopy and X-ray diffraction. The mechanical characterization is accomplished by hardness, tensile and yield strength, impact and fatigue testing. *Prerequisites: PH 1013 and CM 1004. Co-requisite: MT 2813.*

MT 2813 Introduction to Materials Science *3:0:0:3*

Students in this course become familiar with atomic structure and bonding, atomic arrangement in crystals, crystal imperfections, mechanical behavior and failure of materials and binary phase diagrams. *Prerequisites: PH 1013 and CM 1004. Co-requisite: MT 2811.*

MT 4853 Manufacturing Engineering and Processes *3:0:0:3*

This course introduces the manufacturing processes for fabricating components used in mechanical systems; casting processes; bulk metal deformation and sheet-metal forming processes; materials-removal processes; Joining and fastening processes; manufacturing automation; and integrated manufacturing systems. *Prerequisites: MT 2811 and MT 2813.*

GRADUATE COURSES

ME 6003 Applied Mathematics in Mechanical Engineering *3:0:0:3*

Vector and tensor calculus. Ordinary differential equations. Laplace and Fourier Transforms. Sturm-Liouville problems. Partial differential equations. Applications to structural analysis, fluid mechanics and dynamical systems. *Prerequisite: Adviser approval.*

ME 7003 Finite Element Methods *3:0:0:3*

The course explores derivation of element stiffness matrices for spring, bar and beam elements. Topics: Finite element formulation to determine many unknowns such as displacements, forces and reactions. Application to trusses, frames and two-dimensional problems in plane stress and plane strain under static loading conditions. Applications in thermal, heat transfer and fluid mechanics. Interpreting the results, convergence of solution and effect of meshing and symmetry conditions. Introduction to modern meshless techniques. *Prerequisite: Adviser approval.*

FLUID DYNAMICS AND THERMAL SYSTEMS

ME 5103 Biomedical Fluid Dynamics *3:0:0:3*

The course focuses on principles of fluid flow and transport in the human body, emphasizing vascular circulation and hemodynamics. Topics include: physics of pulsatile flow, introductory biology and physiology of the circulatory system, blood flow in vessels, microcirculation, blood rheology, fluid dynamics of vasculature under physiological and pathological conditions, mass transport to vessel walls, mechanics of blood cells, cellular mechanotransduction and biochemical signaling and microfluidics in biomedical devices. *Prerequisite: Adviser approval.*

ME 6013 Thermodynamics *3:0:0:3*

The course covers availability functions, general thermodynamic relations, equations of state, general thermodynamic equilibrium criteria, power production, thermodynamics of reacting systems, energy of formation, chemical equilibrium, applications in combustion systems. *Prerequisite: Adviser approval.*

ME 6043 Transport Phenomena *3:0:0:3*

This course focuses on Fourier, Newton and Ficks flux laws. Topics: Conservation of energy, mass and momentum. Eulerian and Lagrangian frames. Momentum transfer: concept of viscosity, molecular transport of momentum, convective transport in laminar flows and concepts of turbulent transport. Energy transfer: molecular (conduction) transfer of heat, convective transfer of heat and radiative heat transfer. Mass transfer: molecular diffusion of mass, convective mass transfer. *Prerequisite: Adviser approval.*

ME 7063 Convective Heat Transfer *3:0:0:3*

The course examines developments and applications of laminar hydrodynamic and thermal boundary layer equations for fluid media. Topics: Mechanics of turbulence; formulation and analysis of turbulent hydrodynamics and thermal applications; natural convection and film evaporation and condensation. *Prerequisite: ME 6043 or adviser approval.*

ME 7073 Conductive Heat Transfer *3:0:0:3*

This course covers theoretical development of transient and steady-state temperature distributions in finite and infinite solids. Topics: Pertinent mathematical techniques introduced as required. Solids undergoing phase change and two dimensional fields. *Prerequisites: ME 6003 and ME 6043 or adviser approval.*

ME 7083 Radiative Heat Transfer *3:0:0:3*

This course covers fundamentals of radiative mechanisms of energy transfer. Topics: Definitions of basic qualities. Equations of transfer, radiative heat flux vector and conservation equations. Properties of surfaces and participating media. Applications to engineering systems. *Prerequisites: ME 6003 and ME 6043 or adviser approval.*

ME 7113 Viscous Flow and Boundary Layers *3:0:0:3*

The course introduces molecular and macroscopic transport. Topics: Reynold's transport theorem.Concepts of stress and strain and derivation of the Navier-Stokes equations. Similarity principle. Exact solutions to the Navier-Stokes equations. Low Reynolds number flows. Boundary layer theory. Momentum integral equation. Introduction to turbulence. *Prerequisites: ME 6003 and ME 6043 or adviser approval.*

ME 7123 Turbulent Flow *3:0:0:3*

The course covers nature and origin of turbulence. Topics: Instability and transition, Taylor and Grtler vortices. Vorticity dynamics, homogeneous and isotropic turbulence. Reynolds decomposition, turbulent stress tensor and Reynolds-averaged Navier-Stokes equations. Computational modeling of turbulence. Analysis of turbulent boundary layers. Turbulent heat and mass transfer, measurement of turbulence. *Prerequisites: ME 6043 and ME 7113 or adviser approval.*

ME 7133 Compressible Flow *3:0:0:3*

The course examines fundamentals of compressible fluid flow, including subsonic, transonic, supersonic and hypersonic flows over two-dimensional and axisymmetric bodies. Topics: One-dimensional flows with friction and heat addition. Shock-wave development in both two-dimensional steady and one-dimensional unsteady flow systems, including flow in shock tubes. Quasi-one-dimensional compressible flow, including flows in inlets, nozzles and diffusers. Introduction to numerical solution of compressible fluid flow. *Prerequisite: ME 6043 or adviser approval.*

ME 7153 Computational Fluid Mechanics and Heat Transfer *3:0:0:3*

The course centers on engineering solution of thermo-fluid problems by finite-difference methods, error and stability analyses, numerical dispersion and damping, matrix inversion methods, solution of model equations: wave, heat, Laplace, viscous and inviscid Burger's equations. Also covered are implicit and explicit procedures, SOR, ADI, hopscotch and direct solvers for evaluating linear and nonlinear diffusion and convection problems. *Prerequisites: ME 6003 and ME 6043 or adviser approval.*

ME 7163 Experimental Methods in

Thermal-Fluid Sciences *3:0:0:3*

The course discusses basic measurement techniques in thermal and flow sciences and a survey of the modern developments in measurement technology, including optical methods. Topics: Planning of experimental programs, calibration, measurement uncertainty, noise, generalized performance characteristics, various devices for measuring mass and volume-flow rate, velocity, pressure, temperature, density and heat flux, computerized data acquisition and statistical analysis. *Prerequisite: ME 6043 or adviser approval.*

ME 8033 Combustion *3:0:0:3*

The course covers chemical characteristics of flames. Topics: Heat of formation and of reaction; phase and reaction equilibrium and adiabatic flame temperature; and special concentration in stationary and flowing reacting systems. Chemical kinetics of homogeneous and heterogeneous reacting systems. Branching chain reactions and explosion limits. Diffusion and remixed combustion systems. *Prerequisites: ME 6043 and ME 6013 or adviser approval.*

ME 8043 Theory of Propulsion *3:0:0:3*

This course looks at principles of high-speed propulsion based on chemical energy sources. Topics: Air- breathing engines and their components: ramjet, scramjet, turbojet and turbofan, combustion thermodynamics, flows with chemical reactions, thermo-chemistry of solid and liquid rocket engines. Engineering parameters in engine design. *Prerequisite: ME 7133.*

MECHANICS AND STRUCTURAL SYSTEMS

ME 5243 Composite Materials *3:0:0:3*

This course introduces modern polymeric, metallic and ceramic composite materials, fabrication techniques, mechanical property characterization. Topics: Introduction to matrix and reinforcement materials, material selection and composite design criteria. Mechanics based analysis of continuous fiber reinforced unidirectional plies and woven fabrics. Applications of advanced composites in car, aircraft, construction and sports industries. *Prerequisite: Adviser approval.*

ME 5443 Vibrations *3:0:0:3*

The course looks at the dynamics of one-, two- and multi-degree of freedom systems with and without damping. Topics: Vibrations of distributed parameter systems: bars, beams and plates. Numerical methods. Introduction to nonlinear oscillations. *Prerequisite: Adviser approval.*

ME 6213 Introduction to Solid Mechanics *3:0:0:3*

The course explores fundamentals of kinematics of solid bodies; displacement and strain measures, introduction to statics of solid bodies, stress tensor, equilibrium equations. Topics include analysis of columns, beams and beams on elastic foundations. *Prerequisite: Adviser approval.*

ME6223 Advanced Mechanics of Materials *3:0:0:3*

The course discusses two-dimensional stress and strain analysis, applications of energy methods, Reyleighitz method. Topics: Applications of energy methods to beams, frames, laminates and sandwich structures. Torsion of prismatic bars, open and closed thin-walled cylinders, unsymmetric bending and shear center, curved bars. *Prerequisite: ME 6213 or adviser approval.*

ME 6253 Mechanics of Nanomaterials *3:0:0:3*

The course introduces nanosized and nanoscale materials: nanoparticles, nanotubes, nanowires, nanorods. Topics: Classical molecular dynamics, lattice mechanics, methods of thermodynamics and statistical mechanics, introduction to multiple scale modeling and introduction to bridging scale. Characterization techniques for nanomaterials. Applications in nanosystems such as nanocars, nanobots and nanoelectronics. *Prerequisite: Adviser approval.*

ME 6513 Advanced Dynamics *3:0:0:3*

The course covers kinematics and dynamics of a particle in space. Topics: Systems of particles. Two-body central force problem. Kinematics and dynamics of rigid bodies. Euler's equations. Euleragrange equations with holonomic and nonholonomic constraints. Stability analysis. Introduction to calculus of variations. Hamilton's principle. Hamilton's equations. *Prerequisite: Adviser approval.*

ME 7213 Elasticity I *3:0:0:3*

The course looks at stress and strain tensors, generalized Hooke's law. Topics: Formulation of elasticity problems. Plane stress and plane strain concepts; solution by complex variables; stress concentrations. Rotating Discs and cylinders of uniform thickness and variable thickness. Deformation symmetrical about an axis. *Prerequisite: ME 6213 or adviser approval.*

ME 7243 Advanced Composite Materials *3:0:0:3*

The course covers mechanics based analysis of fibrous (continuous and discontinuous) and particulate composites, generalized Hooke's law for anisotropic and orthotropic materials. Topics: Stress strain transformations and failure criterion for anisotropic materials. Analysis of composite beams in tension, flexure and torsion. Analysis of composite shells and grid-stiffened structures. *Prerequisites: ME 5243 and ME 6213 or adviser approval.*

ME 7323 Failure Mechanics *3:0:0:3*

The course introduces fracture mechanics. Topics: Linear elastic, elastic-plastic and fully plastic fracture mechanics modeling and design. Fatigue and design against fatigue failures. Standard fracture mechanics testing procedures and related material properties. Micromechanics of fracture. Dynamic fracture. Continuum damage mechanics. *Prerequisite: ME 6213 or adviser approval.*

ME 7333 Non-Destructive Evaluation (NDE) *3:0:0:3*

The course introduces various NDE techniques used in engineering applications, x-ray radiography, ultrasonic imaging, acoustic emission, optical interferometry, magnetic resonance imaging. Also introduced are embedded optical and electromechanical sensors for continuous health monitoring and defect detection. *Prerequisite: ME 6003 or adviser approval.*

ME 7353 Fracture Mechanics *3:0:0:3*

The course introduces fracture mechanics. Topics: Linear elastic, elastic-plastic and fully plastic fracture mechanics modeling and design. Fatigue and design against fatigue failures. Standard fracture mechanics testing procedures and related material properties. Micromechanics of fracture. Dynamic fracture. Continuum damage mechanics. *Prerequisite: ME 6213 or adviser approval.*

ME 7443 Advanced Vibrations *3:0:0:3*

This course reviews analytical dynamics and vibrations of lumped parameter systems. Topics: Vibrations of distributed parameter systems. Approximate solution methods. Introduction to nonlinear vibrations and analysis tools. Advanced topics. *Prerequisite: ME 5443 or adviser approval.*

ME 8213 Elasticity II *3:0:0:3*

This class continues studies in elasticity problems. Topics: Three dimensional problems; St. Venant problems, extension, flexure, tension. Energy principles and variational methods; approximation techniques. *Prerequisite: ME 7213 or adviser approval.*

ME 8273 Mechanics of Cellular Materials *3:0:0:3*

The course looks at structure of cellular composites and natural cellular materials, including single phase open and closed cell foams and two-phase closed cell foams. Topics: Mechanics of honeycombs and foams, mechanics of wood and bones, effect of density, cell size and cell periodicity, introduction to homogenization techniques for cellular composites. *Prerequisite: ME 7213 or adviser approval.*

CONTROLS AND DYNAMIC SYSTEMS

ME 5643 Mechatronics *3:0:0:3*

The course introduces theoretical and applied mechatronics, design and operation of mechatronics systems; mechanical, electrical, electronic and optoelectronic components; sensors and actuators, including signal conditioning and power electronics; microcontrollers, fundamentals, programming and interfacing; and feedback control. The course includes structured and term projects in designing and developing f prototype integrated mechatronic systems. *Prerequisite: Adviser approval.*

ME 5653 Microelectromechanical Systems *3:0:0:3*

The course covers materials for MEMS, fundamentals of solid mechanics, electrostatics and electromagnetics. Topics: Electromechanical modeling and design of micromachined sensors and actuators. Microscale physics of microsystems. Overview of MEMS applications. Packaging and testing. *Prerequisite: Adviser approval.*

ME 6603 Digital Control Systems *3:0:0:3*

The course introduces digital systems, signal conversion techniques, z-transform and inverse z-transform, transfer function and block diagrams, state-variable techniques, controllability, observability, stability and control design techniques. *Prerequisite: Adviser approval.*

ME 6613 Sensor Based Robotics *3:0:0:3*

Topics in this course include robot mechanisms, robot arm kinematics (direct and inverse kinematics), robot arm dynamics (Euler Lagrange, Newton-Euler and Hamiltonian Formulations), six degree-of-freedom rigid body kinematics and dynamics, quaternion, nonholonomic systems, trajectory planning, various sensors and actuators for robotic applications, end-effector mechanisms, force and moment analysis and introduction to control of robotic manipulators. *Prerequisite: Graduate status or adviser approval. Also listed under EL 5223.*

ME 6703 Linear Control Theory and Design I *3:0:0:3*

The course covers modeling of mechanical systems (e.g., mechatronic, vibrational, robotic and smart systems) in state-space. Topics: Description and analysis of linear mechanical systems, transform and transition matrix methods and properties such as stability, controllability/stabilizability, observability/detectability. *Prerequisite: ME 6703 or adviser approval.*

ME 6713 Linear Control Theory and Design II *3:0:0:3*

The course considers fundamentals of system realizations and random processes. Topics: Performance objectives for mechanical systems (e.g., mechatronic, vibrational, robotic and smart systems). Optimal design of state feedback controllers, observers and output feedback controllers for mechanical systems. *Prerequisite: Adviser approval.*

ME 7613 Nonlinear Systems: Analysis and Control *3:0:0:3*

The course introduces nonlinear phenomenon, behavior and analysis of second-order nonlinear systems, fundamental properties of solutions of nonlinear ordinary differential equations, Lyapunov stability theory, absolute stability theory, describing functions, dissipativity, advanced topics. *Prerequisites: ME 6003 and ME 6713 or adviser approval.*

ME 7623 Cooperative Control *3:0:0:3*

The course examines fundamentals of set theory, metric spaces, linear spaces, matrix theory and differential equations. Topics: Lyapunov stability. Algebraic graph theory. Consensus theory. Linear switched systems. Stochastic convergence. Averaging methods. Synchronization problems. Applications to multivehicle robotic teams, epidemic spreading and opinion dynamics. *Prerequisites: ME 6003 and ME 6703 or adviser approval.*

ME 7703 Optimal Robust Control *3:0:0:3*

The course looks at mathematical preliminaries, matrix theory fundamentals, linear system properties, stability theory, constrained optimization and performance characterization: deterministic/stochastic formulations, Lagrange multiplier versus linear-matrix-inequality formulation of linear quadratic regulation (LQR), state estimation and dynamic output feedback control problems, static output feedback, regulation versus tracking problems, robustness properties of LQR, on lack of robustness of LQG controllers, loop-transfer recovery, small-gain theorem, introduction to H-infinity and multi-objective robust control. *Prerequisite: ME 6703 or adviser approval.*

SELECTED TOPICS, PROJECTS, THESIS AND DISSERTATION

ME 7863 / ME 7873 Special Topics *3:0:0:3*

These course numbers are reserved for special topics offered periodically by the Mechanical Engineering Program and are open to first-year graduate students. When offered, the subject matter is indicated as part of the title after the words "Special Topics," and the complete title appears on the student's transcript. Prerequisite: tailored to the offering. *Prerequisite: Adviser approval.*

ME 8863 / ME 8873 Advanced Topics *3:0:0:3*

These numbers are reserved for advanced topics offered periodically by the Mechanical Engineering Program and are open to second-year and more advanced graduate students. When offered, the specific subject matter is indicated as part of the title after the words "Advanced Topic," and the complete title appears on the student's transcript. *Prerequisite: Adviser approval.*

ME 9013-9043 Guided Readings I-IV
each 3 credits

These readings are open to qualified graduate students interested in special advanced topics. Directed study includes analytical work and/or laboratory investigations. *Prerequisite: Adviser and instructor approval.*

ME 9963 MS Project *each 3 credits*

This course is an engineering project under faculty guidance. A written project proposal and final report must be submitted to the department head and the adviser and may be extended to a thesis with the project adviser's recommendation. Credit only upon completion of project. *Prerequisite: Degree status.*

ME 997x MS Thesis *variable credit*

The master's thesis presents results of original investigation in the student's specialty. This effort can be an extension of ME 9963, with approval of the project adviser. Continuous registration is required. Maximum of 9 credits of ME 9963/ME 9973 are counted toward the degree. *Prerequisite: Degree status.*

ME 9999 PhD Dissertation *each 3 credits*

The doctoral dissertation demonstrates independent study and original contributions in the specialization. Oral examination on subject of dissertation and related topics is required. Also required is a minimum of 24 credits and continuous registration at minimum of 3 credits per semester until the dissertation is completed. *Prerequisite: Passage of PhD Qualifying exam and PhD Dissertation Adviser approval.*

Typical Course of Study for the Bachelor of Science in Mechanical Engineering

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Class	Lab.	Rec.	Cr.
EG 1001	Engineering and Technology Forum	1	0	0	1
EG 1003	Intro Engineering and Design	2	3	0	3
MA 1024	Calculus I	4	0	0	4
CM 1004	General Chemistry	3	1.5	1	4
EN 1013W	College Writing Workshop	3	0	0	3
					15

Spring Semester

Course No.	Course Title	Class	Lab.	Rec.	Cr.
MA 1124	Calculus II	4	0	0	4
PH 1013	Mechanics	4	0	1	3
ME 1012	Intro Mechanical Engineering	2	0	0	2
CS 1133	Eng. Problem Solving and Programming	2	0	3	3
HuSS 1023W	First-Year Writing Seminar	3	0	0	3
					15

SOPHOMORE YEAR

Fall Semester

MA 2012	Linear Algebra I (½ semester)	4	0	0	2
MA 2132	Ordinary Diff. Equ.(½ semester)	4	0	0	2
PH 2023	Electricity, Magnetism and Fluids	3	0	1	3
PH 2021	Introductory Physics Laboratory I	0	1.5	0	.5
MT 2811	Materials Science Lab	.5	1.5	0	1
MT 2813	Intro Materials Science	3	0	0	3
ME 2112	Computer Aided Design	1	3	0	2
Humanities and Social Sciences Elective[1]		3	0	0	3
					16.5

Spring Semester

MA 2112	Multi Calculus A (½ semester)	4	0	0	2
MA 2122	Multi Calculus B (½ semester)	4	0	0	2
MA 2212	Data Analysis I (½ semester)	4	0	0	2
ME 2211	Statics Lab	0	0	3	1
ME 2213	Statics	3	0	0	3
PH 2031	Introductory Physics Lab II	0	1.5	0	.5
PH 2033	Waves, Optics and Thermodynamics	3	0	1	3
Humanities and Social Sciences Elective[1]		3	0	0	3
					16.5

JUNIOR YEAR

Fall Semester

ME 3333	Thermodynamics	3	0	0	3
ME 3211	Mechanics of Materials Lab	.5	1.5	0	1
ME 3213	Mechanics of Materials	3	0	0	3
ME 3511	Measurement Systems Lab	.5	1.5	0	1
ME 3513	Measurement Systems	3	0	0	3
ME 3223	Dynamics	3	0	0	3
Humanities and Social Sciences Elective[1]		3	0	0	3
					17

Spring Semester

ME 3233	Machine Design	3	0	0	3
ME 3311	Fluids Lab	.5	.5	0	1
ME 3313	Fluids	3	0	0	3
ME 3411	Controls Lab	.5	.5	0	1
ME 3413	Automatic Control	3	0	0	3
	ME Elective[2]	3	0	0	3
Humanities and Social Sciences Elective[1]		3	0	0	3
					17

SENIOR YEAR

Fall Semester

ME 4112	Senior Design I	2	0	0	2
ME 4214	Finite Element Design, Modeling and Analysis	3	3	0	4
ME 4311	Heat Transfer Lab	.5	1.5	0	1
ME 4313	Heat Transfer	3	0	0	3
	ME Elective[2]	3	0	0	3
Humanities and Social Sciences Elective[1]		3	0	0	3
					16

Spring Semester

ME 4113	Senior Design II	3	0	0	3
	ME Elective[2]	3	0	0	3
	Technical Elective[3]	3	0	0	3
	Non-Technical Elective[4]	3	0	0	3
Humanities and Social Sciences Elective[1]		3	0	0	3
					15

Total credits required for the degree: 128

1 Humanities and Social Sciences Electives are classes that must begin with one of the following prefixes: AH, AN, EC, EN, HI, MU, PL, PS, CAM, SEG, STS, or URB. At least one of these courses must be Level 3 or Level 4 (3xxx or 4xxx). At least one of these courses must be writing intensive (xxxxW).

2 ME Electives are courses with the following prefixes: AE, ME, MT.

3 Technical Electives are engineering or applied physics courses that are Level 2 or higher.

4 Non-Technical Electives are non-engineering, science based courses that need to have one of the following prefixes: AH, AN, EC, EN, HI, MU, PL, PS, CAM, SEG, STS, URB, MA, PH or BMS. The approval of the ME Undergraduate Adviser is required.

Typical Course of Study for the Bachelor of Science in Mechanical Engineering with Concentration in Aerospace Engineering

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Class	Lab.	Rec.	Cr.
		Hours/Week			
EG 1001	Engineering and Technology Forum	1	0	0	1
EG 1003	Intro Engineering and Design	2	3	0	3
MA 1024	Calculus I	4	0	0	4
CM 1004	General Chemistry	3	1.5	1	4
EN 1013W	College Writing Workshop	3	0	0	3
					15

Spring Semester

Course No.	Course Title	Class	Lab.	Rec.	Cr.
		Hours/Week			
MA 1124	Calculus II	4	0	0	4
PH 1013	Mechanics	4	0	1	3
ME 1012	Intro Mechanical Engineering	2	0	0	2
CS 1133	Eng. Problem Solving and Programming	2	0	3	3
HuSS 1023W	First-Year Writing Seminar	3	0	0	3
					15

SOPHOMORE YEAR

Fall Semester

MA 2012	Linear Algebra I (½ semester)	4	0	0	2
MA 2132	Ordinary Differential Equations (½ semester)	4	0	0	2
PH 2023	Electricity, Magnetism and Fluids	3	0	1	3
PH 2021	Introductory Physics Laboratory I	0	1.5	0	0.5
MT 2811	Materials Science Lab	.5	1.5	0	1
MT 2813	Intro Materials Science	3	0	0	3
ME 2112	Computer Aided Design	1	3	0	2
Humanities and Social Sciences Elective[1]		3	0	0	3
					16.5

Spring Semester

MA 2112	Multi Calculus A (½ semester)	4	0	0	2
MA 2122	Multi Calculus B (½ semester)	4	0	0	2
MA 2212	Data Analysis I (½ semester)	4	0	0	2
ME 2211	Statics Lab	0	0	3	1
ME 2213	Statics	3	0	0	3
PH 2031	Introductory Physics Lab II	0	1.5	0	0.5
PH 2033	Waves, Optics and Thermodynamics	3	0	1	3
Humanities and Social Sciences Elective[1]		3	0	0	3
					16.5

JUNIOR YEAR

Fall Semester

ME 3333	Thermodynamics	3	0	0	3
ME 3211	Mechanics of Materials Lab	.5	1.5	0	1
ME 3213	Mechanics of Materials	3	0	0	3
ME 3511	Measurement Systems Lab	.5	1.5	0	1
ME 3513	Measurement Systems	3	0	0	3
ME 3223	Dynamics	3	0	0	3
Humanities and Social Sciences Elective[1]		3	0	0	3
					17

Spring Semester

ME 3233	Machine Design	3	0	0	3
ME 3311	Fluids Lab	.5	1.5	0	1
ME 3313	Fluids	3	0	0	3
ME 3411	Controls Lab	.5	1.5	0	1
ME 3413	Automatic Control	3	0	0	3
Humanities and Social Sciences Elective[1]		3	0	0	3
Humanities and Social Sciences Elective[1]		3	0	0	3
					17

SENIOR YEAR

Fall Semester

ME 4112	Senior Design I	2	0	0	2
ME 4214	Finite Element Design, Modeling and Analysis	3	3	0	4
ME 4311	Heat Transfer Lab	.5	1.5	0	1
ME 4313	Heat Transfer	3	0	0	3
AE 4603	Compressible Flow	3	0	0	3
AE 4653	Aircraft Flight Mechanics	3	0	0	3
					16

Spring Semester

ME 4113	Senior Design II	3	0	0	3
AE 4613	Aerodynamics	3	0	0	3
AE 4633	Aerospace Propulsion	3	0	0	3
	Non-Technical Elective[2]	3	0	0	3
Humanities and Social Sciences Elective[1]		3	0	0	3
					15

Total credits required for the degree: 128

1 Humanities and Social Sciences Electives are classes that must begin with one of the following prefixes: AH, AN, EC, EN, HI, MU, PL, PS, CAM, STS, SEG, URB. At least one of these courses must be Level 3 or Level 4 (3xxx or 4xxx). At least one of these courses must be writing intensive (xxxxW).

2 Non-Technical Electives are non-engineering, science based courses that need to have one of the following prefixes: AH, AN, EC, EN, HI, MU, PL, PS, CAM, SEG, STS, URB, MA, PH or BMS. The approval of the ME Undergraduate Adviser is required.

NYU-ePOLY ONLINE LEARNING GRADUATE PROGRAMS

NYU-ePoly is a fully accredited e-learning platform of Polytechnic Institute of New York University. Introduced to support the careers of active professionals in management and technology, it offers dozens of online graduate courses, accessible from anywhere in the world. If work or the pace of daily life prevents prospective students from attending class, they can now turn confidently to NYU-ePoly to earn a graduate certificate or master's degree in over a dozen online programs. NYU-ePoly's online courses deliver the same curriculum, taught by the same faculty as those on campus in Brooklyn or in Westchester and Long Island. The degree earned and the education received is exactly the same as students receive by attending classes on campus.

ONLINE LEARNING MASTER'S DEGREES

BIOINFORMATICS

Emerging from unprecedented investigations into biological phenomena over the past decades, the in-demand field of bioinformatics organizes and translates vast streams of data from living organisms generated by the Human Genome Project and other more recent studies. Students seeking a role as an expert in bioinformatics will need to thoroughly appreciate biology, chemistry, computer science, and statistics. This online Master of Science in Bioinformatics prepares students to join a talented cadre of creative specialists in the fast-paced pharmaceutical, biotechnology, alternative energy, and agriculture industries.

Basic Core Courses (6 credits)

BI 7513 Chemical Foundation for Bioinformatics
BI 7523 Biological Foundation for Bioinformatics

Required Core Courses—3 Course Sequence (9 credits)

BI 7533 Bioinformatics I: Sequence Analysis
BI 7543 Bioinformatics II: Protein Structure
BI 7553 Bioinformatics III: Functional Prediction

Required Electives (9 credits)

BI 7613 Introduction to Systems Biology
BI 7623 Systems Biology: -Omes and -Omics
BI 7843 Molecular Modeling and Simulation

Other Electives (9 credits)

CS 5303 Introduction to Programming and Problem Solving
CS 5403 Data Structures and Algorithms
BI 7573 Special Topics in Bioinformatics – DNA Microarrays
BI 7583 Guided Studies in Bioinformatics
BI 7603 Research in Bioinformatics
CM 8103 Liquid Chromatography

Minimum Total: 30 Credits

COMPUTER ENGINEERING

Computer engineers participate in some of the most forward-looking work in industry and government today, particularly telecommunications, computer networks and microelectronics. Students become resourceful experts in such dynamic fields as computer networks, VLSI design and testing, embedded systems design and computer architecture. Focusing on principles and concepts underlying the design and integration of hardware and software components and systems, this online master's in computer engineering gives students what they must know to become serious professionals, practitioners confident in electronically controlled systems and devices.

GROUP 1: (9 credits)
Core Courses–Choose 3 Out of Following

EL 5363 Principles of Communication Networks
EL 5473 Introduction to VLSI design
EL 5493 Advanced Hardware Design (VHDL)
CS 6133 Computer Architecture I

GROUP 2: (6-12 credits)

Two sequences in this group each containing two courses; one course in each sequence may be a core course in Group l. Both sequences must be in EL or CS courses and at least one must be an EL sequence. Approved course sequences are detailed in the ECE Graduate Student Manual.

GROUP 3: (6-12 credits)

Approved electives may be chosen with adviser approval from graduate offerings in EL, CS, and occasionally, pertinent courses from other departments. With adviser approval, students may select other groups or individual courses provided they relate to the various facets of computer engineering.

GROUP 4: (3 credits)

Students must take a project (EL9953) that relates to the computer engineering discipline and is adviser-approved.

Minimum Total: 30 Credits

CYBER SECURITY

As the demand for skilled information-security professionals continues to grow, computer and network professionals now can turn to this online, in-demand master's to emerge as sophisticated practitioners in cyber security, the science of protecting vital computer networks and electronic infrastructures from attack. Students acquire a solid foundation in key technologies—computer and network security, digital forensics, cryptography and biometrics. They study with internationally recognized faculty from the Information Systems and Internet Security (ISIS) Laboratory. With industry continuing to place top priority on safeguarding its data and information systems, students become well prepared for careers in developing security products, as security-application programmers, security analysts, penetration testers, vulnerability analysts and security architects.

Required Computer Science Courses (3 credits each)

CS 6033 Design and Analysis of Algorithms I
CS 6233 Operating Systems I
CS 6843 Computer Networking

Required Security Core Courses (3 credits each)

CS 6813 Computer Security
CS 6823 Network Security
CS 6903 Modern Cryptography
CS 9163 Application Security

Select Any 3 Electives (3 credits each)

CS 6573 Penetration Testing and Vulnerability Analysis
CS 6803 Information System Security Engineering and Management
CS 9093 Biometrics
CS 6963 Digital Forensics
EL 6393 Advanced Network Security
CS 9963 Advanced Projects (in the area of cyber-security)
CS 6243 Operating Systems II
CS 6043 Design and Analysis of Algorithms II
CS 6133 Computer Architecture I
Research Project (Optional)
Master's Thesis (Optional)

Minimum Total: 30 Credits

ELECTRICAL ENGINEERING

Electrical engineers assume a principal role in implementing industrial infrastructure, from vast complexes to intricate applications on hand-held devices. This online Master of Science program in Electrical Engineering prepares students to embrace an advanced, highly sought-after professional career. It also gives them critical knowledge to pursue a PhD in electrical engineering. Students explore key subdisciplines in control, signal processing and computing to achieve a thorough command of the field.

GROUP 1: (9 credits)
Choose 3 Out of Following

EL 5373 Internet Architecture and Protocols
EL 5473 Introduction to VLSI Design
EL 6113 Signals, Systems and Transforms
EL 6303 Probability
EL 6413 Analog and High Frequency Amplifier Design

GROUP 2: (6-12 credits)
Choose 2 Sequences

EL 5363 Principles of Communication Networks
EL 5373 Internet Architecture and Protocols
EL 6373 Local and Metropolitan Area Networks
EL 6013 Principles of Digital Communication
EL 6023 Wireless Communications: Channel Modeling and Coding
EL 6033 Modern Wireless Communication Techniques and Systems
EL 6383 High Speed Networks
EL 6393 Advanced Network Security
EL 7373 High Performance Switches and Routers
EL 6413 Analog and High Frequency Amplifier Design
EL 6433 Digital Integrated Circuit Design
EL 5673 Electronics Power Supplies
EL 6753 UHF Propagation for wireless systems
EL 7133 Digital Signal Processing
EL 7353 Communication Networks I

GROUP 3: (6-12 credits)

Approved electives may be chosen with adviser's approval from graduate offerings in EL, CS, and occasionally, pertinent courses from other departments. With adviser approval, students may select other groups or individual courses provided they relate to the various facets of computer engineering.

Minimum Total: 30 Credits

INDUSTRIAL ENGINEERING

Industrial engineers are key professionals who explore how industrial systems work and spearhead effective and efficient delivery of quality products and services. In this online Master of Science in Industrial Engineering, students learn to exploit analytic modeling, system simulation, queuing systems, work design, project planning, facilities design and quality management and control, practices that are fast becoming essential in global industry.

Required Core Courses (12 credits)

IE 6113 Quality Control and Improvement
IE 6213 Facility Planning and Design
IE 6823 Factory Simulation
MN 7993 Supply Chain Engineering

9 Credits with Either IE or MN Designation
Elective 9 credits (course selection optional)

Minimum Total: 30 Credits

MANUFACTURING ENGINEERING

Global competition for manufacturing productivity and profitability has generated vast new frontiers, introducing new, innovative strategies, tools and technologies. Manufacturing engineers are at the forefront of inventive ways to improve quality, reduce inventory, and curtail cycle time by focusing on design and product-realization processes. Graduates of this online Master of Science in Manufacturing Engineering implement effective manufacturing methods, such as Total Quality Management, Just-In-Time Manufacturing and Total Quality Control. Students emerge as experts in new production-control systems, lean manufacturing and activity-based costing.

Required Core Courses (12 credits)

MN 7893 Production Science
MN 6113 Quality Control and Improvement
MN 7923 Design for Manufacturability
MN 7993 Supply Chain Engineering

9 Credits with Either IE or MN Designation

Elective 9 credits (course selection optional)

Minimum Total: 30 Credits

ORGANIZATIONAL BEHAVIOR

This program gives students the knowledge and tools to deal with the rapidly changing landscape of human--resource management. The course prepares students to help their organizations engage in productive and innovative strategies and practices to deal with today's turbulent work environment. This blended Master of Science in Organizational Behavior and Certificate in Human Resource Management prepares students to become human-resources professionals, skilled in techniques used in technology-intensive workplaces. Students learn to appreciate the changing nature of work and the shifting professional qualities required to become an effective manager of people.

12 Courses Selected from the Following

MG 6013 Organizational Behavior
MG 6123 Human Resource Management
MG 6133 Labor Relations
MG 6143 Conflict Management
MG 6153 Leadership and Team Development
MG 6163 Job and Workplace Design
MG 6173 Performance Measurement and Reward Systems
MG 6203 Consulting in Organizations
MG 6213 Outsourcing: A Human Capital Strategy
MG 6223 Staffing Organizations
MG 6233 Training in Organizations
MG 6243 Organization Development
MG 6263 Human Resource Information Systems
MG 6283 Internet Applications in Human Resource Management
MG 6313 Organization Theory and Design
MG 6333 Research Methods

Minimum Total: 36 Credits

SYSTEMS ENGINEERING

Systems engineers manage the details of large projects encompassing multiple disciplines. One day they work with physicists and astronomers; the next, architects and mathematicians. Typically without a specialty of their own, systems engineers must be proficient in enough technical areas to be able to do their job well. They must also know how to manage budgets, maintain schedules, meet performance goals, and work harmoniously with others to ensure a project's success.

It's a developing field perfectly suited to NYU-Poly's i²e philosophy of invention, innovation, and entrepreneurship. Students learn the specifics of systems engineering: methods of modeling and simulation, theories of communication and control, and data analysis.

The MS in Systems Engineering program trains you to perform computer simulations, as well as signal and systems analysis — all to address real-system problems. The program also covers a range of topics, such as feedback control and instrumentation, to guarantee that students walk away with a baseline understanding of systems engineering project management.The program entails three core courses and two tracks; at least one must be a core track.

Required Core Courses
You must choose 3 courses from the following:

EL 5213 Introduction to Systems Engineering
EL 6213 System Modeling, Analysis and Design
EL 6233 System Optimization Method
EL 6253 Linear Systems
EL 6303 Probability Theory
MG 8203 Project Management

Core Tracks of Systems Engineering

Network Management

EL 5363 Principles of Communication Networks
EL 5373 Internet Architecture and Protocols
EL 6373 Local and Metropolitan Area Networks
EL 7353 Communication Networks I: Analysis, Modeling and Performance
EL 7363 Communications Networks II: Design and Algorithms

Wireless Communications

EL 5013 Wireless Personal Communication Systems
EL 5023 Wireless Information Systems Laboratory I
EL 6013 Principles of Digital Communications: Modulation and Coding
EL 6023 Wireless Communications: Channel Modeling and Receiver Design
EL 6033 Modern Wireless Communication Techniques and System

Systems and Automation

EL 5223 Sensor Based Robotics
EL 5253 Applied Matrix Theory, Credits: 3.00
EL 6243 System Theory and Feedback Control
EL 6253 Linear Systems
EL 8223 Applied Nonlinear Control

Energy Systems

EL 5613 Introduction to Electric Power Systems
EL 6623 Power Systems Economics and Planning
EL 6633 Transients, Surges and Faults in Power Systems
EL 6653 Power System Stability

Large Scale Systems Modeling and Control

EL 6243 System Theory and Feedback Control, Credits: 3.00
EL 6253 Linear Systems, Credits: 3.00
EL 7253 State Space Design for Linear Control Systems, Credits: 3.00
EL 8253 Large Scale Systems and Decentralized Control, Credits: 3.00
EL 92x3 Selected Topics in Control Systems (X=1, 2, ...9), Credits: 3.00

Multimedia Applications
EL 5123 Image Processing
EL 5143 Multimedia Laboratory
EL 6113 Signals, Systems and Transforms
EL 6123 Video Processing
CS 6643 Computer Vision and Scene Analysis

Elective Tracks of Systems Engineering

Computer Systems and Security
CS 6813 Information, Security and Privacy
CS 6823 Network Security
CS 9043 Selected Topics in CS
EL 6393 Advanced Network Security

Software Engineering
CS 6063 Software Engineering I
CS 6073 Software Engineering II
CS 6083 Principles of Database Systems
CS 6183 Fault-tolerant Computers

Operations Research and Management
MG 6303 Operations Management
MG 6463 Supply Chain Management
MG 8203 Project Management
FRE 6023 Economic Foundations in Finance

Financial Engineering
FRE 6023 Economic Foundations in Finance
FRE 6083 Quantitative Methods in Finance
FRE 6103 Corporate Finance
FRE 6291 Options and Derivatives
FRE 6411 Fixed Income Securities and Interest Rate Derivatives

Biological Systems
Selected courses with prefix BE, CH, CM, subject to adviser approval.

Minimum Total: 30 Credits

TELECOMMUNICATIONS NETWORKS

One of the most rapidly growing fields, telecommunications networking is embedded in almost every industry—banking, reservation systems, office-information delivery and the Internet, among thousands of other sectors.

Telecommunications experts are equipped to handle gigabit optical networks, multimedia communications and wireless network access. Students emerge from this online master's in telecommunication networks with an in-depth knowledge of today's rapidly accelerating advances in telecommunications, fueled by a broad spectrum of fundamental and applied courses.

6 Required Core Courses (18 credits)
EL 5363 Principles of Communication Networks
EL 5373 Internet Architecture and Protocols
EL 6373 Local and Metropolitan Area Networks
EL 7353 Communication Networking I
CS 6133 Computer Architecture I
CS 6823 Network Management and Security

Electives Courses
Select Any 4 (12 Credits)
EL 5473 Introduction to VLSI Design
EL 6013 Principles of Digital Communications: Modulation and Coding
EL 6023 Wireless Communications: Channel Modeling and Coding
EL 6033 Modern Wireless Communication Techniques and Systems
EL 6113 Signals, Systems and Transforms
EL 6303 Probability
EL 6383 HighSpeed Networks
EL 7133 Digital Signal Processing I
EL 7373 High Performance Switches and Routers

Minimum Total: 30 Credits

WIRELESS INNOVATION: INTERDISCIPLINARY STUDIES IN ENGINEERING

With the wide-scale introduction of cellular telephones, wireless tools have penetrated the marketplace spectacularly. Newly launched services, such as wireless LANs, local loop, PDAs and the emerging wireless Internet, offer experts dynamic participation in the industry's continuing dramatic growth. By enrolling in this online program in Interdisciplinary Studies in Engineering, students earn a Master of Engineering degree, giving them the chance to acquire in-depth knowledge in fields drawn from many disciplines, especially those offered by dispersed academic departments. Students emerge as widely knowledgeable professionals, capable of integrating expertise from a wide array of fields, an accomplishment in high demand in fast-paced, multidisciplinary industries.

GROUP 1: Required (6 Credits)
EL 6303 Probability (Required)
EL 9953 Advanced Project I (Required)

GROUP 2: Restricted Electives (9 Credits)
EL 5013 Wireless Personal Communication Systems
EL 6013 Principles of Digital Communications: Modulation and Coding
EL 6023 Wireless Communications: Channel Modeling and Coding
EL 6033 Modern Wireless Communications: Techniques and Systems
EL 6753 Radio Propagation for Wireless Systems

GROUP 3: Electives (15 credits)
Electrical engineering, management or computer science. A maximum of three management courses is allowed. Sample courses are:

EL 5363 Principles of Communication Networks
EL 6373 Local and Metropolitan Area Networks
EL 6393 Advanced Network Security
CS 6813 Information, Privacy and Security
CS 6823 Network Management and Security

Minimum Total: 30 Credits

ONLINE LEARNING GRADUATE CERTIFICATES

BIOINFORMATICS

Emerging from unprecedented investigations into biological phenomena over the past decades, the in-demand field of bioinformatics organizes and translates vast streams of data from living organisms generated by the Human Genome Project and other more recent studies. Students seeking a role as an expert in bioinformatics will need to thoroughly appreciate biology, chemistry, computer science, and statistics. This online graduate certificate prepares students to join a talented cadre of creative specialists in the fast-paced pharmaceutical, biotechnology, alternative energy, and agriculture industries.

Requirements
The Certificate in Bioinformatics requires five 3-credit courses. Students must take one basic core course, three core courses, plus one elective. Students must maintain a GPA of 3.0 in all required core courses to receive the certificate.

Basic Core Courses (Choose 1)
For students with CS or similar background

BI 7513 Chemical Foundation for Bioinformatics
BI 7523 Biological Foundation for Bioinformatics

Basic Core Courses (Choose 1)
For students with chemistry, biology or similar background
CS 5303 Introduction to Programming and Problem Solving
CS 5403 Data Structures and Algorithms

Required Core Courses
BI 7533 Bioinformatics I: Sequence Analysis
BI 7543 Bioinformatics II: Protein Structure
BI 7553 Bioinformatics III: Functional Predictions

Elective Courses (Choose 1)
BI 7563 Chemoinformatics
BI 7613 Systems Biology: Modeling of Biological Networks
BI 7623 Systems Biology: -Omes and -Omics
BI 7843 Molecular Modeling and Simulation
CS 9013 PERL

Minimum Total: 15 Credits

COMPUTER ENGINEERING

For students looking to participate in one of the more rapidly expanding computer professions, this graduate certificate prepares them for work across the spectrum of computer engineering, from supercomputers to laptops. Graduates can play a significant role in networking computers with intelligent devices, designing specialized hardware, and monitoring and controlling industrial plants and the environment. They can enter such growth fields as computer graphics, robotics, biomedical devices and embedded hardware software systems.

Required Courses (Choose 3)
EL 5363 Principles of Communication Networks
EL 5473 Introduction to VLSI Systems Design
EL 5493 Advanced Hardware Design (VHDL)
CS 6133 Computer Architecture I

Elective Courses (Choose 1)
EL 5483 Real-Time Embedded Systems
EL 6413 Analog and High Frequency Amplifier Design
EL 6433 Digital Integrated Circuit Design
EL 6443 VLSI System Architectures

EL 6453 VHDL-Based Behavioral Synthesis
EL 6493 Digital VLSI System Testing
CS 6143 Computer Architecture II
CS 6183 Fault-tolerant Computers

Minimum Total: 12 Credits

CYBER SECURITY

As the demand for skilled information-security professionals continues to grow, computer and network professionals can now turn to this in--demand graduate certificate to emerge as sophisticated cyber security specialists. Students acquire a solid foundation in key technologies—computer and network security, digital forensics, cryptography and biometrics. They are able to apply their skills immediately to manage the risk of cyber attacks. At Polytechnic, students study with internationally recognized faculty from the Information Systems and Internet Security (ISIS) Laboratory.

5 Required Courses (15 credits)
3 Required Courses
CS 6803 Information System Security Engineering and Management
CS 6813 Information, Privacy and Security
CS 6823 Network Management and Security

Choose 2 Electives
CS 6573 Penetration Testing and Vulnerability Analysis
CS 9093 Biometrics
CS 9163 Application Security
CS 9963 Digital Forensics
CS 9043 Cryptography

Minimum Total: 15 Credits

TELECOMMUNICATION NETWORK MANAGEMENT

Explosive growth of data networks in industry has launched a massive demand for effective network managers. Now, with widespread deployment of standards-based solutions, such as SNMP, giant steps are being taken to design and manage these ubiquitous networks. To become a telecom-network expert, students need to absorb a thorough knowledge of network protocols and network-management standards. This online graduate certificate provides a solid foundation of technologies and standards.

4 Required Courses (12 credits)
Select 3 Required Courses
EL 5363 Principles of Communication Networks
EL 5373 Internet Architecture and Protocols
or
CS 6843 Network Protocols
EL 6373 Local and Metropolitan Area Networks
CS 6813 Information, Privacy and Security
or
CS 6823 Network Management and Security

1 Elective Course (3 Credits)
EL 5473 Introduction to VLSI Design
EL 6013 Principles of Digital Communications: Modulation and Coding
EL 6023 Wireless Communications: Channel Modeling and Coding
EL 6033 Modern Wireless Communication Techniques and Systems
EL 6113 Signals, Systems and Transforms
EL 6303 Probability
EL 6383 High-Speed Networks
EL 7133 Digital Signal Processing I
EL 7373 High Performance Switches and Routers

Minimum Total: 15 Credits

WIRELESS COMMUNICATION

With the wide-scale introduction of cellular telephones, wireless telecommunication has experienced spectacular market penetration. Now, with FCC licensing the spectrum for Personal Communication Services (PCS) and other services, such as wireless LAN, wireless local loop, wireless PDA and the emerging wireless Internet, the industry is poised for even further dramatic growth. Electric engineers or professionals with similar skills can earn this online graduate certificate to become a wireless expert.

Required Course (3 credits)
EL 6303 Probability

Choose Any 3 Electives (9 credits)
EL 5363 Principles of Communication Networks
EL 5473 Introduction to VLSI Design
EL 6013 Principles of Digital Communications: Modulation and Coding
EL 6023 Wireless Communications: Channel Modeling and Coding
EL 6033 Modern Wireless Communication Techniques and Systems
EL 6063 Information Theory
EL 6433 Digital Integrated circuits
EL 6753 UHF Propagation for Wireless Systems

Minimum Total: 12 Credits

POWER ELECTRONICS AND SYSTEMS

With the continuing high demand for energy and recent trends toward finding innovative alternative-power solutions that link to national grids, sophisticated power engineers are needed now more than ever. Today, power engineers are engaged in the search for sustainable-energy practices, aiming to achieve increasingly more efficient systems. This unique online graduate certificate prepares students for key roles as power engineers in electric utilities and in the transportation, power equipment and defense industries. Students become familiar with power equipment and systems, ranging from miliwatts, as in a mobile phone, to hundreds of gigawatts, as in an HVDC transmission system.

Required Courses
EL 5613 Introduction to Electric Power Systems
EL 5673 Electronic Power Supplies

Elective Courses (Choose 2)
EL 5663 Physics of Alternative Energy
EL 5683 Electric Drives Characteristics and Controls
EL 6603 Power Electronics
EL 6623 Power Systems Economics and Planning
EL 6633 Transients, Surges and Faults in Power Systems
EL 6643 Relay Fault Protection
EL 6653 Power System Stability
EL 6663 Distributed Generation Systems
EL 6683 Adjustable Speed Drives
EL 96X3 Selected Topics in Power Engineering

Minimum Total: 12 Credits

NYU-POLY ENTERPRISE LEARNING

NYU-Poly Enterprise Learning meets the complex needs of large organizations worldwide, helping tie learning to company objectives. Whether organizations need to encourage technical leadership, or provide creative intelligence to run R&D centers, or introduce strategic ways to launch new tools and technologies, it can count on NYU-Poly Enterprise Learning to deliver what management and technical staffs need—wherever they are deployed—online, at company sites, or at Polytechnic's campuses on every continent. Corporate learning and performance officers or training staff will recognize how these non-credit executive-education certificates meet strategic-learning objectives. For details, go to www.poly.edu/enterpriselearning/.

CLEAN ENERGY LEADERSHIP CERTIFICATE

If a company or government agency is looking to train professionals qualified to promote, design, specify, market and manage clean-energy products and systems, this five-module executive-education certificate offers a unique, comprehensive approach. Employees receive a set of technologically advanced modules that build a professional team trained in clean-energy technologies to meet state renewable-energy requirements. A corporate staff emerges as technically proficient and up-to-date on current practice, ensuring that installers are qualified and perform to standard.

Participants are exposed to graduate-level courses in power, green building and alternative energy technologies, gaining the skills and mindset of clean-energy experts with the required knowledge to design and manage specification, construction and management of clean-energy, alternative-energy, photovoltaic, tidal, hydroelectric, nuclear and wind-powered generation systems. Focused on training engineers and managers, rather than technicians, the certificate is for R&D staff, product developers, and technical managers who influence installations and specifications.

This non-credit executive-education certificate is available as an overview for delivery to senior managers or as an in-depth program for technical personnel. A graduate-credit version is also available. It can be delivered at company sites, online, in blended mode—partly online and partly in classrooms—or at Polytechnic's satellite campuses everywhere.

MODULE: POWER SYSTEMS ECONOMICS AND PLANNING

Participants learn about power-system economics, revenue requirements, load duration and reserve requirements. They investigate load forecasting, including econometric methods, and explore optimal expansion planning and methodologies, including optimal generation-expansion computer modeling and decision-analysis techniques. They also explore the deregulation of the electric-power industry and learn efficient use of energy and energy-use analysis to reduce energy consumption and carbon footprint. Upon completion, participants should be able to obtain a Certified Energy Management certificate.

MODULE: DISTRIBUTED GENERATION SYSTEMS

This module gives employees insight into the benefits and limitations of distributed generating systems. Participants review classification of small generating systems and understand the operating principles of electrical-equivalent circuits of fuel and solar cells, micro-turbines, reciprocating engines, wind turbines and gas turbines. They appreciate fault conditions, reactive-power support and power quality. Employees learn about the engineering, marketing, public communications and policy issues involved with grid-connected alternative and renewable systems, such as photovoltaic arrays and wind-powered electric generators.

MODULE: PHYSICS OF ALTERNATIVE ENERGY

This module introduces the physics of non-petroleum sources of energy—photovoltaic cells, photocatalytic generators of hydrogen from water, and nuclear-fusion reactors. Company staff learn about semiconductor junctions, optical absorption in semiconductors, and the photovoltaic effect. They understand energy-conversion efficiency of silicon solar cells and of single-crystal, polycrystalline and thin-film solar cells. Participants explore the nature of excitons in bulk and in confined geometries, as well as excitons in energy transport in an absorbing structure. They learn about methods of making photocatalytic surfaces and structures for water splitting as well as conditions for nuclear fusion, plasmas and plasma compression. Employees are exposed to toroidal chamber with magnetic coils, nuclear fusion by laser compression (inertial fusion), and small-scale exploratory approaches to fusion based on liquid compression and electric-field ionization of deuterium gas. Engineers and technical managers are steeped in the options available in specifying and designing with alternative systems. The program prepares professionals to understand new alternatives as they come into the market, allowing them to go beyond what is now available.

MODULE: INFRASTRUCTURE PLANNING, ENGINEERING AND ECONOMICS

The program covers methods for identifying, formulating, preliminarily appraising and analyzing in detail projects and systems in civil engineering. The module offers various approaches appropriate for government agencies, public utilities, industry and private entrepreneurs. Employees learn how to plan projects that satisfy single and multiple purposes and objectives that meet local and regional needs. It provides financial and economic analyses, including sensitivity and risk analysis; presents mathematical models to evaluate alternatives and optimization; and explores the impact of projects, including environmental, social, regional economic growth, legal and institutional, and public involvement. The module introduces technologies and economics of clean buildings, zero-energy buildings and LEED practice in building planning and construction. Upon completion, participants should be able to become LEED-certified professionals.

MODULE: CAPSTONE PROJECT IN CLEAN ENERGY GENERATION AND USE

The program introduces theoretical and experimental projects in electrical and computer engineering. Projects are assigned based on a company's specialized interest. The capstone module is a hands-on practical application of materials covered in previous modules. It encourages participants to delve deeper into actual situations they will face as they implement and integrate clean-energy projects, products and services into their company's business. At the conclusion, employees present their work before a review board of industry executives, providing a high-level assessment.

ENABLING TOOLS AND TECHNOLOGIES FOR 21ST CENTURY INDUSTRY

Global industry is faced with creating new products designed by R&D teams worldwide. Drawn from different cultures and formed by different management, engineering and scientific traditions, modern corporations must build a cohesive, collaborative scientific and technical enterprise. Delivered by NYU-Poly faculty, this

non-credit executive-education program offers technical personnel—R&D staff, engineers, and product developers—a deep appreciation of tools and technologies propelling companies into the next generation, and establishes an enterprise-wide shared technical language. Framed by systems engineering, this program exposes engineers and other technical personnel to the most advanced work on the following:

- Sensors
- Biosensors
- Web-based technologies
- Digital methods and technologies
- Cybersecurity
- Nanotechnologies
- Flexible electronics
- Optical and electrooptics
- RFID applications
- High-end materials
- Components and modules
- Quantum tools
- Neural networks
- Vulnerability analysis
- Wireless technologies and applications
- Green energy
- Energy management technologies
- Sustainability
- Other challenging fields

Customized to support corporate engineering and research programs, "Enabling Tools and Technologies for 21st Century Industry" is delivered skillfully in a variety of enterprise-learning modes to meet the needs of global organizations—face-to-face, online and in blended solutions.

ADVANCED TECHNICAL LEADERSHIP CERTIFICATE

This eight-module, executive-education certificate offers key technical employees the management strategies and relationship skills to meet present demands for technical personnel—R&D staff, IT specialists, engineers and scientists—to engage with clients and participate in corporate-strategic decisions. This non-credit executive-education program can be delivered entirely online, at Polytechnic's Brooklyn campus, or at satellite locations on Long Island and Westchester. It can also be offered to technical staff at company headquarters, R&D facilities or anywhere in the world a technical staff is deployed.

MODULE: IMPACT LEADERSHIP

Participants will be able to:

- identify personal career orientation, personality-driven, on-the-job behaviors and current stage of contribution;
- leverage an individual development plan to guide continued personal development as a leader, through effective goal setting;
- leverage confidence and influencing styles to effectively build a professional brand as a technical leader; and
- use personalized feedback provided by an executive coach to turn feedback into change on the job.

MODULE: LEADING EFFECTIVELY IN A TECHNICAL ENVIRONMENT

Participants will be able to:

- understand how the environment they create for their team can have a direct impact on the bottom line;
- use mobilizing skills to leverage effective communication;
- use strategies for handling the impact of critical management situations on ROI;
- leverage processes to measure, transfer and reinforce changed leadership behaviors on the job; and
- create action plans to track the effectiveness of communicating key messages and for creating alignment.

MODULE: CHANGE MANAGEMENT IN A TECHNICAL ENVIRONMENT

Participants will be able to:

- employ a process to assess current functional performance against strategic organizational goals to determine alignment, gaps and continuous improvement opportunities;
- develop a change plan to target change goals, activities, resources, barriers and risk; and
- use effective decision-making strategies to lead teams to consensus and guide discussions that support necessary change.

MODULE: MENTORING IN A TECHNICAL ENVIRONMENT

Participants will be able to:

- leverage clearly the definition of development within the framework of organizational culture and expectations;
- use skills and techniques for supporting a healthy, interactive mentor/mentee relationship; and
- provide behavioral feedback.

MODULE: RESULT-ORIENTED LEADERSHIP

Participants will be able to:

- identify the impact of biases and assumptions on decisions about people and activities;
- articulate clearly a vision for an employee's area of responsibility and communicate concisely and compellingly; and
- employ a process to determine actions to bring the vision to life in tangible ways.

MODULE: LEADING VIRTUALLY

Participants will be able to:

- apply techniques to continue developing virtual relationships through effective planning, collaboration and technology use;
- identify how to leverage the "differences" created by distance and by cultural and functional factors to ensure collaboration.

MODULE: CONTRIBUTING AS A STRATEGIC LEADER

Participants will be able to:

- articulate clearly functional/personal goals as they support organizational goals and daily activities;
- identify the impact of internal and external factors on success;
- use a process to develop a strategic plan derived from established organizational goals and direction; and
- identify activities, resources, and developmental next steps required to achieve a strategic plan.

MODULE: LEADING FOR SUCCESS IN A HYPERGROWTH ECONOMY

Participants will be able to:

- explore perceptions about diverse cultures;
- address the scope and key components of culture;
- identify cultural filters and their impact on thoughts, behaviors and interactions;
- explore cultural styles vs. stereotypes and judgment; and
- manage cultural differences (techniques and application practice).

SUSTAINABILITY LEADERSHIP CERTIFICATE

How does a society meet present needs without compromising the ability of future generations to meet their needs? To inform future leaders, NYU-Poly, in collaboration with John Wiley & Sons Publishers and The New York Times Knowledge Network, has created the "Sustainability Leadership Certificate" to train professionals in the interdisciplinary nature of sustainability. Relating theory to practice and implementation, participants come away equipped with tactical skills needed to develop and implement sustainable practices throughout their organizations nationally and globally as well as in local communities.

This non-credit executive-education certificate is for executives, managers and professionals working in industry, government and nonprofit sectors. The program is suited for all functional areas—finance, management, marketing, engineering, facilities, or product and service development. The certificate guides organizations to "go green." It can be implemented enterprise-wide, addressing environmental health and safety and other corporate sustainability programs. The program is available online, on campus, in blended delivery, at company sites or anywhere in the world employees are deployed.

Select any eight modules to build a program. All courses are customizable.

MODULE: SUSTAINABILITY LEADERSHIP
Participants will be able to:
- write a sustainability plan; and
- implement strategic vision.

MODULE: MANAGING THE SUSTAINABLE ENTERPRISE
Participants will be able to:
- understand legal developments involving sustainability;
- identify ethical considerations in sustainability; and
- use green marketing techniques.

MODULE: GLOBAL SUSTAINABILITY AND CORPORATE RESPONSIBILITY
Participants will be able to:
- develop a strategy for sustainable global development;
- understand the effect of global protocols and conventions on development strategies; and
- better anticipate and manage your corporation's social and environmental issues.

MODULE: MEASURING ENVIRONMENTAL AND CLIMATE RISK IN YOUR ORGANIZATION
Participants will be able to:
- measure their organization's carbon footprint; and
- employ tools to mitigate climate change.

MODULE: THE SUSTAINABLE SUPPLY CHAIN: PURCHASING AND PROCUREMENT
Participants will be able to:
- think in terms of product and service life cycles;
- purchase and maintain products and facilities while improving their organization's carbon footprint and impacts on human health and ecosystems; and
- understand major certifications and ecolabels and how to use them.

MODULE: BUILDING AND MANAGING SUSTAINABILITY TEAMS
Participants will be able to:
- form and facilitate teams; and
- engage and train employees.

MODULE: PUBLIC/PRIVATE PARTNERSHIPS FOR SUSTAINABILITY
Participants will be able to:
- identify innovative, sustainable partnerships; and
- engage in sustainable advocacy.

MODULE: SUSTAINABILITY AND TECHNOLOGY
Participants will be able to:
- identify sustainable building design and materials;
- use sustainable energy systems; and
- purchase, use and recycle sustainable technology and materials.

MODULE: ACCOUNTING FOR SUSTAINABILITY
Participants will be able to:
- understand sustainable-reporting principles and concepts; and
- perform financial reporting, disclosure requirements, and decision-making related to environmental activities.

MODULE: ECONOMICS OF SUSTAINABILITY
Participants will be able to:
- understand economic concepts and theories for analyzing sustainable development;
- use roles and practices of business, government and nonprofit sectors to foster sustainability.

MODULE: SUSTAINABILITY IN HYPERGROWTH AND DEVELOPING ECONOMIES
Participants will be able to:
- understand sustainability issues directly affecting hypergrowth economies.

MULTI-PROTOCOL LABEL SWITCHING

Multi-Protocol Label Switching (MPLS) is one of the most critical high-speed networking technologies. It is IP-compatible, provides quality of service (QoS) guarantee, and supports high-performance failure recovery. Combining intelligence, scalability, reliability and manageability together, MPLS enables the convergence of multiple protocols (such as IP, ethernet, ATM, frame relay) to the same backbone network. It is also the key technology to build scalable virtual private networks (VPNs) to support various applications.

MODULE: FUNDAMENTALS OF COMMUNICATION NETWORKS
Participants will be able to:
- understand concepts of digital communication, circuit switching, packet switching, TDM and SONET communication protocols, ethernet, IP, TCP, UDP and applications, routing.

MODULE: THE EVOLUTION TO MPLS
Participants will be able to:
- explore IP routing, ATM switching, MPLS, ethernet switching; Compare: Ethernet, IP, and MPLS.

MODULE: THE MPLS ARCHITECTURE
Participants will be able to:
- learn label allocation, next hop label forwarding entry, label-switched Path (LSP), explicit routing label stacking.

MODULE: LABEL SWITCHING ROUTERS (LSRS)
Participants will be able to:
- clearly leverage the basics of packet switch, table lookup (MAC table, IP table and MPLS label table), LSR.

MODULE: MPLS LABELS
Participants will be able to:
- understand MPLS labels basics, label assignment and distribution, upstream and downstream LSR, label distribution: purpose, label distribution: protocols, label distribution: methods.

MODULE: NETWORK RESILIENCE
Participants will be able to:
- learn requirements on resilience, path-based protection in MPLS, link-based protection in MPLS, failure recovery in IP networks.

MODULE: VIRTUAL PRIVATE NETWORKS
Participants will be able to:
- get an overview of VPNs, connection-oriented VPNs, connectionless VPNs, comparison of VPN technologies, MPLS VPN, advantages of MPLS VPNs, carrier ethernet and MPLS VPN.

MODULE: MPLS TRAFFIC ENGINEERING
Participants will be able to:
- explore the need for traffic engineering on the Internet, unequal-cost load balancing via metric manipulation, MPLS traffic engineering elements (dynamic/static LSPs) and MPLS traffic engineering configuration.

MODULE: MPLS QUALITY OF SERVICE
Participants will be able to:
- learn introduction to quality of service, integrated services, differentiated services, and MPLS QoS implementation.

ORGANIZATIONAL BEHAVIOR GRADUATE PROGRAM

Academic Director: Harold G. Kaufman
Administrative Director: Vivek Veeraiah

GOALS AND OBJECTIVES

The graduate program in Organizational Behavior is a unique and pioneering curriculum which prepares professionals and managers to address critical human problems in rapidly changing organizations in today's technology-driven climate. The program provides the knowledge, skills and technologies to deal effectively with human resource issues in order to achieve high quality innovation and productivity as well as job satisfaction in turbulent organizational settings. The changing nature of work and shifting professional needs are addressed by the continuous updating of the curriculum and addition of cutting-edge courses that focus on the effective management of people and organizations within the context of technological and other types of change.

GRADUATE PROGRAM

The course of study for the Master of Science in Organizational Behavior is for individuals with a wide variety of experiences. These range from human resource practitioners who need to update and broaden their qualifications to those with diverse backgrounds who wish to acquire the expertise to enter a field related to one of the following concentrations:

- Human Resource Management
- Management of Change
- Training and Development
- Human Resource Information Systems

In addition, those pursuing careers as managers in a variety of functions benefit greatly from this program. The courses provide the knowledge, skills and technologies needed to effectively manage people, which is essential to being a successful manager.

Some of the unique aspects of the program focus on topics that address rapidly changing organizational environments, such as:

- Managing the impact of changing technology on employees and organizations;
- Motivating knowledge workers to stay up-to-date with developments in their field;
- Conflict resolution in turbulent and uncertain environments;
- Designing new organizational structures that are more responsive to rapid change;
- Improving utilization of knowledge workers through talent management and coaching;
- Training and development innovations to cope with changing job requirements;
- Utilizing job and workplace design to improve motivation and performance;
- Applying career management to knowledge workers in restructuring firms;
- Addressing human resource issues in organizations affected by globalization;
- Developing effective leadership and teamwork in dealing with change;
- Outsourcing as a human capital strategy to address changing organizational needs; and
- Enhancing organizational effectiveness through human resource information systems and web-based human resource technologies.

Because most Polytechnic students are working professionals, many with managerial responsibilities, class schedules are offered in the evenings after normal office hours. Seminar-style classes, emphasizing participation and discussion, enable Organizational Behavior students to receive individual attention from faculty and to work closely with classmates, often in teams. The degree can be completed in one to two years, depending on the course load.

PROFESSIONAL RECOGNITION AND CAREER DEVELOPMENT

The Society for Human Resource Management (SHRM) has assessed the Organizational Behavior HR curriculum as being aligned with the guidelines of SHRM. Moreover, the Organizational Behavior Program sponsors an active, award-winning student chapter of the SHRM that was selected as one of the top ten in the country. The chapter provides extracurricular opportunities for professional seminars, workshops, networking and mentoring to enhance individual career development.

With the unique knowledge and skills acquired from the Organizational Behavior Program, combined with professional development activities, graduates have been able to pursue successful careers in prestigious firms, ranging from high-tech to financial institutions as well as in the public sector, or as private consultants.

ADMISSION AND DEGREE REQUIREMENTS

Criteria for admission include a bachelor's degree with at least a B average from an accredited college or university and demonstrated evidence of motivation, maturity and the ability to benefit from and contribute to professional graduate studies in Organizational Behavior. Applicants who do not meet all the criteria may be admitted as nondegree students with the opportunity, subsequently, to become a degree candidate. Satisfactory scores on the Graduate Record Examination (GRE) or the Graduate Management Admission Test (GMAT) may be used as additional support for admission to degree studies.

Students who have not completed an undergraduate course in statistics must enroll in MG 5050 Probability and Managerial Statistics or its equivalent. Students without an adequate background in computers may be required to enroll in one or more of the preparatory courses offered by the Department of Computer and Information Sciences. These courses are in addition to the degree requirements of 12 courses or 36 credits, which must be completed with an average of B or better.

A maximum of 9 transfer credits may be granted for graduate courses completed elsewhere, as evaluated by the Academic Director.

For the most current information on the Master of Science program in Organizational Behavior, please visit www.poly.edu/academics/programs/organizational-behavior-ms.

ADVANCED CERTIFICATE PROGRAMS

Graduate certificate programs, designed primarily for professionals and managers with work experience, are offered in the two following fields:

- Organizational Behavior
- Human Resource Management

Individualized programs enable specialists and generalists to improve and update their knowledge and skills in critical areas ranging from talent management to the redesign of jobs and organizations to human resource information systems.

Applicants for certificate programs must hold a bachelor's degree. A certificate program requires five courses (see Requirements for Advanced Certificates below). In consultation with the Academic Director, students may design a custom-made certificate program with relevant courses to meet their professional development requirements.

Those who choose to apply for a Master of Science in Organizational Behavior are able, upon admission, to apply all courses completed for a certificate toward fulfillment of the graduate degree requirements. Additional information may be obtained from the Academic Director of the Organizational Behavior Program.

PROGRAMS FOR DISTANCE LEARNING STUDENTS

The Master of Science in Organizational Behavior as well as the advanced certificate programs may be completed partly or completely via distance learning. The program offers fully accredited graduate courses, which are blended in a unique format to allow students the opportunity to actually participate in classroom lectures and discussions. This format has proven te be effective for students who cannot physically attend the class because of work demands, home/child care responsibilities or medical disabilities. Permission to participate as a distance learning student must be obtained from the Academic Director.

THE CURRICULUM

In any concentration there are four components to the Master of Science in Organizational Behavior degree:

1. Core Courses (required)
2. Concentration Courses (including required electives)
3. Free Electives
4. Research Project

A total of 12 courses (36 credits) are required in these four components, as described below.

1. CORE COURSES

Core courses provide an introduction to the theory, research and practice basic to the field of organizational behavior. This scientific foundation consists of three core courses upon which the student can build a more applied cutting-edge specialization within the degree program.

Students who have previously completed courses as undergraduates in any of these areas may be excused from taking them by presenting proof of competence and receiving waivers from the Academic Director. Other courses must be substituted with permission of the Academic Director. The core courses should be taken as early in the program as possible.

Required Core Courses (9 credits)

MG 6013 Organizational Behavior
MG 6313 Organization Theory and Design
MG 6333 Research Methods

2. AREAS OF CONCENTRATION

Students are expected to choose an area of concentration, representing the applications or technologies, built on the scientific foundations from the field of Organizational Behavior. This may be one of the four concentrations listed below or, with the Academic Director's approval, a concentration may be revised to consist of 18 credits of courses designed to meet a student's special needs.

Each concentration consists of 9 credits of required courses plus 9 credits of elective courses selected from a list in each concentration. Courses in each concentration may consist of both 3 credit and 1.5 credit courses.

Students who have previously completed a specific course as undergraduates in any of the areas of concentration may be excused from taking that course by presenting proof of competence and receiving a waiver from the Academic Director. Other courses must be substituted, with permission of the Academic Director.

Courses in each of the four areas of concentration are shown below:

Human Resource Management (18 credits)

The concentration in human resource management prepares professionals to deal with the critical human issues involved in staffing, evaluating and rewarding employees in an era of rapidly changing work environments.

Required:

MG 6123 Human Resource Management
MG 6173 Performance Management and Reward Systems
MG 6223 Staffing Organizations

Electives, select 9 credits:

MG 6113 Career Management
MG 6133 Labor Relations
MG 6143 Conflict Management
MG 6181 Talent Management (1.5 credit)
MG 6191 Coaching in Organizations (1.5 credit)
MG 6211 Outsourcing: A Human Capital Strategy (1.5 credit)
MG 6253 Seminar in Organization and Career Change
MG 6263 Human Resource Information Systems
MG 6271 Managing New Technology in Human Resources (1.5 credit)
MG 6283 Web-Based Human Resource Management
MG 6293 Managing Technical Professionals
MG 6321 Global Human Resource Management (1.5 credit)
MG 8653 Managing Technological Change and Innovation

Human Resource Information Systems (18 credits)

The concentration in human resource information systems integrates knowledge and skills in information systems and web-based technologies together with human resource management to achieve organizational effectiveness.

Required:

MG 6123 Human Resource Management
MG 6263 Human Resource Information Systems
MG 6283 Web-Based Human Resource Management

Electives, select 9 credits:

MG 6163 Job and Workplace Design
MG 6173 Performance Management and Reward Systems
MG 6181 Talent Management (1.5 credit)
MG 6223 Staffing Organizations
MG 6271 Managing New Technology in Human Resources (1.5 credit)
MG 6503 Management of Information and Information Technology
MG 7173 Enterprise Data Systems
MG 8653 Managing Technological Change and Innovation

Management of Change (18 credits)

The concentration in management of change provides human resource professionals and managers with the latest tools and techniques necessary to guide organizations and their employees through periods of rapid, potentially disruptive change, especially transitions created by changing technologies.

Required:

MG 6163 Job and Workplace Design
MG 6243 Organization Development
MG 6253 Seminar in Organization and Career Change

Electives, select 9 credits:

MG 6113 Career Management
MG 6123 Human Resource Management
MG 6143 Conflict Management
MG 6153 Leadership and Team Development
MG 6181 Talent Management (1.5 credit)
MG 6191 Coaching in Organizations (1.5 credit)
MG 6201 Consulting in Organizations (1.5 credit)
MG 6211 Outsourcing: A Human Capital Strategy (1.5 credit)
MG 6233 Training in Organizations
MG 6271 Managing New Technology in Human Resources (1.5 credit)
MG 6321 Global Human Resource Management (1.5 credit)
MG 8653 Managing Technological Change and Innovation

Training and Development (18 credits)

The concentration in training and development prepares human resource professionals to design, administer and evaluate complex training and development programs, particularly in organizations affected by the introduction of new technology.

Required:

MG 6113 Career Management
MG 6233 Training in Organizations
MG 6243 Organization Development

Electives, select 9 credits:

MG 6123 Human Resource Management
MG 6143 Conflict Management
MG 6153 Leadership and Team Development
MG 6163 Job and Workplace Design
MG 6181 Talent Management (1.5 credit)
MG 6191 Coaching in Organizations (1.5 credit)
MG 6201 Consulting in Organizations (1.5 credit)
MG 6253 Seminar in Organization and Career Change
MG 6271 Managing New Technology in Human Resources (1.5 credit)
MG 6321 Global Human Resource Management (1.5 credit)
MG 8653 Managing Technological Change and Innovation

3. FREE ELECTIVES
(6 credits maximum)
Up to 6 credits of related graduate courses may be chosen from any program at Polytechnic with the Academic Director's permission.

4. RESEARCH PROJECT (3 credits)
MG 9343 Research Project in Organizational Behavior

All students must submit an independent research project, typically during the final semester.

REQUIREMENTS FOR ADVANCED CERTIFICATES

ADVANCED CERTIFICATE IN ORGANIZATIONAL BEHAVIOR (15 CREDITS):

Required (6 credits):
MG 6013 Organizational Behavior
MG 6313 Organization Theory and Design

Electives (9 credits) Selected from the following:
MG 6143 Conflict Management
MG 6153 Leadership and Team Development
MG 6163 Job and Workplace Design
MG 6181 Talent Management (1.5 credit)
MG 6201 Consulting in Organizations (1.5 credit)
MG 6243 Organization Development
MG 6253 Seminar in Organization and Career Change
MG 8653 Managing Technological Change and Innovation

Other MG courses may be substituted with the permission of the Academic Director.

ADVANCED CERTIFICATE IN HUMAN RESOURCE MANAGEMENT (15 CREDITS):

Required (9 credits):
MG 6123 Human Resource Management
MG 6173 Performance Measurement and Reward Systems
MG 6223 Staffing Organizations

Electives (6 credits) Selected from the following:
MG 6133 Labor Relations
MG 6181 Talent Management (1.5 credit)
MG 6201 Consulting in Organizations (1.5 credit)
MG 6211 Outsourcing: A Human Capital Strategy (1.5 credits)
MG 6233 Training in Organizations
MG 6263 Human Resource Information Systems
MG 6271 Managing New Technology in Human Resources (1.5 credit)
MG 6283 Web-Based Human Resource Management
MG 6293 Managing Technical Professionals
MG 6321 Global Human Resource Management (1.5 credit)
MG 8653 Managing Technological Change and Innovation

Other MG courses may be substituted with the permission of the Academic Director.

COURSES

MG 6013* Organizational Behavior *3:0:0:3*

Introduction to theory, research and practice to better understand human behavior in organizations. Topics include motivation and job satisfaction; decision making; group dynamics; work teams; leadership; communication; power, politics and conflict; organization culture, structure and design; impact of technology; management of work stress; organizational change and development; and career management. Analysis of organizational behavior problems by self assessments, case studies and simulations. **Distance learning available.*

MG 6113 Career Management *3:0:0:3*

This course integrates theory, research and practice pertaining to careers in organizations, particularly as they change through the life span. It examines careers from the perspectives of both the individual and the organization, including topics such as career-stage models, organizational entry, early career development, mid-career transition, career change and career issues for women. The course develops greater understanding and insight into one's own career growth and development through the use of career-assessment techniques and standardized instruments for self-evaluation. *Co-requisite: MG 6013 or instructor's permission.*

MG 6123* Human Resource Management *3:0:0:3*

This course introduces the broad range of human resource functions and their organizational role. It addresses issues in managing people that have an impact not only on HR professionals but also on line managers. The course is divided into four modules: (1) an overview of HRM from a strategic perspective; (2) the management of human resources, including recruitment and selection, performance management, compensation and benefits, training and career support; (3) human resource challenges, including diversity, procedural justice and ethics, collective bargaining and managing change and innovation; and (4) professional roles in HRM. **Distance learning available.*

MG 6133* Labor Relations *3:0:0:3*

This course introduces labor relations from various perspectives in both union and non-union organizations. Topics include labor movement history; the current state of the labor movement; labor statistics; labor laws and practices; union organizing; negotiating; economics and labor unions; contract administration; achieving cooperation; grievances; labor and employment arbitration; employee discipline; engineering and professional unions, public sector unions; global aspects; and the future for unions. **Distance learning available.*

MG 6143* Conflict Management *3:0:0:3*

This course investigates the nature and meaning of conflict in professional and technical organizations and in society. It analyzes the design of conflict avoidance and mitigation programs. Alternative dispute resolution modalities are presented and demonstrated. Students learn strategies to build successful relationships on an ongoing basis, and how to build skills around collaborative conflict resolution. *Co-requisite: MG 6013 or instructor's permission. *Distance learning available.*

MG 6153* Leadership and Team Development *3:0:0:3*

This course focuses on the essential role of multifaceted leadership in diverse organizational settings, especially those utilizing technology. Students learn the nature of leadership and its relationship to team development and organizational effectiveness. The course broadly surveys theory and research on leadership and teams in organizations. Students learn a hands-on approach involving experiential learning and case analyses. Working in teams, students are required to participate actively. *Co-requisite: MG 6013 or instructor's permission. *Distance learning available.*

MG 6163* Job and Workplace Design *3:0:0:3*

This course examines theory, research and applications of job and workplace design. Presented from an interdisciplinary perspective, the course shows how job design influences attitudes and work behavior within organizations. Students learn diagnostic tools for measuring and evaluating jobs and the psycho-social aspects of the workplace environment, as well as the principles of work redesign. Topics include the influences on work design by innovations in information technology, modern manufacturing, virtual work arrangements and open office systems; design and support of effective work teams; reengineering and total quality management; and privacy and communication in the workplace. *Co-requisite: MG 6013 or instructor's permission. *Distance learning available. Also listed under IE 6163.*

MG 6173* Performance Management and Reward Systems *3:0:0:3*

Students learn to create performance-appraisal systems that include theoretical and applied issues. Topics include coaching and feedback; team settings; multi-source feedback and self-ratings; executive performance; and improving evaluations. The course examines the role of compensation, benefits and other rewards in attracting, retaining and motivating employees, including technical and professional personnel. *Co-requisite: MG 6123 or instructor's permission. *Distance learning available.*

MG 6181 Talent Management *1.5:0:0:1.5*

In this survey course, students gain a knowledge and understanding of the strategies and range of processes, methods and tools that organizations use in effective Talent Management programs. The focus is on developing and managing leadership talent and on Talent Management practices for general management, professional, technical and other positions. Topics include identifying and competing for critical talent pools; alignment and integration of HR practices; recruiting and employment branding; identifying, selecting, developing, reviewing and managing leadership talent; retention and recognition strategies; and career paths and career planning. *Co-requisite: MG 6123 or instructor's permission.*

MG 6191 Coaching in Organizations *1.5:0:0:1.5*

This course focuses on the role of coaching in organizations as part of a talent-management program to develop human resources. Students gain an understanding of the definition, theoretical basis, functions and models of coaching. Topics: How coaching is linked to the adult development lifecycle and the range of contexts in which it is applied. How coaching is used in leadership development as well as performance management, the multicultural aspects of coaching and the access minorities have to coaching. The course provides a familiarity with different coaching tools and instruments as well as how leading organizations use coaching in their talent management programs. Issues related to certification as a coach are addressed. *Co-requisite: MG 6013 or instructor's permission.*

MG 6201 Consulting in Organizations *1.5:0:0:1.5*

This course provides a practical orientation to consulting in organizations within an academic framework. The course prepares students from a variety of disciplines for roles as internal and external consultants by building knowledge and skills to successfully take a client and project from entry through termination and evaluation. Each student is required to take a project from conception to presentation. This project gives students an in-depth understanding of the details and issues that consultants need to address.

MG 6211 Outsourcing: A Human Capital Strategy *1.5:0:0:1.5*

This comprehensive course prepares students from a variety of disciplines with the knowledge and skills necessary for a "make or buy" decision when considering outsourcing human capital. Topics include strategic implications, financial aspects, project management, internal consulting, metrics, legal considerations, development of an effective template RFP (request for proposal), internal communication details, and management of the vendor/provider relationship. *Co-requisite: MG 6123 or instructor's permission.*

MG 6223* Staffing Organizations *3:0:0:3*

This course examines the design and management of successful staffing practices used to build, deploy and retain a quality workforce to achieve organizational effectiveness and individual job satisfaction. Topics include staffing strategy; human-resource planning and workforce diversity; job analysis; recruitment; hiring methods; the reliability and validity of employee-assessment methods; and retention management. The course reviews psychological theories of personnel assessment and integrates legal issues pertaining to staffing practices. *Co-requisite: MG 6123 or instructor's permission. *Distance learning available.*

MG 6233* Training in Organizations *3:0:0:3*

This overview of numerous forms of training and related learning activities found in the modern workplace includes management development, technical training, career planning and mentoring. The course focuses on training as both an asset to the organization and a necessity for delivering goods or services that customers value. Topics include needs analysis, preparation of employees for jobs, training program design, traditional training methods, computer-based methods, development, implementation and evaluation of training, targeting various groups with special training needs, and management development. **Distance learning available.*

MG 6243* Organization Development *3:0:0:3*

This course surveys theory, research and applications related to the process of managing planned change in organizations. Organization development (OD) encompasses a variety of interventions and techniques, including strategic management sessions, team building, organizational climate studies, career development and job enrichment. The course addresses the practical application of group, inter-group and individual changes; planned structural revisions in formal organizations; and the dynamics of organizational change processes. Experiential techniques are emphasized. *Co-requisite: MG 6013 or instructor's permission. *Distance learning available.*

MG 6253 Seminar in Organization and Career Change *3:0:0:3*

This course explores organizational restructuring, including downsizing, reengineering, delayering, mergers and acquisitions, and focuses on the impact of such change on professional and managerial careers. The course emphasizes current organizational and individual management practices in coping with rapid structural, cultural and technological change in the work environment. Experts from the private and public sectors and from consulting firms address these management practices. *Co-requisite: MG 6013 or instructor's permission.*

MG 6263* Human Resource Information Systems *3:0:0:3*

This course introduces the design, selection, implementation, enhancement and operation of human- resource information systems (HRIS), a computer-based tool that allows the efficient entry and updating of employee-related information. The focus is on the design and use of HRIS to facilitate the objectives of HR functions and of the organization. Students participate in a "hands-on" experience with the design of prototype simulations and database programming systems used to solve common HR problems and efficiently manage employee information. *Co-requisite: MG 6123 or instructor's permission. *Distance learning available.*

MG 6271 Managing Human Resource Technology in Organizations *1.5:0:0:1.5*

This course examines factors critical to the effective organizational adoption and use of technology in human-resource applications. Topics include project management; HR data and process standardization; organizational governance; the unique security requirements of HR data; metrics; and HR process and technology outsourcing. By understanding these issues and how organizations can address them, students improve their ability to plan and to implement effectively HR process re-engineering and HR technology. *Co-requisite: MG 6123 or instructor's permission.*

MG 6283* Web-Based Human Resource Management *3:0:0:3*

This course surveys the effective use and application of Internet and Intranet technologies for HR functions. Topics include employee self-service and online recruiting as well as software that handles peer reviews, applicant tracking, performance management, succession planning and benefits administration. Issues include best practices in using Web technology for HRM; creating websites to achieve organizational goals; determining HR information to include in an organization website; impact of Web technology on organization design; evaluating privacy and security issues; and developing a vision and a plan for utilizing Web technology in HRM. *Co-requisite: MG 6123 or instructor's permission. *Distance learning available.*

MG 6293 Managing Technical Professionals *3:0:0:3*

This course provides a survey of research and practice focusing on the effective management of technical professionals, who have come to represent a significant segment of the labor force. The success of organizations today is largely a result of the knowledge and skills applied by their technical professional employees. The effective management of such a work force has been one of the most critical problems faced by organizations that depend on their contributions. This course closely examines research and case studies that examine various management techniques to improve the utilization, development and motivation of technical professionals for achieving high levels of performance, innovation and creativity. *Prerequisite: MG 6013 or instructor's permission.*

MG 6313* Organization Theory and Design *3:0:0:3*

This course introduces theories of organizations including structure, design and culture. It also provides an understanding of how organizations work and how they relate to the external environment. The course examines the process by which managers select and supervise aspects of structure and culture to achieve organizational goals. Topics include characteristics of bureaucracy, adhocracy, suboptimization, human dynamics and informal systems; influence and control systems; management of technology; and planned change. Students learn about organizations through research and case studies. *Prerequisite: MG 6013 or instructor's permission. *Distance learning available.*

MG 6321 Global Human Resource Management *1.5:0:0:1.5*

This course is an overview of human-resource management practices in today's global work environment. Topics include international/socio-cultural diversity; key characteristics of select countries' international business behavior; international strategic alliances; identification, recruiting and selection of international personnel; training and development of expatriates and home-country nationals; evaluation and coaching of employees in international organizations; intercultural skills acquisition for the line manager and human resources professional; team-development strategies; and design of practical language learning tools for the HR professional and the line manager. *Co-requisite: MG 6123 or instructor's permission.*

MG 6333* Research Methods *3:0:0:3*

This course introduces theories and techniques related to research methods applied to organizations. It also provides an understanding of why and how organizational research is carried out. The focus is on analyzing organizational problems and using research as a problem-solving tool. Topics include problem definition, theoretical framework, hypothesis development, research design, experimental designs, measurement, data-collection methods, sampling strategies and preparing research proposals. Students develop a research proposal they apply to a problem of interest. *Prerequisite: MG 5050 or undergraduate statistics course. *Distance learning available.*

MG 9683 Technology Management-Internship and Action Learning *3:0:0:3*

This course provides graduate students with the opportunity to work in the field in an action-learning context under faculty supervision. This course exposes graduate students to relevant, state-of-the-art and best practices in modern technology management from the perspective of reflective involvement and interaction in the field.

MG 9343 Research Project in Organizational Behavior *3:0:0:3*

This project integrates and applies advanced research techniques used in studies of organizations. Students develop and carry out individual applied research projects. *Prerequisite: Advanced standing and MG 6333 or instructor's permission.*

MG 9853 Selected Topics in Organizational Behavior *3:0:0:3*

This course discusses and analyzes current topics in organizational behavior. *Prerequisites: Advanced standing and instructor's permission.*

MG 9861 Readings in Organizational Behavior *1.5:0:0:1.5*

Students undertake directed individual study or supervised readings in advanced areas of organizational behavior. *Prerequisite: Academic Director's permission.*

MG 9873 Readings in Organizational Behavior *3:0:0:3*

This course emphasizes directed individual study or supervised readings in advanced areas of organizational behavior. *Prerequisite: Program Director's permission. Note: Course descriptions for other than Organizational Behavior courses can be found in the MS in Management [MSM] section of this catalog.*

PHYSICS PROGRAM

Undergraduate Adviser: Lorcan M. Folan
Graduate Adviser: Edward L. Wolf

Physics is the basic science of the natural world, the study of matter, energy and motion. Worthy of study for its own beauty, physics is also the foundation of engineering and the natural sciences.

GOALS AND OBJECTIVES

The mission of the Physics Program is to provide Polytechnic undergraduates with a strong foundation in physics, suited to the discipline, and to offer advanced opportunities for formal study in physics.

UNDERGRADUATE PROGRAMS

BACHELOR OF SCIENCE IN PHYSICS

The aim of the four-year Bachelor of Science in Physics is to prepare students thoroughly for any one of the many careers based on a concentration in physics. For some students, this means preparation for graduate school and further study leading to the master's or doctoral degree. For many others, it means professional work in industry, government or in high school teaching. Some students use their major in physics to prepare for work in mathematics, chemistry, biology, medicine, engineering, law, history of science, writing or business. The program's emphasis on fundamental knowledge, thorough analytic training and the universal logic of science enables physics students to take these different career paths.

The core of the program is 34 credits of required physics courses. Students begin with a general, calculus-based introductory sequence, followed by an introduction to Modern Physics, then intermediate courses in the fundamentals, i.e., Classical Mechanics, Electromagnetism, Thermal Physics and Statistical Mechanics and Quantum Physics. Students are provided with a solid grounding in mathematics and in the humanities and social sciences, and the choice to round out their education with two free electives. Students select the balance of their major courses from available elective physics offerings. Technical electives from other disciplines may be substituted with adviser approval, especially if a student is pursuing a concentration or minor.

Core Physics Requirements (34 credits)

PH 1002 Physics: The Genesis of Technology
PH 1013 Mechanics
PH 2021 Introductory Physics Lab I
PH 2023 Electricity, Magnetism and Fluids
PH 2031 Introductory Physics Lab II
PH 2033 Waves, Optics and Thermodynamics
PH 2344 Introduction to Modern and Solid State Physics
PH 2104 Analytical Mechanics
PH 3234 Electricity and Magnetism
PH 4124 Thermodynamics and Statistical Physics
PH 4364 Introduction to Quantum Theory
PH 4912 Senior Seminar in Physics

Other Required Courses (38 Credits)

MA 1024 Calculus I
MA 1124 Calculus II
MA 2012 Elements of Linear Algebra
MA 2132 Ordinary Differential Equations
MA 2112, MA 2122 Multivariable Calculus A and B
MA 2212, MA 2122 Data Analysis I and II
CM 1004 General Chemistry for Engineers and BMS 1004 Introduction to Cell and Molecular Biology or General Chemistry I and II
CS 1133 Engineering Problem Solving and Programming
EN 1013 College Writing Workshop
HuSS 1023W First-Year Writing Seminar
EG 1001 Engineering and Technology Forum

Technical Electives (26 Credits)

Students should select six physics elective and two math electives courses. Electives from other disciplines may be substituted with adviser approval.

Electives in the Humanities and Social Sciences (18 Credits)

Students are required to take 18 elective credits in the humanities and social sciences, with EN 1013 and HuSS 1023W as prerequisites. To gain depth of knowledge, it is recommended that one or more of these electives be taken at an advanced level.

Free Electives, Independent Study and Projects (12 Credits)

Twelve credits are reserved for free electives and independent study courses, of which 6 credits are recommended for use on a project or thesis topic.

An illustrative typical course of study for the Bachelor of Science degree in physics is shown at the end of this section.

DUAL MAJOR IN PHYSICS AND MATHEMATICS

The core of the program is 30 credits of required Physics courses and 29 credits of required Math courses. Students pursuing the dual major must also take an additional 10 credits of Physics electives and 9 credits of Math electives. 15 credits are reserved for free electives and independent study courses, of which 6 to 8 credits are reserved for a senior project. The remaining credits are used to satisfy other Institute and state requirements. The proposed curriculum is outlined in detail below.

Physics Requirements (30 credits)

PH 1013 Mechanics, Credits: 3.00
PH 2021 Introductory Physics Laboratory I, Credits: .50
PH 2023 Electricity, Magnetism, and Fluids, Credits: 3.00
PH 2031 Introductory Physics Laboratory II, Credits: .50
PH 2033 Waves, Optics and Thermodynamics, Credits: 3.00
PH 2104 Analytical Mechanics, Credits: 4.00
PH 2344 Introduction to Modern and Solid State Physics, Credits: 4.00
PH 3234 Electricity and Magnetism, Credits: 4.00
PH 4124 Thermodynamics and Statistical Physics, Credits: 4.00
PH 4364 Introduction to the Quantum Theory, Credits: 4.00

Math Requirements (29 credits)

MA 1024 Calculus I, Credits: 4.00
MA 1124 Calculus II, Credits: 4.00
MA 2012 Linear Algebra, Credits: 2.00
MA 2112 Multivariable Calculus A, Credits: 2.00
MA 2122 Multivariable Calculus B, Credits: 2.00
MA 2132 Ordinary Differential Equations, Credits: 2.00
MA 3012 Introduction to Probability I, Credits: 2.00
MA 3112 Complex Variables I, Credits: 2.00
MA 4113 Introduction to Mathematical Statistics, Credits: 3.00
MA 4413 Applied Partial Differential Equations, Credits: 3.00
MA 4423 Intro Numerical Methods, Credits: 3.00

Physics Electives (10 Credits)

Students should select 10 credits from the following list of Physics elective courses. Graduate courses may be substituted with adviser's approval.

PH 2814 Astronomy and Astrophysics, Credits: 4.00
PH 3054 Introduction to Polymer Physics, Credits: 4.00
PH 3103 Fundamentals of Applied Nuclear Physics, Credits: 3.00
PH 3244 Concepts of Nanotechnology, Credits: 4.00
PH 3423 Light and Lighting, Credits: 3.00
PH 3474 Introduction to Modern Optics, Credits: 4.00
PH 3503 Introduction to Radiation Physics and Dosimetry, Credits: 3.00
PH 4244 Techniques and Applications of Nanotechnology, Credits: 4.00
PH 4444 Quantum Optics, Credits: 4.00
PH 4554 Solid State Physics, Credits: 4.00
PH 4603 Special Topics in Physics, Credits: 3.00

Math Electives (9 credits)

Students should select 9 credits from the following list of Math elective courses. Graduate courses may be substituted with adviser's approval.

MA 3103 Problem Solving and Proofs, Credits: 3.00
MA 3203 Linear Optimization, Credits: 3.00

MA 3303 Differential Geometry, Credits: 3.00
MA 4013 Intro. to Number Theory, Credits: 3.00
MA 4023 Elements of Abstract Algebra, Credits: 3.00
MA 4613 Analysis I, Credits: 3.00
MA 4623 Analysis II, Credits: 3.00

Free Electives, Independent Study and Projects (15 Credits)
15 credits are reserved for free electives and independent study courses, of which 8 credits are reserved for a math project/thesis or a 6 credit physics project plus senior physics seminar.

Electives in the Humanities and Social Sciences (18 Credits)
Students are required to take 18 credits in the humanities and social sciences requiring EN 1013W and HuSS 1023W as prerequisites. To ensure some depth of knowledge, it is required that one or more of these elective courses be taken at an advanced level.

Other Required Courses (17 Credits)
PH 1002 Physics: the Genesis of Technology, Credits: 2.00 or
MA 1002 The Art of Mathematics, Credits: 2.00
EG 1001 Engineering and Technology Forum, Credits: 1.00
CM 1004 General Chemistry For Engineers, Credits: 4.00
EN 1013W College Writing Workshop, Credits: 3.00
HUSS 1023W First-Year Writing Seminar, Credits: 3.00
CS 1114 Intro to Programming and Problem Solving, Credits: 4.00

MINOR IN PHYSICS

The undergraduate physics minor consists of a set of four or more physics courses, totaling at least 15 credits. The courses should be at intermediate or advanced level and have the introductory physics sequence, PH 1013, 2021, 2023, 2031 and 2033, as prerequisites. An overall GPA of 2.0 in these courses is required to earn the minor. For transfer students, at least 8 credits must be earned at Polytechnic with a 2.0 GPA.

CONCENTRATION AND MINOR IN NUCLEAR SCIENCE AND ENGINEERING

This interdisciplinary program aims to produce engineering and science graduates who understand clearly the benefits and risks of nuclear technologies and who will seriously consider employment in nuclear industry and government.

Students may obtain an Interdisciplinary Concentration or Minor in Nuclear Science and Engineering, in conjunction with a traditional degree. Those majors include civil, chemical and biological, computer, electrical, financial and risk, or mechanical engineering, or the physical or computational sciences (all are majors currently offered by Polytechnic).

The concentration consists of three courses taken typically during the junior and senior years. Students can use the available technical and free electives in their curriculum to take these courses.

PH 3103 Fundamentals of Applied Nuclear Physics, Credits: 3.00
PH 3503 Introduction to Radiation Physics and Dosimetry, Credits: 3.00
ME 4373 Introduction to Nuclear Engineering, Credits: 3.00

The core of the minor is the three course concentration (PH 3103 Fundamentals of Applied Nuclear Physics, PH 3503 Introduction to Radiation Physics and Dosimetry, and ME 4373 Introduction to Nuclear Engineering). The balance of the 15 credits required for the minor shall be selected from the approved elective courses listed below. An overall GPA of 2.0 is required in the courses to earn the minor.

Approved elective courses include:
ME 4863 Corrosion and Non-Destructive Evaluation of Materials
FIN 3593 Probabilistic Risk Assessment
PS 2723 Human Factors in Engineering Design
EE 2613 Fundaments of Electric Power Engineering for the Nonelectrical Students

MASTER OF SCIENCE IN PHYSICS

The Master of Science in Physics will be offered only on the Brooklyn Campus and the courses will be offered primarily in the evening. Admitted students will be expected to have a BS in physics or a closely-related discipline and to make up any deficiencies before commencing graduate studies. Letters of recommendation, GRE and TOEFL scores, and application letters will be considered in the admission process.

DEGREE REQUIREMENTS

Completion of the Master of Science in Physics requires a minimum of 30 semester credits. Students are required to take 6 credits of basic courses (a 3-credit course in quantum mechanics and two semesters of graduate seminar) with the balance of the necessary credits earned in elective physics courses. The elective courses may include a 6-credit research project or a 9-credit thesis in physics. Choice of a project or thesis option and of elective courses should be made with the approval of the graduate adviser. As many as 9 credits of physics courses taken elsewhere may be accepted towards the degree, with the approval of the graduate adviser. No comprehensive examination is required for the master's degree in physics.

Minimum Course Requirements
PH 6673 Quantum Mechanics I, Credits: 3.00
PH 9531 - 9541 Graduate Seminar I, II, Credits: 3.00

Elective Courses, Credits: 24
Total Credits: 30

Of elective courses, 4 will be allowed at the 5000 level.

Electives
PH 5343 Physical Basis of Nanotechnology, Credits: 3.00
PH 5443 Physical Techniques and Application of Nanotechnology, Credits: 3.00
PH 5473 Modern Optics, Credits: 3.00
PH 5481 Modern Optics Lab, Credits: 1.00
PH 5493 Physics of Nanoelectronics, Credits: 3.00
PH 5553 Physics of Quantum Computing, Credits: 3.00
PH 5663 Physics of Alternative Energy, Credits: 3.00
PH 6403 Physical Concepts of Polymer Nanocomposites, Credits: 3.00
PH 6513 Introduction to Solid-state Physics I, Credits: 3.00
PH 6523 Introduction to Solid-state Physics II, Credits: 3.00
PH 6553 Advanced Quantum Computing, Credits: 3.00
PH 6683 Quantum Mechanics II, Credits: 3.00
PH 8013 Selected Topics in Advanced Physics, Credits: 3.00
PH 8023 Selected Topics in Advanced Physics, Credits: 3.00
PH 9993 Research in Physics, Credits: Variable

UNDERGRADUATE COURSES

PH 1002 Physics: The Genesis of Technology *2:0:0:2*

This course introduces contemporary topics in physics, along with readings and discussions of topics with technological implications.

PH 1013 Mechanics *3:0:1:3*

This course is the first of a three-semester lecture sequence in general physics for science and engineering students. Motion of particles and systems of particles. One-dimensional motion. Vectors and two-dimensional motions. Forces and acceleration. Conservation of energy and momentum. Rotations. The free and driven harmonic oscillator. Gravitation. (This class meets four hours per week for lectures and recitation.) *Prerequisite: MA 1024 or an approved equivalent. Co-requisite: MA 1124 or approved equivalent.*

PH 1213 Motion and Sound *3:0:1:3*

First of a two courses introductory sequence in general physics for majors other than science or engineering. (Not an acceptable substitute for PH 1013.) One-dimensional motions. Vectors and Two-Dimensional Motions. Newton's Laws of motion. Conservation Laws of Energy and Momentum.

Collisions. Rotational motions. Gravity. Statics and Elasticity. Fluids. Oscillations. Mechanical Waves. Superposition and Standing Waves. Sound and Acoustics. *Co-requisite: MA 1024.*

PH 1223 Electricity and Light *3:0:1:3*

Second of two introductory courses in general physics for non science or engineering majors. (Not an acceptable substitute for PH 2023 or PH 2033) Electric forces and fields. Electric potential and capacitance. Electric current. Magnetic forces and fields. Faradays law and inductance. Maxwell's Theory of Electromagnetism. Electromagnetic waves. Light and Color. Geometrical optics. Image Formation. Interference and diffraction. *Prerequisite: PH 1213.*

PH 2021 Introductory Physics Laboratory I *0:1.5:0:0.5*

This course is the first of a two-semester sequence. Introduction to the science of measurement and data analysis. Accompanies PH 2023. Experiments cover topics from PH 1013 and PH 2023. *Prerequisites: PH 1013 and MA 1124 or an approved equivalent. Co-requisite: PH 2023.*

PH 2023 Electricity, Magnetism and Fluids *3:0:1:3*

This is the second course of a three-semester lecture sequence in general physics for science and engineering students. Fluids at rest and in motion. An introduction to electric and magnetic forces and fields. Electric charge density. Electric fields from simple charge distributions. Electric potential. Capacitance. Magnetic forces. Magnetic field from a current loop. Inductance. Magnetism in matter. Current and resistance. (This class meets four hours per week for lectures and recitation.) *Prerequisites: PH 1013 and MA 1124 or an approved equivalent. Co-requisite: PH 2021.*

PH 2031 Introductory Physics Laboratory II *0:1.5:0:0.5*

This is the second course of two-semester sequence. Continuation of the introduction to the science of measurement and data analysis. The course accompanies PH 2023. Experiments cover topics from PH 2023 and PH 2033. *Prerequisites: PH 2021 and PH 2023. Co-requisite: PH 2033.*

PH 2033 Waves, Optics and Thermodynamics *3:0:1:3*

This is the third course of a three-semester lecture sequence in general physics for science and engineering students. Water, sound and electromagnetic waves. Reflection, scattering and absorption. Standing waves and spectra. Superposition, diffraction and beats. Geometrical optics. Introduction to thermodynamics; temperature, heat, and entropy. (This class meets four hours per week for lectures and recitation.) *Prerequisites: PH 2021 and PH 2023. Co-requisite: PH 2031.*

PH 2104 Analytical Mechanics *4:0:0:4*

This course covers statics by virtual work and potential energy methods. Stability of equilibrium. Particle dynamics, harmonic oscillator and planetary motion. Rigid body dynamics in two and three dimensions. Lagrangian mechanics. Dynamics of oscillating systems. *Prerequisites: MA 2122 and PH 2023.*

PH 2344 Introduction to Modern and Solid State Physics *4:0:0:4*

Special theory of relativity, Michelson-Morley experiment. Planck's quantum hypothesis, photoelectric effect, Compton effect, Rutherford scattering, Bohr's atom, DeBroglie wavelength, electron diffraction, wave function, uncertainty principle, Schrodinger equation. Application to: square well potential, one electron atom. Atomic nucleus, fission and fusion. Energy bands in a periodic lattice, Kronig Penney model, valence, conduction bands, impurity states, electron mobility. Semiconductor properties. Introduction to superconductivity; electron pairs, energy gap, Josephson effect. *Prerequisite: PH 2023. Co-requisite: PH 2033.*

PH 2813 Astronomy and Astrophysics *3:0:0:3*

This course covers the historical development of observational astronomy. Traditional and modern observational techniques. Theories of formation and evolution of stars, planets and galaxies. Current developments in astronomy, cosmology and astrophysics. *Prerequisite: PH 2033.*

PH 3054 Introduction to Polymer Physics *4:0:0:4*

This course introduces polymer physics and its applications in engineering. The course includes polymer assemblies, morphology and motion, mechanical and dielectric response, transitions and relaxations, time-temperature equivalence, yield and fracture, conducting polymers, optics of polymers, oriented structures, nanofibers, composites. *Prerequisite: CM 1004. Co-requisite: PH 2023.*

PH 3103 Fundamentals of Applied Nuclear Physics *3:0:0:3*

This course surveys the fundamentals of nuclear physics with application to nuclear engineering. Topics include an introduction to quantum mechanics, nuclear forces and nuclear structure, nuclear stability and reactions, natural and induced radioactivity. *Prerequisites: CM 1004, PH 2033 and MA 2132.*

PH 3234 Electricity and Magnetism *4:0:0:4*

The course covers properties of the electrostatic, magnetostatic and electromagnetic field in vacuum and in material media. Maxwell's equations with applications to elementary problems. *Prerequisites: MA 2122 and PH 2033.*

PH 3244 Concepts of Nanotechnology *3:0:1:4*

This course is the first of an interdisciplinary, two-semester sequence on concepts, techniques and applications of nanotechnology. Introduction to nanotechnology, examples of nanoscale systems. Systematics in miniaturization from the mm to the nm scale. Limits to miniaturization. Quantum concepts and elementary Schrodinger theory. Quantum effects in the behavior of chemical matter. Examples of self-assembled nanosystems from nature and from contemporary industrial products. *Prerequisite: PH 2033.*

PH 3423 Light and Lighting *3:0:0:3*

The course explores physical concepts in conversion of electric energy into visible light. Nature of light. Visualization of light. Principles of operation and characteristics of modern light sources. Incandescent and tungsten halogen lamps. Fluorescent mercury lamps. Low-pressure sodium lamps. High intensity discharge (HID) lamps. Solid-state light sources. Latest trends in lighting technology. *Prerequisites: CM 1004 and PH 2033. Also listed under EE 3424.*

PH 3474 Introduction to Modern Optics *4:0:0:4*

This course covers the physics of optics using both classical and semi-classical descriptions. The classical and quantum interactions of light with matter. Diffraction of waves and wave packets by obstacles. Fourier transform optics, holography, Fourier transform spectroscopy. Coherence and quantum aspects of light. Geometrical optics. Matrix optics. Crystal optics. Introduction to electro-optics and nonlinear optics. *Prerequisite: PH 2033 or equivalent.*

PH 3503 Introduction to Radiation Physics and Dosimetry *3:0:0:3*

The course examines the basic theory and practice of Radiation and Health Physics. Atomic and nuclear radiation. X-ray and gamma radiation. Interaction of radiation with matter, and the effects on living tissue. Principles of radiation detection, radiation measurement, external and internal dosimetry. Radiation Protection. *Prerequisites: PH 3103 or PH 2344. Also listed under ME 4383.*

PH 3603 Mathematical Physics *3:0:0:3*

Course in mathematical physics for undergraduate students in physics and engineering. Line, surface and volume integrals, gradient, divergence, and curl. Cylindrical and spherical coordinate systems. Tensors and tensor transformations. The Dirac delta function, and integrals and derivatives of the delta function. Functions of complex variables, analytic functions, and the residue theorem. Fourier series, integrals, and transforms. *Prerequisites: PH 2033 and MA 2122. Also listed under MA 3603.*

PH 3614 Computational Physics *4:0:0:4*

An introduction to numerical methods. Solving ordinary differential equations, root finding, Fourier transforms, numerical integration, linear systems. Techniques are applied to projectile motion, oscillatory motion, planetary motion, potentials and fields, waves, and quantum mechanics. *Prerequisite: CS 1133 (or CS 1114), MA 2132 (or an approved equivalent) and PH 2344.*

PH 3801-3804 Guided Studies in Physics *0:0:0:1 - 0:0:0:4*

These guided studies courses in physics are supervised by staff member. *Prerequisites: Physics adviser approval. (Course may be repeated for additional credit.)*

PH 4124 Thermodynamics and Statistical Physics *4:0:0:4*

The course covers fundamental laws of macroscopic thermodynamics, heat, internal energy and entropy. Topics include an introduction to statistical physics, and applications of Maxwell, Fermi-Dirac and Bose-Einstein distributions. *Prerequisites: MA 2122 and PH 2344.*

PH 4244 Techniques and Applications of Nanotechnology *3:0:1:4*

This is the second of a two-course sequence on concepts and techniques of nanotechnology. Novel function and performance can occur with materials or devices of size scales of one to 100 nanometers, a range extending from molecular scale to that of typical linewidths in contemporary microelectronics. Nanosystems may provide entirely new functions, by virtue of access enabled by the small size. Photo and x-ray lithographic patterning. Scanning probe microscopes for observation and for fabrication. Molecular machines as envisioned by Drexler. The role of Van der Waals force. Questions of machine manufacturability on the nm scale. The IBM GMR hard-drive read head. Micro- and nanoelectromechanical devices and systems. Single-electron electronics. Molecular electronics. *Prerequisite: PH 3244.*

PH 4364 Introduction to the Quantum Theory *4:0:0:4*

The course gives a quantitative introduction to the quantum theory, which describes light, electrons, atoms, nuclei and solid matter. Superposition principle, expectation values, momentum operator and wave function, duality, current vector, Hermitian operators, angular momentum, solution of the radial equation, electron in a magnetic field, perturbation theory, WKB approximation, identical particles. Applications include alpha decay, electrons in a periodic lattice, hydrogen spectrum, helium atom, neutron-proton scattering, and quark model of baryons. *Prerequisites: MA 2122 and PH 2344.*

PH 4444 Quantum Optics *4:0:0:4*

Beginning with a review of classical optics and quantum mechanics, this course covers foundations of spectroscopy, including atomic transition rates, selection rules and spectral line shapes. The course explores the quantum nature of light. Topics include photon statistics, coherent states, squeezed light, resonant light-atom interactions, atoms in cavities and laser cooling. *Prerequisite: PH 3474.*

PH 4554 Solid State Physics *4:0:0:4*

The course covers basic concepts in condensed matter physics and preparation for the advanced quantum theory of solid state. *Prerequisite: PH 2344.*

PH 4601-4604 Special Topics in Physics *0:0:0:1 - 0:0:0:4*

Variable credit special topics courses in physics. *Prerequisites: PH 2344 and Physics adviser approval. (Course may be repeated for additional credit.)*

PH 4902 Introduction to Senior Project in Physics *0:4:0:2*

A qualified senior physics student or group of students work with a faculty member (and possibly graduate students) on an advanced problem in physics. In this introductory phase the student(s) and adviser select a suitable theoretical or experimental problem in the subject area and use various resources to solve it.

PH 4904 Senior Project in Physics *0:8:0:4*

In the project's concluding phase, senior physics students or group of students work with a faculty member (and possibly graduate students) to solve an advanced problem in interdisciplinary physics. The conclusion of the project is a written report and an oral presentation made to the supervising faculty.

PH 4912 Senior Seminar in Physics *2:0:0:2*

Senior physics students, in consultation with the instructor, study and prepare presentations on several current research topics in the general area of interdisciplinary physics. Students' performance is rated on the mastery of the material chosen and also on the quality of the presentation made to the instructor and the seminar members.

GRADUATE COURSES

PH 5343 Physical Basis of Nanotechnology *3:0:0:3*

This course focuses on the underlying physical basis of nanotechnology. Introduction to nanotechnology, examples of nanoscale systems. Systematics in miniaturization from the mm to the nm scale. Limits to miniaturization. Quantum concepts and elementary Schrodinger theory. Quantum effects in the behavior of chemical matter. Examples of self-assembled nanosystems from nature and from contemporary industrial products. *Prerequisite: PH 2033.*

PH 5443 Physical Techniques and Applications of Nanotechnology *3:0:0:3*

This course focuses on physical techniques and applications of nanotechnology. Scanning probe microscopes for observation and fabrication. Photolithographic methods of patterning, deposition techniques. Dense memory based on arrays of cantilevers. Magnetic Tunnel Junctions as elements of magnetic disc memory read heads and in Magnetic Random Access Memory. Nanoscale high-electric-field devices. Nanoscale confinement techniques and devices. Applications of carbon nanotubes and semiconductor nanowires. Assembly methods for nanoscale objects. *Prerequisite: PH 2033.*

PH 5473 Modern Optics *3:0:0:3*

The course covers the physics of optics, using both classical and semi-classical descriptions. Topics include the classical and quantum interactions of light with matter. Diffraction of waves and wave packets by obstacles. Fourier transform optics, holography, Fourier transform spectroscopy. Coherence and quantum aspects of light. Geometrical optics. Matrix optics. Crystal optics. Introduction to electro-optics and nonlinear optics. *Prerequisites: MA 2122 and PH 3234 or equivalents.*

PH 5481 Modern Optics Lab *0:3:0:1*

The modern optics laboratory includes experimental investigations into laser modes, velocity of light by time-of-flight, Fourier optics, holography, Fourier transform spectroscopy, crystal optics and nonlinear optics. *Co-/Prerequisite: PH 5473 or equivalent.*

PH 5493 Physics of Nanoelectronics *3:0:0:3*

This course covers limits to the ongoing miniaturization (Moore's Law) of the successful silicon-device technology imposed by physical limitations of energy dissipation, quantum tunneling and discrete quantum electron states. Quantum physical concepts and elementary Schrodinger theory. Conductance quantum and magnetic flux quantum. Alternative physical concepts appropriate for devices of size scales of 1 to 10 nanometers, emphasizing role of power dissipation. Tunnel diode, resonant tunnel diode, electron wave transistor; spin valve, tunnel valve, magnetic disk and random access memory; single electron transistor, molecular crossbar latch, quantum cellular automata including molecular and magnetic realizations. Josephson junction and "rapid single flux quantum" computation. Photo- and x-ray lithographic patterning, electron beam patterning, scanning probe microscopes for observation and for fabrication; cantilever array as dense memory, use of carbon nanotubes and of DNA and related biological elements as building blocks and in self-assembly strategies. *Prerequisite: PH 2033. Also listed under EL 5533.*

PH 5553 Physics of Quantum Computing *3:0:0:3*

This course explores limits to the performance of binary computers, traveling salesman and factorization problems, security of encryption. The concept of the quantum computer based on linear superposition of basis states. The information content of the qubit. Algorithmic improvements enabled in the hypothetical quantum computer. Isolated two-level quantum systems, the principle of linear superposition as well established. Coherence as a limit on quantum computer realization. Introduction of concepts underlying the present approaches to realizing qubits (singly and in interaction) based on physical systems. The systems in present consideration are based on light photons in fiber optic systems; electron charges in double well potentials, analogous to the hydrogen molecular ion; nuclear spins manipulated via the electron-nuclear spin interaction, and systems of ions such as Be and Cd which are trapped in linear arrays using methods of ultra-high vacuum, radiofrequency trapping and laser-based cooling and manipulation of atomic states. Summary and comparison of the several approaches. *Prerequisite: PH 2033. Also listed under EL 5553.*

PH 5663 Physics of Alternative Energy *3:0:0:3*

The course examines non-petroleum sources of energy including photovoltaic cells, photocatalytic generators of hydrogen from water, and nuclear fusion reactors. The advanced physics of these emerging technical areas are introduced in this course. Semiconductor junctions, optical absorption in semiconductors, photovoltaic effect. Energy conversion efficiency of the silicon solar cell. Single crystal, polycrystal, and thin film types of solar cells. Excitons in bulk and in confined geometries. Excitons in energy transport within an absorbing structure. Methods of making photocatalytic surfaces and structures for water splitting. Conditions for nuclear fusion. Plasmas and plasma compression. The toroidal chamber with magnetic coils as it appears in recent designs. Nuclear fusion by laser compression (inertial fusion). Small scale exploratory approaches to fusion based on liquid compression and electric field ionization of deuterium gas. *Prerequisite: PH 2033. Also listed under EL 5663.*

PH 6153 Theoretical Mechanics I *3:0:0:3*

Principles of particle and rigid body dynamics. Lagrange's equations. Small vibrations of coupled systems, normal modes of oscillation. *Prerequisites: Graduate standing, or for undergraduates, PH 2104 or equivalent and physics graduate adviser's approval.*

PH 6163 Theoretical Mechanics II *3:0:0:3*

Hamiltonian mechanics. Transformation theories of mechanics including the Poisson Bracket and Hamilton-Jacobi formulations. Lagrangian formulation of mechanics of continuous media. *Prerequisite: PH 6153.*

PH 6243 Electromagnetic Theory I *3:0:0:3*

Electro- and Magneto-statics. Boundary value problems in three dimensions. Green's functions and multipole expansions. Polarization and magnetization. Scalar and vector potentials and gauges. Maxwell's equations. *Prerequisites: Graduate Standing, or for undergraduates, PH 3234 or equivalent and physics graduate adviser's approval.*

PH 6253 Electromagnetic Theory II *3:0:0:3*

Electromagnetic waves. Propagation in free space and in dielectric and conducting media. Polarization, dissipation and dispersion. Guided waves and cavities. Special Relativity. Scattering. *Prerequisites: PH 6243.*

PH 6403 Physical Concepts of Polymer Nanocomposites *3:0:0:3*

This course presents fundamental aspects of polymer nanocomposites and updates on recent advancements and modern applications. Topics include nanostructured materials; assembly at interfaces; interactions on surfaces; properties of polymer nanocomposites; reliability; nanodevices.

PH 6513/6523 Introduction to Solid-State Physics I/II *each 3:0:0:3*

Phenomena and theory of physics of crystalline solids. Topics from thermal, magnetic, electrical and optical properties of metals, insulators and semiconductors. *PH 6513 Prerequisite: PH 2344 or equivalent. PH 6523 prerequisite: PH 6513.*

PH 6553 Advanced Quantum Computing *3:0:0:3*

Advanced topics in quantum computation are explored. *Prerequisite: PH 5553.*

PH 6633 Statistical Mechanics I *3:0:0:3*

Equilibrium distributions. Relationships to laws of thermodynamics. Quantum effects. Maxwell-Boltzmann, Fermi-Dirac, Bose-Einstein distributions. Applications to bulk properties phenomena using Boltzmann transport equation.

PH 6643 Statistical Mechanics II *3:0:0:3*

Micro-, macro-, and grand-canonical ensembles and principles of classical statistical mechanics. Condensation phenomena. Treatment of fluctuation and transport phenomena. Density matrix formalism of quantum statistical mechanics. Many-body problems. *Prerequisite: PH 6633.*

PH 6673/6683 Quantum Mechanics I, II *each 3:0:0:3*

Quantum mechanics with applications to atomic systems. The use of Schrodinger's equations. Angular momentum and spin. Semi-classical theory of field-matter interaction. *Prerequisites: MA 2122 and PH 3234 or equivalents. PH 6683 prerequisite: PH 6673. Also listed under EL 6553, EL 6563.*

PH 8013/8023 Selected Topics in Advanced Physics *each 3:0:0:3*

Current or advanced topics of particular interest to graduate students are examined. Subject matter is determined each year by students and faculty. The course may be given in more than one section. Consult department office for current offerings. *Note: this course is not offered every semester.*

PH 9531-9541 Graduate Seminar in Physics I, II *each 1.5:0:0:1.5*

Students presenting current topics in Physics in a seminar setting to other students and supervising faculty. Topics chosen by the student with guidance from faculty.

PH 9983 Thesis for Master of Science Degree in Physics *each 3 credits*

Independent research project performed under guidance of thesis adviser. Bound thesis volume and oral defense in presence of at least three faculty members. Continuous registration with total 9 credits required.

PH 9993 Research in Physics *each 3 credits*

An original investigation in some branch of physics, which may serve as basis for the MS or PhD degree, is performed under the direction of a member of the department. The number of research credits registered for each semester should realistically reflect the time devoted to research. *Prerequisites: Degree status and graduate advisers and research director's consent.*

Typical Course of Study for the Bachelor of Science in Physics

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Class	Hours/Week Lab.	Rec.	Cr.
PH 1002	Physics: The Genesis of Technology	2	0	0	2
CM 1004/1014	General Chemistry for Engineers/ General Chemistry I[1]	3	2	1	4
MA 1024	Calculus I	4	0	0	4
EN 1013W	College Writing Workshop	3	0	0	3
EG 1001	Engineering and Technology Forum	1	0	0	1
					14

Spring Semester

Course No.	Course Title	Class	Hours/Week Lab.	Rec.	Cr.
PH 1013	Mechanics	3	0	1	3
CM/BMS 1024/1004	General Chemistry II/ Intro. to Cell and Molecular Biology[1]	3/3	2/3	1/0	4
MA 1124	Calculus II	4	0	0	4
CS 1133	Engineering Problem Solving and Programming	2	0	3	3
HuSS 1023W	First-Year Writing Seminar	3	0	0	3
					17

SOPHOMORE YEAR

Fall Semester

PH 2021	Introductory Physics Lab I	0	1.5	0	0.5
PH 2023	Electricity, Magnetism and Fluids	3	0	1	3
MA 2012	Linear Algebra	2	0	0	2
MA 2132	Ordinary Differential Equations	2	0	0	2
***3	Free Elective	3	0	0	3
Humanities and Social Sciences Elective #1		3	0	0	3
Humanities and Social Sciences Elective #2		3	0	0	3
					16.5

Spring Semester

PH 2031	Introductory Physics Lab II	0	1.5	0	0.5
PH 2033	Waves, Optics and Thermodynamics	3	0	1	3
PH 2104	Analytical Mechanics	4	0	0	4
PH 2344	Intro to Modern and Solid State Physics	4	0	0	4
MA 2112	Multivariable Calculus I	2	0	0	2
MA 2122	Multivariable Calculus II	2	0	0	2
					15.5

JUNIOR YEAR

Fall Semester

PH 3234	Electricity and Magnetism	4	0	0	4
PH 2/3**3	PH Elective	3	0	0	3
MA 2212	Data Analysis I	2	0	0	2
MA 2222	Data Analysis II	2	0	0	2
CM 5040	Laboratory Safety	1	0	0	0
***3	Free Elective	3	0	0	3
Humanities and Social Sciences Elective #3		3	0	0	3
					17

Spring Semester

PH 4364	Introduction to Quantum Theory	4	0	0	4
PH 2/3/4**4	PH Elective	4	4	0	4
MA 2/3/4**4	Math Elective	4	0	0	4
Humanities and Social Sciences Elective #4		3	0	0	3
					15

SENIOR YE*AR*

Fall Semester

PH 4124	Thermodynamics and Statistical Physics	4	0	0	4
PH 4902	Introduction to Senior Project	2	0	0	2
PH 4912	Senior Seminar	2	0	0	2
PH 3/4/5**3	PH Elective	3	0	0	3
MA 3/4**3	Math Elective	3	0	0	3
Humanities and Social Sciences Elective #5		3	0	0	3
					17

Spring Semester

PH 4904	Senior Project	0	8	0	4
PH 3/4/5**3	PH Elective	3	0	0	3
PH 3/4/5**3	PH Elective	3	0	0	3
PH 3/4/5**3	PH Elective	3	0	0	3
Humanities and Social Sciences Elective #6		3	0	0	3
					16

Total credits required for the degree: 128

1. Students may choose to take a two-semester sequence in chemistry, or a combination of a single semester of chemistry and a semester of biology.

SCIENCE AND TECHNOLOGY STUDIES PROGRAM

Program Director: Myles Jackson
Program Advisers: Chris Leslie, Jonathan Bain

GENERAL INFORMATION

Rapidly changing technology requires science and engineering students and professionals to keep abreast of the latest discoveries and innovations in their fields. While this is vital, it is also important for scientists and engineers, as well as an informed public, to see new knowledge in a larger context–that is, to be able to recognize and understand how these advances influence everyday life and, in turn, how the influence of society leads to these developments. Embryonic stem cell research, intellectual property and human genetics, the thrust towards alternative energies, genetic technologies, and the rise of digital entertainment are just a few of the latest examples of how science and technology interact with society. Throughout history, scientific and technological innovations have had ethical, economic, social, and political impacts.

Science and Technology Studies (STS) is an interdisciplinary field of study committed to exploring the interrelationships between science and technology on the one hand, and society on the other. STS unites a myriad of disciplines, such as history, philosophy, rhetoric, literary studies, and sociology, in order to investigate these interrelationships. How do science and technology shape society? How do social processes frame scientific and technological enterprises? What is the relationship between the content of scientific and technological knowledge, and the social and intellectual context in which it is created?

The STS program at NYU-Poly is characterized by its collegiality, compact size, and its focus on interdisciplinary collaboration with other degree programs. An STS graduate bears the distinctive marks of all three parts of an NYU-Poly degree: top-notch education in a scientific or technical field, a comprehensive foundation in the humanities, and an awareness of the synergies between science, technology, and society.

AT NYU-POLY, STS MAJORS STUDY TOPICS THAT INCLUDE:

The History of Science and Technology

The Scientific Revolution significantly altered humankind's conception of itself and the universe. Scholastic methods of reasoning were replaced by new scientific methods of observation and experimentation as evidenced by Galileo's telescope. New tensions arose between religion and science: who had the power to interpret God's universe, philosophers or theologians? STS students study these important events to help understand current scientific controversies and directions.

Biology and Genetics

The fields of biotechnology and genetic engineering raise significant scientific and ethical issues in the areas of new pharmaceuticals, cloning, stem cell research, genetic privacy, and the patenting of human genes. STS students approach these topics from a broad perspective, understanding both the scientific and philosophical issues arising in these important fields so that they can be capable advisers of public policy and thoughtful innovators in the next round of scientific inquiry.

History and Philosophy of Physics

The field of physics plays an important role in our scientific and technological understanding of the world, but what do the fundamental theories in physics really tell us about the world? What is the relationship between the mathematical descriptions that physicists employ and the nature of physical phenomena such as matter and forces, space and time? STS students obtain firm foundations in both philosophy and physics in order to consider these and other questions related to the role physics plays in both science and technology.

The History of Media Technology

An STS approach to the history of media considers media as specific, technological devices. STS students study such topics as the diffusion of Internet technologies across international borders during the latter part of the 20th century, the history of the dialogue between such technologies and their cultural and physical environments, and the on-going evolution of their interaction with national systems of laws, politics, and economics.

PROGRAM HIGHLIGHTS

The Resources of New York City's Preeminent Technological Institution

What better place to study the relations among science, technology, and society than in New York City, the most culturally and socially diverse, technology-driven urban center in the world? In addition, STS majors take full advantage of the course offerings of the second-oldest engineering research institute in the country as well as the computing and research facilities associated with a premier leader in technology innovation.

The Technology/Science Requirement

STS majors fulfill a tech/sci requirement that is the equivalent of a minor in a particular field of technology or science, with significant exposure to other fields. Tech/Sci offerings include courses in multi-disciplinary subjects such as nanotechnology, robotics, and computer game design, as well as more traditional subjects in engineering and the natural sciences.

Faculty Mentors

Each STS major is assigned a faculty mentor who provides assistance and advice in choosing electives, constructing the tech/sci minor, and designing and implementing project courses.

Project-Oriented Education and Research

STS majors may elect to undertake a project-oriented semester studying abroad or engaged in a service-learning internship. In addition, students may undertake Directed Studies projects during their time at NYU-Poly; and all STS majors must complete a senior Capstone Project. These requirements and opportunities provide students with essential experience in conducting and presenting research at public forums within the institute.

CAREER TRACKS

Their training in both tech/sci and the liberal arts allows STS graduates to pursue:

- Medical school, law school, or business school.
- Technology consultants at consulting firms.
- Technology equity analysts at investment institutions.
- Science journalists or science educators.
- Science and technology policy administrators in the public or private sectors.
- Graduate school in Science and Technology Studies; Science, Technology, and Environmental Policy; History of Science, or Philosophy of Science; Science and Technology Journalism.

BACHELOR OF SCIENCE DEGREE REQUIREMENTS

STS majors take 120 credits, divided into four parts:

1. General Education Requirement (40 credits)

(a) Humanities and Social Sciences General Education Requirement (8 courses, 24 credits)

(i)EN1013W (or EN1033W or EN1013H) and HuSS1023W (or EN1233W or EN1203H): College Writing Workshop and First-Year Writing Seminar.

(ii) Six courses from any of the Humanities and Social Sciences clusters, at least one at Level 3 and at least one Writing Intensive.

(b) University General Education Requirement (16 credits)

General Tech Elective
General Math Elective
General Science Elective 1
General Science Elective 2

2. Technology/Science Requirement (28 credits)

The minimum cumulative GPA for this requirement must be 3.0.

(a) Introduction to Engineering (4 cr)

EG1003 Intro to Engineering and Design
EG1001 Engineering and Technology Forum

(b) Technology/Science Electives (24 cr)

24 Technology/Science credits taken from any of the following general fields, at least 15 credits of which must be from the same field (unless otherwise indicated by minor requirements specific to a given department and/or approved by the adviser).

- Biological Sciences
- Chemistry
- Computer Science
- Engineering
- Mathematics
- Physics

3. STS Requirement (34 credits)

Each class must be passed with a minimum grade of C.

(a) Core (10 credits)

STS2003 Science, Technology, and Society
STS3003 Seminar in Science and Technology Studies
STS4014 Capstone Project

(b) Restricted Electives (24 credits)

8 courses from the Science, Technology, and Society (STS) cluster of Humanities and Social Sciences courses (excluding those taken to fulfill the Core Requirement 3a). These courses include the STS-prefixed courses listed below as well as those listed under the STS Cluster in the catalog entry for the Department of Technology, Culture and Society.

4. Free Electives Requirement (18 credits)

STS MINOR

The minor in STS requires 15 credits consisting of:

1. Core Requirement: STS 2003 (3 credits).

2. Elective Requirements: Remaining credit requirements (12 credits) must be satisfied by courses chosen from the STS electives list.

Requirement 1 and one of the STS electives (requirement 2) must be taken at NYU-Poly; the remaining elective requirements may be met with appropriate transfer credits.

The minor in STS is open to all majors. For engineering or natural science majors, benefits of an STS minor include:

- An understanding of the conceptual, historical, and cultural foundations of their major field.
- A rigorous humanistic education essential to the practice of science and engineering in our global society.
- Writing and communication skills that employers seek.

For other majors, benefits of an STS minor include:

- Exposure to key subjects in science and engineering fields and their impact on society, at a broad conceptual, yet nontrivial, level.
- An appreciation of the problem-solving techniques and practices that scientists and engineers engage in.
- Critical reasoning and analytical skills that employers seek.

STS DOUBLE MAJOR

Students in a technical or scientific major at NYU-Poly or a different unit of NYU may easily obtain a second major in STS. These students can fulfill the Technology/Science Requirement for the STS major with the courses for their other major. These students can also use their six General Education Humanities and Social Sciences Electives to partially satisfy the STS Restricted Electives Requirement. In addition, an STS double major must also satisfy the STS Core Requirement.

COURSES

STS 2003/W Science, Technology, and Society

This course introduces students to important issues, historical and contemporary, related to science and technology from a variety of social, political, and philosophical viewpoints. We shall use a multidisciplinary approach to understand the interaction between science, technology and society and to discover the conditions that foster technological innovation. The scientific and technological way of thinking will become clear through historical examples, helping us to consider important issues of science and technology policy, such as how science and technology can be used to benefit society and how one can foster innovation in a society or an organization. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 2113/W History and Philosophy of Internet Technology

This course investigates implementations of internet technologies. We will examine the founding premises of the internet, uncovering the assumptions about culture, policy objectives, and ideals of practitioners, both before and after the worldwide web. The course investigates typical claims about the internet, such as its capability to inculcate democracy, and also the development of the attendant hardware and software infrastructure. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 2133W Perspectives on Science and Technology Reporting

The effective communication of scientific and technological ideas is essential in a society and culture as influenced by science and technology as our own. At some point in their careers, scientists and engineers will be called on to convey technical concepts and ideas to each other, to government agencies, to private corporations, and to the public at large. These job functions are required for various reasons, including: (1) to support the marketing and public relations efforts of a company, (2) to provide the latest state-of-the-art information for the benefit of peers working in a specific industry and (3) to demonstrate to shareholders and customers the achievements attained in the corporation's research and development laboratories. Moreover, non-experts in technical fields may be called on to participate in these and similar discussions. This course addresses these issues by having

students study, research and write articles about three technologies where R&D activity is proceeding at a rapid pace: telecommunications, plastics materials development and processing, and energy. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 2143 Public Policy Issues in Telecommunications

This course addresses the myriad public policy issues arising from the phenomenal growth of the telecommunications industry, especially in light of convergence and the fierce competition that it has spawned over the past decade. Among the most pressing issues of the day are networking neutrality, Internet censorship, privacy, standardization, the enforcement powers of the FCC, workplace monitoring, and spectrum allocation. In addition, the course will introduce the student to the basic concepts of the technology, provide a historical perspective of the industry (with an emphasis on the cataclysmic chain of events set off by the Modified Final Judgment in 1983 that led to the break-up of AT&T), and explore trends. As a major requirement, students will be asked to give oral and written presentations on a major international or domestic public policy issue currently besetting this industry. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 2153 Addressing Public Policy Issues in the Sciences, Engineering and Medicine

This course explores public-policy issues on critical and often controversial questions in science (e.g., cap-and-trade, global warming, LEDs as lighting sources, biofuels, spectrum allocation), medicine (e.g., embryonic stem-cell research, national health care, genetic therapy, workplace risks of nanotechnology), and technology (e.g., off-shore drilling, biotechnology, clean coal, nuclear energy, "smart" power). Students will select areas in which to specialize and will be required to submit a white paper on one of these major issues. The report will be based on library research and face-to-face interviews with experts in the field. As students draft sections of their white papers, they will submit them for class discussion and they will meet periodically with the instructor to review their progress. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 2163 Science Fiction

A distinct genre of literature emerges during the twentieth century that imagines new possibilities and challenges for human society in light of scientific and technological change. This course reviews important authors of this field, considering whether science fiction can be an agent of social change and how well it can critique or imagine the interaction between science, technology, and society. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 2233W Magic, Medicine, and Science

This course looks at the metaphysical and epistemological origins of three systems of thought - the organic, the magical, and the mechanical - and considers the extent to which modern science can be seen as arising from their synthesis. Topics include Presocratics, Plato, Aristotle, Plotinus, the Hermetic Corpus, Ficino's naturalistic magic, Pico's supernatural magic, Paracelsus and the ontic theory of disease, Copernicus, Galileo, Kepler, Descartes, the Cambridge Platonists, and Newton. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 2253/W Biology and Society

This course explores the relationship between the biological sciences and society from Enlightenment France to the Human Genome Project and biotechnology in the United States. Ever since the Enlightenment, the study of nature has played an ever-increasing role in shaping social issues. For example, we shall exam the roles played by gender, social class, and natural theology in eighteenth-century classifications of plants and animals. We shall also investigate how biologists and anthropologists drew upon rather ambiguous notions of nature to classify humans into races. We shall then trace Darwin's theory of evolution and how it shaped, and was shaped by, socio-economic, political, and religious views. We shall discuss the depressing history of eugenics in Britain and the U.S. We shall conclude by provocatively asking if there is a link between eugenics and the Human Genome Project. We shall also see how economics, politics, and religion have shaped biotechnology and human-embryonic-stem-cell research. The student is invited to think about the way in which debates concerning "nature versus nurture" have been framed historically, in order to understand current controversies over that distinction. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 2263W The Rhetoric of Science

This course is an introduction to the history, theory, practice, and implications of rhetoric - the art and craft of persuasion. Specifically, this class focuses on the ways that scientists use various methods of persuasion as they construct scientific knowledge. By first examining the nature of science and rhetoric, we will then examine texts written by scientists and use rhetorical theory to analyze those texts. We will look at the professional scientific research articles and other genres of scientific writing. Finally, we'll investigate the way that rhetoric plays a role in the everyday life of scientists. Throughout the class, we will wrestle with questions, such as: How is science rhetorical?; What can rhetorical analysis tell us about the ways that scientists use persuasion?; and, How might rhetorical analysis limit our understanding of science? *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 2273W Science and Sexuality

This course explores and analyzes the constructions of sexuality in the biological, social, and medical sciences, focusing on issues in evolutionary biology, endocrinology, neuroscience, psychiatry, comparative anatomy, and genetics. Throughout the semester, we shall compare the various meanings given to sexuality across disciplinary frameworks, paying attention to the increasingly unstable relationships between the categories of fiction and science, reproduction and sexuality, nature and culture, male and female, animal and human, and hetero- and homosexuality. We shall also assess how expert scientific discourses influence popular understandings of sexuality and vice versa. Specifically, we will examine how they contribute to the normalization and official regulation of certain kinds of behavior, how they satisfy a desire for stories about human origins, and how they fashion terms of attraction, repulsion, affection, antagonism, dominance, and submission according to which sexuality is putatively expressed. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 2313 It's About Time

From looking at our watch and noting the change from day to night and counting the days, months and years, time seems so mundane that we take it for granted and usually think little more about it. But what is time and why do we measure it so obsessively and with such precision? This course will concern itself with all aspects of time, from

the evolution of calendars (including our own) to precision timepieces and our own internal clocks. And finally, the nature of time itself and its relationship to space and other aspects of our universe will be discussed. This course will draw on knowledge from history, anthropology, psychology, technology, astronomy and physics to gain an understanding of this very basic "dimension". *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 2323 Dinosaurs: Resurrecting an Extinct Species

Large fossil bones have fascinated people since ancient times, and after 1842 some of these fossils were described as belonging to the taxum Dinosauria. Since then, new discoveries and scientific techniques have led to a series of changes in both the views of scientists and the public as to what dinosaurs were, what groups they were related to, and how they behaved and interacted with their environments. This course will look at the views of fossils in ancient Greece and Rome, and also in some modern tribal societies. Most emphasis will be on the changing views of paleontology, geology, biology and evolution from the Enlightenment period to the present. All major dinosaur groups will be discussed, as well as their physiology, relationships to other animals, behavior and ecology, as scientific ideas evolve and new discoveries are made. Finally, how scientists reconstruct dinosaurs through images, sculpture and mountings for the public and popular culture's fascination with dinosaurs will be discussed. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 2333 Evolution

This course discusses the development of the theory of evolution based on the amassed evidence from the geological and biological sciences over the past two hundred years. Darwin's idea that natural selection was the driving force behind evolution will be considered in detail. Early rival theories to Darwin's ideas will also be discussed as part of the process leading to the modern theory. The integration into the theory of genetics and molecular biology have led to a much deeper understanding of how organisms are related. The role of chance factors will also be considered. Application of evolution theory to problems in economic biology and modern medicine and epidemiology will also be discussed. Finally, current controversies regarding Intelligent Design will be addressed and put into a historical context. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 2343 Imaging the Past

Images of prehistoric landscapes, creatures and human cultures abound in our society. This course will discuss the scientific bases for reconstructing prehistoric environments and cultures. Information derived from field work in geology, paleontology and archaeology - stratigraphy, fossils, mineralogy and human artifacts - is used to piece together an ancient landscape and its life. The use of modern chemical and isotopic techniques to establish paleoclimates and water conditions will be described. Information from taxonomy, biomechanics, and comparative anatomy, physiology and genetics can "flesh out" the appearance and lifestyles of extinct groups. Equally important, is how this scientific information is transformed into images, sculpture, dioramas and digital information that can physically visualize past life, culture and environments. The history of such depictions and the scientific techniques that have produced them will be discussed in some detail. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 241x Special Topic in STS

Variable credit special topic in Science and Technology Studies. Topic to be decided by instructor. *Credits: Variable. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 3003/W Seminar in Science and Technology Studies

This course considers the current state of the field of Science and Technology Studies. Students are exposed to the range and methods of STS as well as their own place within the field. The course is designed specifically to bring students with different academic backgrounds into contact with each other in a classroom setting. *Credits: 3. Prerequisite: One Level 2 STS Cluster Humanities and Social Sciences Elective. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 3013 Directed Study in STS

Directed study under supervision of faculty adviser in Humanities and Social Sciences. Students are exposed to foundational research techniques under the guidance of a faculty adviser. Library research, written and oral reports required. *Credits: 3. Prerequisites: STS 2003 and permission of STS faculty adviser. Note: Does not satisfy a Humanities and Social Sciences Elective.*

STS 3163 Science and Technology in the Literary Sphere

How does literature seek to accommodate new ideas from science? When do new technologies find their way into the public sphere? What happens when scientists and engineers translate their findings into novels or other narratives? This course reads literature as evidence of the diffusion of technological and scientific ideas. When literary forms are used to promote, challenge, or even misrepresent scientific or technical developments, we gain insight into the interaction between scientists, engineers, and society at large. This course may be organized around different themes, but it always explores how scientific and technological ideas fare in the republic of letters. *Credits: 3. Prerequisites: One Level 2 STS Cluster Humanities and Social Sciences Elective. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 3173 Hypermedia in Context

This course investigates precursors to new media, revealing the possibilities and limitations of today's incarnations. Searching analog media for examples of supposedly new technologies like associative thinking, multimedia, and participatory design, we will examine the social and economic structures that allow for such tools to arise and to determine what exactly is new in new media. Further, we consider how we can use the concept of antecedent to critique present manifestations of media and how we can incorporate ideas from the past into the present while avoiding homologies. *Credits: 3. Prerequisites: One Level 2 STS Cluster Humanities and Social Sciences Elective. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 3243W Humans, Machines, and Aesthetics

This seminar proffers a glimpse into the historically contingent relationships between machines and humans from the Enlightenment to the Industrial Revolution. We shall underscore the ways in which those interactions helped define aesthetics, particularly in music. In a very real sense this course traces the history of creativity over the past three centuries. *Credits: 3. Prerequisites: One Level 2 STS Cluster Humanities and Social Sciences Elective. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 3263W Science and Difference

This course considers the historical development of the science of difference – in particular, race and gender – from the scientific revolution to the present. We seek to understand historical episodes of cultural anxiety over biological variation by examining the construction of difference in living populations. Topics include historical theories of human variation, scientific racism and its rejection, the history of ethnicity and sexuality, colonialism and eugenics. *Credits: 3. Prerequisite: One Level 2 STS Cluster Humanities and Social Sciences Elective. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 340x Independent Study in STS

Variable credit independent study in Science and Technology Studies. Topic to be decided by instructor. *Credits: Variable. Prerequisites: One Level 2 Humanities and Social Sciences Elective from the STS Cluster and instructor's permission. Note: Satisfies a Humanities and Social Sciences Elective.*

STS341x Special Topic in STS

Variable credit special topic in Science and Technology Studies. Topic to be decided by instructor. *Credits: Variable. Prerequisites: One Level 2 STS Cluster Humanities and Social Sciences Elective and instructor's permission. Note: Satisfies a Humanities and Social Sciences Elective.*

STS 4003 Internship/Study Abroad

For STS majors only. Takes the form of either an internship or a semester studying abroad. Internship option: Supervised semester-long project carried out in a community or industry setting. Evaluated on the basis of written and oral reports presented to faculty and external project co-sponsors. Students must maintain a course-load equivalent of 12 credits (including the 3 for STS 4003) during this semester. Study-Abroad option: Semester-long course of study at a foreign institution. Students must maintain a course-load equivalent of 12 credits (including the 3 for STS 4003) during this semester. *Credits: 3. Prerequisites: Junior/Senior status and permission of STS faculty adviser. Note: Does not satisfy a Humanities and Social Sciences Elective.*

STS 4014 Capstone Project

This is a research project under the supervision of an STS faculty adviser. Library research, written and oral reports are required. *Credits: 4. Prerequisites: Senior status, permission of STS faculty adviser, STS 2003, STS 3003, and STS 3013. Note: Does not satisfy a Humanities and Social Sciences Elective.*

SAMPLE TYPICAL COURSES OF STUDY

A typical STS semester is split between two tech/science courses and two humanities/social sciences courses. The flexibility of the STS major admits many variations, some with heavier tech/sci concentrations than others. Students work closely with their mentors in constructing an appropriate programs of study. The following sample schedules indicate some of the possible Tech/Sci concentrations. Additional sample schedules are available upon request.

Typical Course of Study for STS Major, Tech/Sci Concentration Undefined

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Cr.
EN 1013W	College Writing Workshop	3
EG 1003	Intro Eng and Design	3
EG 1001	Engineering and Tech Forum	1
	General Science Elective 1	4
	General Tech Elective	4
		15

Spring Semester

Course No.	Course Title	Cr.
HuSS 1023W	First-Year Writing Seminar	3
	Free Elective 1	3
	General Science Elective 2	4
	Tech/Sci Elective 1	4
		14

SOPHOMORE YEAR

Fall Semester

STS 2003	Core 1: Sci, Tech and Soc	3
	STS Elective 1	3
	Tech/Sci Elective 2	4
	General Math Elective	4
Humanities and Social Sciences Elective 1		3
		17

Spring Semester

	STS Elective 2	3
	STS Elective 3	3
	Tech/Sci Elective 3	4
	Free Elective 2	3
Humanities and Social Sciences Elective 2		3
		16

JUNIOR YEAR

Fall Semester

STS 3003	Core 2: Seminar in STS	3
	STS Elective 4	3
	STS Elective 5	3
	Tech/Sci 4	4
Humanities and Social Sciences Elective 3		3
		16

Spring Semester

	STS Elective 6	3
	Free Elective 3	4
	Free Elective 4	4
Humanities and Social Sciences Elective 4		3
		14

SENIOR YEAR

Fall Semester

	STS Elective 7	3
	Tech/Sci Elective 5	4
	Free Elective 5	4
Humanities and Social Sciences Elective 5		3
		14

Spring Semester

STS 4014	Core 3: Capstone	4
	STS Elective 8	3
	Tech/Sci Elective 6	4
Humanities and Social Sciences Elective 6		3
		14

Total credits required for the degree: 120

Typical Course of Study for Biotechnology and Society: STS Major/BMS Concentration

This program of study is suitable for students with interests in the ethical and societal implications of biotechnology and related fields. (Other BMS concentration variants need not reflect the choice of STS electives made below.)

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Cr.
EN 1013W	College Writing Workshop	3
EG 1003	Intro Eng and Design	3
EG 1001	Engineering and Tech Forum	1
CM 1014	General Chemistry I (GenSci1)	4
	General Tech Elective	4
		15

Spring Semester

Course No.	Course Title	Cr..
HuSS 1023W	First-Year Writing Seminar	3
PL 2143	Ethics and Technology (STS1)	3
CM 1024	General Chemistry II (GenSci2)	4
	Free Elective 1	4
		14

SOPHOMORE YEAR

Fall Semester

STS 2003	Core 1: Sci, Tech and Soc	3
PL 2133	Ethical Theories (Humanities and Social Sciences1)	3
CM 2214	Organic Chem I (Tech/Sci1)	4
MA 1024	Calculus I (GenMath)	4
		14

Spring Semester

BMS 1004	Cell/Molecular Bio (Tech/Sci2)	4
MA 1124	Calculus II (Tech/Sci3)	4
HI 3223	Sci/Ethics 20th Cent (STS2)	3
	Free Elective 2	3
Humanities and Social Sciences Elective 2		3
		17

JUNIOR YEAR

Fall Semester

STS 3003	Core 2: Seminar in STS	3
PL 2203	Phil of Technology (STS3)	3
PL 2263	Magic, Med, and Sci (STS4)	3
BMS 2004	Intro Physiology (Tech/Sci4)	4
Humanities and Social Sciences Elective 3		3
		16

Spring Semester

PL 3213	Phenom of Life (STS5)	3
	Free Elective 2	3
	Free Elective 4	4
Humanities and Social Sciences Elective 4		3
		13

SENIOR YEAR

Fall Semester

STS 3243W	Humans, Machines, Aesthetics (STS6)	3
HI 3233	Biology and Society (STS7)	3
BMS 3214	Microbiology (Tech/Sci5)	4
BMS 3114	Genetics (Tech/Sci6)	4
Humanities and Social Sciences Elective 5		3
		17

Spring Semester

STS 4014	Core 3: Capstone	4
PL 3253	Phil of Science (STS8)	3
	Free Elective 5	4
Humanities and Social Sciences Elective 6		3
		14

Total credits required for the degree: 120

Typical Course of Study for Computation, Society, and the Internet: STS Major/Computer Science Minor

This program of study combines substantial training in computer science with the history and societal implications of digital media technology. (Other CS minor variants need not reflect the choice of STS electives made below.)

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Cr.
EN 1013W	College Writing Workshop	3
EG 1003	Intro Eng and Design	3
EG 1001	Engineering and Tech Forum	1
CS 1114	Prog/Prob Solving (Tech/Sci1)	4
MA 1024	Calculus I (GenMath)	4
		15

Spring Semester

Course No.	Course Title	Cr.
HuSS 1023W	First-Year Writing Seminar	3
PL 2143	Ethics and Technology (STS1)	3
MA 1124	Calculus II (Tech/Sci2)	4
	General Tech Elective	4
		14

SOPHOMORE YEAR

Fall Semester

STS 2003	Core 1: Sci, Tech, and Soc	3
PL 2203	Phil of Technology (STS2)	3
CS 1124	Object Prog (Tech/Sci3)	4
MA 2012/2132	Linear Alg I/ODE (Tech/Sci4)	4
MD 2163W	Media Studies 1 (Humanities and Social Sciences1)	3
		17

Spring Semester

PS 2613	Psychology of the Internet (STS3)	3
CS 2134	Data Struc and Algs (Tech/Sci5)	4
MA 2312/2322	Discrete Math I/II (Tech/Sci6)	4
Humanities and Social Sciences Elective 2		3
		14

JUNIOR YEAR

Fall Semester

STS 3003	Core 2: Seminar in STS	3
ST S2113	Hist/Phil Internet Tech (STS4)	3
CS 2204	Digital Logic (Free Elective 1)	4
PS 3603	Psych Internet Security (STS5)	3
MD 3163W	Media Studies II (Humanities and Social Sciences3)	3
		16

Spring Semester

STS 3173	Hypermedia in Context (STS6)	3
	Free Elective 2	4
	Free Elective 3	3
Humanities and Social Sciences Elective 4		3
		13

SENIOR YEAR

Fall Semester

HI 3413	Hist Intelectual Prop (STS7)	3
PL 3263	Physics, Info, Comp (STS8)	3
	General Science Elective 1	4
MD 4163W	Media Studies 3 (Humanities and Social Sciences5)	3
	Free Elective 5	4
		17

Spring Semester

STS 4014	Core 3: Capstone	4
	General Science Elective 2	4
	Free Elective 6	3
Humanities and Social Sciences Elective 6		3
		14

Total credits required for the degree: 120

Typical Course of Study for History and Philosophy of Physics: STS Major/Physics Minor

This program of study is suitable for students with interests in the historical and philosophical foundations of modern physics. (Other physics concentration variants need not reflect the choice of STS electives made below.)

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Cr.
EN 1013W	College Writing Workshop	3
EG 1003	Intro Eng and Design	3
EG 1001	Engineering and Tech Forum	1
MA 1024	Calculus I (GenMath)	4
	General Tech Elective	4
		15

Spring Semester

Course No.	Course Title	Cr.
HuSS 1023W	First-Year Writing Seminar	3
PL 2003	Symbolic Logic (STS1)	3
MA1124	Calculus II (Tech/Sci1)	4
PH 1013	Mechanics (GenSci1)	3
		13

SOPHOMORE YEAR

Fall Semester

STS 2003	Core 1: Sci, Tech, and Soc	3
PH 2023/2021	Elec, Mag, Fluids/Lab (GenSci2)	3.5
STS 2243	Physics and Society (STS2)	3
PL 2273	Space and Spacetime (STS3)	3
Humanities and Social Sciences Elective 1		3
		15.5

Spring Semester

PL 2283	Philosophy of Relativity (STS4)	3
PH 2033/2031	Waves, Optics, Therm/Lab (Tech/Sci2)	3.5
MA 2012/2132	Linear Algebra/ODE (Tech/Sci2)	4
Humanities and Social Sciences Elective 2		3
		13.5

JUNIOR YEAR

Fall Semester

STS 3003	Core 2: Seminar in STS	3
PL 2293	Phil Quantum Mech (STS5)	3
PH 2344	Modern Physics (Tech/Sci4)	4
MA 2112/2122	Multivar Calc A/B (Tech/Sci5)	4
Humanities and Social Sciences Elective 3		3
		17

Spring Semester

HI 2243	The History of Light (STS6)	3
PH 3234	Elec and Mag (Tech/Sci6)	4
	Free Elective 1	4
	Free Elective 2	4
Humanities and Social Sciences Elective 4		3
		18

SENIOR YEAR

Fall Semester

HI 2253	Heat Eng/Black Holes (STS7)	3
PH 3244	Concepts of Nanotech (Free3)	4
	Free Elective 4	4
Humanities and Social Sciences Elective 5		3
		14

Spring Semester

STS 4014	Core 3: Capstone	4
STS 3223	Phys, Info and Comp (STS7)	3
PH 4124	Thermo and Stat Physics (Free 5)	4
Humanities and Social Sciences Elective 6		3
		14

Total credits required for the degree: 120

Typical Course of Study for Engineering and Society: STS Major/Civil Engineering Concentration

This program of study is suitable for students with interests in the relations between civil engineering, science, and society. (Other C.E. concentration variants need not reflect the choice of STS electives made below.)

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Cr.
EN 1013W	College Writing Workshop	3
EG 1003	Intro Eng and Design	3
EG 1001	Engineering and Tech Forum	1
MA 1024	Calculus I (GenMath)	4
CE 1002	Intro to Civil Engineering (Tech/Sci1)	2
		13

Spring Semester

Course No.	Course Title	Cr.
HuSS 1023W	First-Year Writing Seminar	3
CE 2113	Statics and Dynamics (Tech/Sci2)	3
MA 1124	Calculus II (Tech/Sci3)	4
PH 1013	Mechanics (GenSci1)	3
	General Tech Elective	4
		17

SOPHOMORE YEAR

Fall Semester

STS 2003	Core 1: Sci, Tech, and Soc	3
PH 2023/2021	Elec, Mag, Fluids/Lab (GenSci2)	3.5
PL 2143	Ethics and Technology (STS2)	3
HI 2303	Medieval Technology (STS1)	3
Humanities and Social Sciences Elective 1		3
		15.5

Spring Semester

PL 2203	Philosophy of Technology (STS3)	3
PH 2033/2031	Waves, Optics, Therm/Lab (Tech/Sci2)	3.5
STS 2263	Rhetoric of Science (STS4)	3
	Free Elective 1	3
Humanities and Social Sciences Elective 2		3
		15.5

JUNIOR YEAR

Fall Semester

STS 3003	Core 2: Seminar in STS	3
CE 2123	Mech of Materials (Tech/Sci5)	3
CE 2213	Fluid Mechanics (Tech/Sci4)	3
	Free Elective 2	4
Humanities and Social Sciences Elective 3		3
		16

Spring Semester

HI 3413	Hist Intellectual Property (STS5)	3
PS 2643	Creativity and Innovation (STS6)	3
CE 3153	Geotechnical Engineering	3
	Free Elective 3	3
Humanities and Social Sciences Elective 4		3
		15

SENIOR YEAR

Fall Semester

STS 3263	Science and Difference (STS7)	3
CE 3133	Struc Analysis (Tech/Sci6)	4
	Free Elective 4	4
Humanities and Social Sciences Elective 5		3
		14

Spring Semester

STS 4014	Core 3: Capstone	4
STS 3243	Humans, Mech, Aes (STS8)	3
	Free Elective 5	4
Humanities and Social Sciences Elective 6		3
		14

Total credits required for the degree: 120

Typical Course of Study for Sophomore Engineering Transfers: STS Major/Electrical Engineering Concentration

This program of study is suitable for E.E. students desiring to make the transition to a humanities-based orientation of their field. Similar schedules can be constructed for other engineering disciplines.

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Cr.
EN 1013W	College Writing Workshop	3
EG 1003	Intro Eng and Design	3
EG 1001	Engineering and Tech Forum	1
MA 1024	Calculus I (GenMath)	4
CS 1114	Prog/Prob Solving (Tech/Sci1)	4
		15

Spring Semester

Course No.	Course Title	Cr.
HuSS 1023W	First-Year Writing Seminar	3
CS 1124	Object Prog (Tech/Sci2)	4
MA 1124	Calculus II (Tech/Sci3)	4
PH 1013	Mechanics (GenSci1)	3
		14

SOPHOMORE YEAR

Fall Semester

EE 2013	Electric Circuits I (Tech/Sci4)	3
MA 2012/2132	Linear Alg I/ODE (Tech/Sci5)	4
PH 2023/2021	Elec, Mag, Fluids/Lab (GenSci2)	3.5
Humanities and Social Sciences Elective 1		3
		13.5

Spring Semester

EE 2024	Electric Circuits II (GenTech)	4
MA 2112/2122	MultiCalc A/B (Free Elective 1)	4
CS 2204	Digital Logic (Free Elective 2)	4
PH 2033/2031	Waves, Optics, Therm/Lab (Tech/Sci2)	3.5
Humanities and Social Sciences Elective 2		3
		18.5

JUNIOR YEAR

Fall Semester

STS 2003	Core 1: Sci, Tech, and Soc	3
	STS Elective 1	3
	STS Elective 2	3
	Free Elective 3	3
Humanities and Social Sciences Elective 3		3
		15

Spring Semester

	STS Elective 3	3
	STS Elective 4	3
	Free Elective 4	4
Humanities and Social Sciences Elective 4		3
		13

SENIOR YEAR

Fall Semester

STS 3003	Core 2: Seminar in STS	3
	STS Elective 5	3
	STS Elective 6	3
	Free Elective 5	3
Humanities and Social Sciences Elective 5		3
		15

Spring Semester

STS 4014	Core 3: Capstone	4
	STS Elective 7	3
	STS Elective 8	3
	Free Elective 6	3
Humanities and Social Sciences Elective 6		3
		16

Total credits required for the degree: 120

SUSTAINABLE URBAN ENVIRONMENTS

Program Director: Richard Wener
Program Adviser: Christopher Leslie

GENERAL INFORMATION

Sustainable Urban Environments is an interdisciplinary program based in the Department of Technology, Culture and Society and supported by the Civil Engineering Department. Students receive a liberal arts education focused on the social and technical issues providing healthy and satisfying environments for the swelling populations of the world's cities. Billions of urban dwellers around the world need clean water and air, housing, healthy secure living conditions, and adequate transportation and education. The best city planners and managers assess technical challenges in their historical and social context. This program unites technology, planning, economics, psychology, ecology and history to address the political and social challenges of applying urban technology. In addition to General Education courses, students take a set of Urban Core courses to provide breadth in understanding of urban issues.

In courses, projects, field trips and internships this program capitalizes on its location in the heart of New York City, for decades one of the largest and most innovative urban laboratories in the world and the prototypical 21st-century globalizing city. Sustainable development and management is a necessity, not a luxury, and students in this program will be qualified to work for public and private agencies that will be in the center of this effort.

Among the topics addressed in SUE at NYU-Poly are:

- Urban infrastructure: What it is, how it works and history and political systems in development with emphasis on New York City.
- Urban sustainability.
- The design and planning of cities to promote health and well-being.
- The city as a social and technical system, including the psychology of sustainable design.
- Human and natural ecology in the city: How do people, animals and plants survive and interact in the urban environment to make the city survivable, healthy and pleasant.

PROGRAM HIGHLIGHTS

NYU-Poly offers a unique combination of New York City's resources and the city's preeminent technological institution.

New York City is a cultural, social, technological and financial capital to America and the world. The city has committed itself to becoming "green" and a grand scale and rapid pace—the issues we study in SUE—will be played out in New York City, as will opportunities to learn, study and work in the process. The SUE program is a rare combination of liberal arts (such as urban history and environmental psychology) and technology (civil and transportation engineering), combining offerings in a way that will produce students who are conversant with both the technical and social aspects of sustainability issues facing our cities.

Project-Oriented Education and Research

A project-oriented semester—studying abroad or engaging in a service-learning internship—bridges the gap between academics and the outside world. Directed Studies and Capstone Projects provide students with essential experience in conducting and presenting research at public forums within NYU-Poly.

Careers

Students with the BS Degree in SUE might pursue further study and careers in fields such as:

- Urban planning
- Historical preservation
- Civil engineering
- Architecture or Landscape architecture
- Urban management
- Law
- Social work
- Education
- Museum curator
- Journalism

BACHELOR OF SCIENCE DEGREE REQUIREMENTS

SUE majors take 120 credits, divided into three parts:

GENERAL EDUCATION REQUIREMENT

Humanities and Social Sciences General Education Requirement (8 courses, 24 credits)

	credits	subtotal	total
EN 1013W and HuSS 1023W (Freshman writing sequence)	6		
Six Humanities and Social Sciences courses, one at Level 3	18	24	24

General Education Requirement (20 credits)

	credits	subtotal	total
General Technical Elective	4		
General Math Elective	4		
General Science Elective 1	4		
General Science Elective 2	4		
Intro to Engineering and Design	3		
Engineering and Technology Forum 1	20	44	

SUSTAINABLE URBAN ENVIRONMENTS REQUIREMENTS

A. Core (Six courses, 18 credits):

HI 2053/W/URB 2053/W Introduction to Urban Policy
HI 2313/W History of New York's Urban Infrastructure
CE 4033/URB 3533 Intro to Urban Infrastructure Systems Engineering Management
CE 4053 Biosoma—Environmental Design of the City of the Future
URB 2023/W The Design of Cities
URB 3543 Sustainable Cities

B. Concentration (6 courses, 18 credits). Human and Social Systems in the Urban Context (at least 1 course from each group):

History Group

CE 3353/HI 2353 A History of NYC Transit and the Development of NYC
HI 2303/W Introduction to New York City History
HI 2313/W History of New York's Urban Infrastructure
HI 2713 Urban Environmental History
HI 3253 History of Political Technology
HI 3313/W History and Literature of NYC in the 20th Century
HI 4303/W Seminar in Urban Infrastructure History

Behavioral Science Group

PS 2323/W Environmental Psychology
PS 3723 Psychology of Sustainability
PS 3743 Psychology of Transportation
PS 3753 Design of Extreme Environments
URB 2033 Humans and The Urban Environment
URB 3353 Urban Impact Assessment Environmental Group
CE 4053 Biosoma—Environmental Design of the City of the Future
SEG 291x Special Topics in Society, Environment and Globalization
SEG 391x Special Topics in Society, Environment and Globalization
URB 2223 Natural Environment of New York City
URB 2233 Environmental Disasters and Cities
URB 3033 Evidence-Based Design
URB 3313 History, Ecology and Design of Urban Parks

URB 4113 Case Studies in Sustainability

C. Project Courses

URB 3013 Directed Study in SUE
URB 4014 Internship/Study Abroad
URB 4023 Capstone Project

ELECTIVES REQUIREMENT

A. Technical Electives (4 courses, 12 credits):

Can include CE (Transportation planning, water resources, etc.), ME (energy), MG (MG 3002 Project Management and MG 3404 Innovation Management), GIS, video presentation, etc.

B. Free electives
(6 courses from any department)

SUE MINOR
The minor in SUE requires 15 credits, consisting of at least two courses from the SUE Core and three courses from any of those offered in the Concentration. The minor in SUE is open to all majors.

COURSES

URB 2023/W Design of Cities

This course helps students examine cities from different perspectives, and to understand the design principles that create effective city spaces and how the city is a dynamic force, always changing through the impact of individuals and organizations. The class focuses on the role of historical, physical and social context in making sense of cities and how city problems can be identified, presented to others and addressed in various ways (through psychological and sociological studies, literature, art, etc.). Students complete a team-based project that involves the study of an innovative development project within the city and how it relates to its physical and social context. *Credits: 3. Prerequisite: EN 1013W, HuSS 1023W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

URB 2033 Humans in the Urban Environment

In an increasingly urban dominated world, the environmental and ecological underpinnings of the human species help us understand why and how permanent settlements and cities evolve. The course covers basic environmental and ecological relationships, including geological, climatological, biomes, population growth models and carrying capacity. Receiving special emphasis are those ecosystems most important to humans throughout prehistory and history. The development of agriculture, increased human resource productivity and the resulting increase in population density is discussed as an underlying basis for developing and maintaining urban population areas. Also included is a discussion of changes in human social organization and psychology necessary for urban living. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

URB 2223 Natural Environment of New York City

New York is one of the world's great cities and, like others, rests on a foundation of the natural environment. The geology and geographic history of the greater New York area is discussed—from plate tectonic origins through the recent (and ongoing) Ice Age, including the formation of river systems and the port. Also considered in detail is the evolution of ecological relationships, including human, throughout this time. Other topics include the changing climate through past epochs as well as today and their impact on the modern city. Also covered are current environmental challenges, such as water supply and quality, air quality, waste disposal and global effects, including atmospheric and ocean warming. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

URB 2233 Natural Environmental Catastrophes and Cities

Cities are extremely complex physical and human systems that can be severely disrupted by acute human-caused events such as war. However, the natural world can also have a severe impact on cities over brief intervals. This course concerns itself with four well-known phenomena that can and have influenced the development, sustainability and even the survival of cities. Meteorological catastrophes, such as hurricanes, cyclones and typhoons, are discussed in detail. Also covered are less violent but equally destructive flooding by river and ocean; earthquake damage and its relationship to population density and the permanence of towns and cities throughout history; and volcanic eruptions, which, though rare, have disrupted cities and determined their initial locations. Finally, biological catastrophes, both macro and micro, such as pestilence and infestations, are discussed. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Notes: Satisfies a humanities and social sciences elective.*

URB 3013 Directed Study in SUE

Directed study supervised by a faculty adviser in Humanities and Social Sciences. Students, guided by a faculty adviser, are exposed to foundational research techniques. Library research, written and oral reports are required. *Credits: 3. Prerequisites: URB 2033 or URB 2023, and permission of SUE faculty adviser. Note: Does not satisfy a humanities and social sciences elective.*

URB 3033 Evidence-Based Design

Designers—at the product, building, neighborhood or urban level—necessarily base their work on the perceived needs and desires of users and clients. Historically, these understandings have come from past practice, close interactions with clients or designer intuition. In recent years, however, design researchers have accumulated enough information to provide an empirical base upon which to base many design decisions. This class reviews the evidence for design, particularly as it relates to well-studied settings, such as health care, corrections and neighborhood design. *Credits: 3. Prerequisite: HuSS 1023W or EN 1233W or EN 1203H. Note: Satisfies a humanities and social sciences elective.*

URB 3313 History and Design of Urban Parks

Today, urban parks have become an integral feature of most modern cities. This course describes the origins of urban parks—from private urban-palace gardens to the large, open "natural" public parks so critical to urban life today. The design of these parks, from formal Italian and French gardens to British Landscape gardens, is discussed. The course also examines the changing view of nature in Europe and America, from the Renaissance to the present, and how park design was influenced by this evolving view. The design was strongly influenced by the changing view of nature's psychological, spiritual and even supposedly medical benefits, and by the need for "parks for the people" as an expression of the new democratic spirit in a changing world. This course also includes two of New York City's most famous parks, Central Park in Manhattan and Prospect Park in Brooklyn. *Credits: 3. Prerequisite: URB 2033 or URB 2023. Note: Satisfies a humanities and social sciences elective.*

URB 3353 Urban Impact Assessment

Impact assessment is an international, interdisciplinary field of knowledge and practice for anticipating the conditions of change and managing their consequences in order to enhance everyone's quality of life. Two phrases can describe its essence: "comprehensive and integrated" and "proactive and creative." Urban impact assessment applies that knowledge at the urban scale, ranging from local to global. Coupled with the recent innovation of "sustainability assessment," it aims to advance the proposition of urban sustainability. This course

also explores the dimensions and proportions of that prospect by applying urban impact assessment methodology to a variety of cases at hand. *Credits: 3. Prerequisite: URB 2033 or URB 2023. Note: Satisfies a humanities and social sciences elective.*

URB 3533/CE 4033 Introduction to Urban Infrastructure Systems Management

This course provides students with an overview of key issues involved in the planning, management, operations and maintenance of urban infrastructure systems, including transportation, water supply, power, communications and information systems. It includes elements of engineering and technology, management, economics, finance, regulatory and public policy that have an impact on the sustainable development of the urban environment. The course features several distinguished guest lecturers from infrastructure industries and public agencies who share significant case studies with students. The course includes a component on GIS, with a focus on how to collect, integrate and share spatial data in urban infrastructure management. Group projects are required. *Credits: 3. Notes: Satisfies a humanities and social sciences elective.*

URB 3543 Sustainable Cities

The course provides an overview of issues that need to be addressed to make a city sustainable, beginning with a definition of what is intended by the concept of sustainability and a discussion of what is the essence of a city. Students are asked to become familiar with the major challenges in making a city sustainable, and to provide, as part of their homework, a paper addressing a topic covered by the course through research and, where necessary, proposed solutions. *Credits: 3. Note: Does not satisfy a humanities and social sciences elective.*

URB 3553 Biososoma — Environmental Design of the City of the Future

The goal of this course is to improve the engineering design of a city and its components. The course focuses on the city as an entity that concentrates living organisms, societal organizations and activities and machines, interacting with the environment both outside and inside the city. A number of essential questions about the future of cities will be examined, such as: (1) what does urbanization mean for the future of humankind in terms of resources, capabilities, ideologies and culture? (2) How can the design of cities affect their future? (3) What should be the role of the engineer? (4) How can the engineer of the future be prepared for that role? (5) What critical engineering interventions are needed to influence the future of today's cities? Each student will select a project that deals with some aspects of the course and present its results to the class. *Credits: 3. Note: Does not satisfy a humanities and social sciences elective.*

URB 3833 Special Topics in Sustainable Urban Environments

Special topics in Sustainable Urban Environments at the 3000 level, to be decided by instructor. *Credits: 3. Prerequisite: URB 2033 or URB 2023. Note: Satisfies a humanities and social sciences elective.*

URB 4014 Internship/Study Abroad

For SUE majors only, this course may be either an internship or a semester studying abroad. The internship option is a supervised semester-long project in a community or industry setting. The internship is evaluated on the basis of written and oral reports presented to faculty and external project co-sponsors. Students must maintain a course-load equivalent of 12 credits during this semester. The study-abroad option is a semester-long course at a foreign institution. Students must maintain a course-load equivalent of 12 credits during this semester. *Credits: 4. Prerequisites: Junior/Senior status and permission of SUE faculty adviser. Note: Does not satisfy a humanities and social sciences elective.*

URB 4023 Capstone Project

This is a research project supervised by an STS faculty adviser and requires library research and written and oral reports. *Credits: 3. Prerequisites: Senior status, permission of SUE faculty adviser. Note: Does not satisfy a humanities and social sciences elective.*

URB 4113 Case Studies in Sustainability (Ancient Egypt and Mesoamerica)

Today, many societies are addressing whether their lifestyles and standard of living are environmentally sustainable or not. This course examines a few societies, some now much changed from what they once were, that also faced such questions. Ancient Egypt, arguably Earth's oldest civilization, developed along the Nile River. The agricultural surpluses supported a large population and freed many from farming to be artisans, clerks, lawyers, soldiers and rulers. This course describes the rise and flourishing of ancient Egypt and its social relationships, culture and customs. It also covers the rise of Egyptian cities, warfare and empire building. In contrast, the Mayans of Central America produced a complex civilization that had declined even before Europeans arrived. Victims of resource depletion, the Maya no longer live in their great cities. The history and relationships of these two cultures to their environments illustrate the fate of civilizations based on resource availability and sustainability. *Credits: 3. Prerequisite: URB 2033 or URB 2023. Note: Satisfies a humanities and social sciences elective.*

URB 4443 Guided Readings in Sustainable Urban Environments

This course, supervised by faculty, covers selected problems in sustainable urban environments and involves guided reading and/or research on topics to be arranged. The course is for mature students seeking specialized independent study under tutorial guidance. *Credits: 3. Prerequisite: URB 2033 or URB 2023. Note: Satisfies a humanities and social sciences elective.*

SAMPLE SCHEDULE

A typical SUE semester is split between two tech/science courses and two humanities/social sciences courses. The flexibility of a SUE major allows many variations, some with heavier tech/sci concentrations than others. The following sample schedule indicates a Tech/Sci concentration. Additional sample schedules are available upon request.

Typical Course of Study for the Bachelor of Science in Sustainable Urban Environments

FRESHMAN YEAR

Fall Semester

Course No.	Course Title	Cr.
EN1013W	College Writing Workshop	3
EG 1003	Intro to Eng and Design	3
EG 1001	Engineering and Tech Forum	1
	Gen Sci 1	4
	Gen. Tech. Elective	4
		15

Spring Semester

Course No.	Course Title	Cr.
HuSS1023W	First-Year Writing Seminar	3
	Gen Sci 2	4
HI 2053	Intro to Urban Policy	3
SUE	Tech Elect 1	3
Humanities and Social Sciences Elective 1		3
		16

SOPHOMORE YEAR

Fall Semester

URB 3543	Sus Cities	3
HI 2313	Urb Infra.	3
CE 4033	Urb. Infra.	3
SUE	Concen. 1	3
	Free Elective 1	3
		15

Spring Semester

URB 2023	Design of Cities	3
SUE	Tech Elect 2	3
URB 3013	Directed study	3
SUE	Concen. 2	3
	Gen Math Elective	4
		16

JUNIOR YEAR

Fall Semester

SUE	Tech Elect 3	3
URB 3553	Biosoma	3
SUE	Concen. 3	3
Humanities and Social Sciences Elective 2		3
Humanities and Social Sciences Elective 3		3
		15

Spring Semester

URB 4014	Study Abroad/Internship	4
	Free Elective 2	3
	Free Elective 3	3
	Free Elective 4	3
		13

SENIOR YEAR

Fall Semester

SUE	Concen. 4	3
SUE	Concen. 5	3
SUE	Tech Elect 4	3
Humanities and Social Sciences Elective 4		3
Humanities and Social Sciences Elective 5		3
		15

Spring Semester

URB 4023	Capstone	3
SUE	Concen. 6	3
	Free Elective 5	3
	Free Elective 6	3
Humanities and Social Sciences Elective 6		3
		15

Total credits required for the degree: 120

SYSTEMS ENGINEERING PROGRAM

Program Co-Directors: Zhong-Ping Jiang and Farshad Khorrami

Systems engineering is the theoretical knowledge underlying the engineering of modern complex systems. Systems engineers apply this knowledge to designing systems, usually integrating several disciplines to achieve the desired objective. Theoretical resources include newer branches of applied mathematics, modeling and simulation, analysis of signals and systems, communication and control theories, optimization and decision-making techniques, and computer science.

Faced with a diverse and complex scientific environment, systems engineering assignments cross traditional engineering-applications lines. These applications include communications, networking, transportation, urban services, bioengineering, resource management, power and energy, and environmental and pollution control.

The Systems Engineering Program stresses computer use. The interdisciplinary program covers the viewpoints, analysis and mathematical techniques of signals and systems; feedback control; data analysis; optimization and simulation, information communication; instrumentation and measurement. NYU-Poly orientation and training gives systems engineering students the ability to analyze and solve today's complex technological and societal problems.

The Department of Electrical and Computer Engineering administers the Master of Science in Systems Engineering Program. Outstanding students should apply for financial aid including research fellowships, teaching fellowships or partial tuition remission. Students who wish to continue graduate study toward a PhD in systems engineering may do so in the PhD in Electrical Engineering Program.

GOALS AND OBJECTIVES

The Master of Science program in Systems Engineering aims to provide students with:

- Skills and advanced knowledge in engineering-systems design and analysis, including modeling and simulation, signals and systems analysis, communication and control theories, and optimization and decision-making techniques.
- Modern computer training for analysis, simulation and solving real system problems.
- Baseline skills and knowledge in systems engineering project management.
- A basis for continued, lifelong learning in the profession.

REQUIREMENTS FOR THE MASTER OF SCIENCE

The entrance requirement for a Master of Science in Systems Engineering is a bachelor's degree in engineering or science from an accredited institution, with a GPA of 3.0 or above in undergraduate courses. For some tracks, students need undergraduate courses in differential equations, probability, linear systems, feedback control and computer programming. Students with subject-area deficiencies should take the necessary required courses.

To satisfy MS in Systems Engineering requirements, students must complete three core courses and two tracks; at least one must be a core track. A minimum of three courses should be taken in a track. One course in each track may be a core course. Students can choose the remaining credits (up to 9 credits) from any science, engineering and management courses. If a student elects to write a MS thesis (6 credits), only two courses in a track are required. The total number of credits required is 30 and at least 15 credits should be from EL-prefixed courses. A GPA of 3.0 or above is required in all graduate courses.

Core Courses

Three courses from among the following:

EL 5213 Introduction to Systems Engineering
EL 6213 System Modeling, Analysis and Design
EL 6233 Systems Optimization Methods
EL 6253 Linear Systems
EL 6303 Probability Theory
MG 8203 Project Management

Total: 9 Credits

Core Tracks:

Network Management
(EL 5363, 5373, 6373, 7353, 7363)
Wireless Communications
(EL 5013, 5023, 5033, 6013, 6023, 6033)
Systems and Automation
(EL 5223, 5253, 6243, 6253, 8223)
Energy Systems
(EL 5613, 6623, 6633, 6653)
Large Scale Systems Modeling and Control
(EL 6253, 6243, 7253, 8253, 92x3)
Multimedia Applications
(EL 5123, 5143, 6113, 6123, CS 6643)

Total: 6-18 Credits

Elective Tracks:

Computer Systems and Security
(CS 6813, 6823, 9043, EL 6393)
Software Engineering
(CS 6063, 6073, 6083, 6183)
Operations Research and Management
(MG 6303, 6463, 8203, FE 6023)
Financial Engineering
FRE 6023, 6083, 6103, 6411, 6291)
Biological Systems (Selected courses with prefix BE, CH, CM, subject to adviser approval)

Total: 0-9 Credits

Free Electives

Any courses in science, engineering or management.

Total: 0-9 credits

Grand Total: 30 Credits

The list of tracks and approved courses within a track may be updated after publication of this catalog. Students should consult the Department of Electrical and Computer Engineering's Graduate Student Manual (www.poly.edu/academics/departments/electrical/graduate-resources) for any updated list. The Graduate Manual also contains more detailed rules and procedures on student status, transfer credits, recommended electives, current research areas and disqualification for low grades.

Descriptions of graduate courses in engineering, science and management used in the Systems Engineering Program are found in relevant program sections of this catalog.

DOCTOR OF PHILOSOPHY IN TECHNOLOGY MANAGEMENT

Academic Director: Anne-Laure Fayard

Modern technologies are redefining products, services, processes, organizational forms, business models and industry structures. Understanding the managerial implications of these technologies has become a fast-growing and highly important arena for business research. High-quality scholars, capable researchers and expert professionals are needed to expand the knowledge base in technology management through significant intellectual and educational contributions. Additionally, these developments have created a huge international demand for new kinds of managers who can strategically integrate technology and management to innovate and achieve a sustainable competitive advantage for a company. To prepare these managers, qualified educators able to teach technology management are increasingly in demand.

The mission of the Doctor of Philosophy in Technology Management (PhD-TM) Program is to educate and train scholars who will produce first-rate TM research and who will become faculty members in leading universities. The program is focused on quality (max. 3 students recruited per year) and ensures the research production of students through high-quality supervision and training. The program is under the auspices of the Department of Technology Management and is offered full time or part time.

Faculty members possess significant research strengths in a diverse range of technology management-related fields. The faculty's major professional commitment is to research, thereby contributing to the theory and practice of technology management in important and fundamental ways.

Located in the high-technology heart of New York City, the PhD-TM Program provides immediate access to the world-leading business community and industries (such as financial services, entertainment and media, health care and pharmaceuticals, publishing, advertising and fashion). This broad industrial base serves as a platform for research, obtaining research support and discovering diverse opportunities for scholarly and educational collaboration.

The Department of Technology Management offers a full range of academic programs and knowledge-generation activities, all related to technology management in some essential fashion. These programs include the executive master's programs Management of Technology (MOT) and Telecommunications and Information Management (TIM); evening master's programs in management and organizational behavior; and the BS in Business and Technology Management (BTM). Together, these programs create a broad value chain of educational efforts in which courses and students with a strong interest in technology management provide PhD-TM students with a host of opportunities for intellectual and educational experiences.

This terminal degree program is for research-oriented students who are largely interested in research-based positions at academic and research institutions. Universities with undergraduate and graduate programs that emphasize the integration of technology and management are a primary source of career opportunities for PhD-TM graduates. In addition, government agencies, not-for-profit research organizations, corporate research centers and research-based consulting firms also will seek PhD-TM graduates.

For more information, please visit www.poly.edu/academics/departments/technology/.

SAMPLE THEMES

The following are examples of the themes that a PhD-TM student can select:

- Managing Emerging Technologies
- Global Innovation Strategy
- Knowledge management
- Information economics and strategy
- Technology-mediated communication
- Impacts of technology upon individuals, organizations and society
- Social computing
- Service design and innovation
- Impacts of technology upon individuals, organizations and society
- Citizen science
- Behavioral aspects of information systems
- Distributed collaboration and virtual teams

ADMISSION INFORMATION

Admission to the PhD-TM Program is based on an in-depth evaluation of an applicant's academic record, professional experience, research potential, interest in doctoral study, and overall intellectual and professional qualifications. Students must submit the following to be considered for admission:

- Application form with required application fee.
- Official transcripts of all previous undergraduate and graduate records indicating a bachelor's degree with at least a B average from an accredited college or university. The transcripts must be sent directly to the Office of Graduate Admissions.
- Official score from either the Graduate Management Aptitude Test (GMAT) or Graduate Record Examination (GRE).
- A minimum score of 90 for the IBT is required for admission.
- Three letters of recommendations from persons qualified to comment on the applicant's aptitude for doctoral study and research. At least two should be from academics.
- A statement of purpose that at least covers why applicants seek the PhD-TM at Polytechnic Institute and how well they are prepared for this study.
- A research-based writing sample (minimum of 10 pages). This could be a paper or research project you have worked on in the past.

Note that part-time and full-time students have to submit the same documentation. There is no financial aid available for part-time students.

In some cases, the department contacts applicants for a telephone or personal interview.

In rare cases, the PhD-TM Admissions Committee may admit an applicant who does not meet all required admissions criteria as a nondegree student. Such a student then has a later opportunity to apply for admission to the PhD-TM Program.

DEGREE REQUIREMENTS AND CURRICULUM

The curriculum for the PhD-TM Program fosters a research-intensive doctoral education relevant for the rapidly emerging area of technology management. Management core courses provide a necessary foundation in management. Technology management courses expose students to the fundamental and most current research and thinking in the broadly defined technology management field. Research methods courses help students develop quantitative and qualitative research skills. Thematic elective courses help students gain in-depth knowledge in a focused thematic area related to technology management. Working together, students and doctoral advisers select which courses relate to the student's course of study in the PhD-TM Program. As part of each thematic elective course, students also take an associated thematic independent research course to investigate thoroughly previous research in the selected theme. All PhD students must undertake a doctoral research project, preferably in the second summer semester of study. This course introduces students to the require-

ments of management research. Finally, students work on the dissertation, an original investigation of a research question(s) related to technology management. Students are required to complete 75 credits, including 51 credits from the course work and 24 credits from the dissertation. For the most current information visit: http://www.poly.edu/academics/programs/technology-management-phd.

1. Management Core Courses
(15 credits)
Management core courses should be taken as early in the program as possible. Choose five courses.
MG 6013 Organizational Behavior
MG 6073 Marketing
MG 6083 Economics
MG 6093 Accounting and Finance
MG 6303 Operations Management
MG 6503 Management of Information Technology and Information Systems

2. Technology Management Courses
Choose three courses (9 Credits)
MG 6313 Organization Theory and Design
MG 6543 Economics for Information Sectors
MG 6603 Management of New and Emerging Technologies
MG 8653 Managing Technological Change and Innovation
MG 8693 Special Topics

Associated Doctoral Seminars
(12 Credits)
Four 3-credit doctoral seminar courses must be taken with an associated technology management course. These seminars provide strong research background required for doctoral studies in technology management.

Choose four seminars.
MG 9203 Seminar in Managing Knowledge- Workers in Innovative Organizations
MG 9213 Seminar in Information Systems Management
MG 9223 Seminar in Business Process Innovation
MG 9233 Seminar in Managing Technological Change and Innovation
MG 9243 Technology Management and Policy
MG 9253 Technology Strategy, Structure and Decision Making
MG 9263 Strategic Marketing Seminar
MG 9273 Doctoral Seminar on Technology Adoption and Diffusion
MG 9283 Doctoral Seminar on Entrepreneurship
MG 9293 Seminar on Content Innovation
MG 9303 Advanced Topics – Organizational Behavior and Organizational Theory
MG 9313 Introduction to Behavioral Sciences
MG 9323 Special Topics

Note: Doctoral seminars are offered on a rotating basis. Not all the course options are available to all PhD-TM students during their study.

3. Research Methods Courses: (12 Credits)
Students must take all four courses.
MG 9403 Business Research Methods
MG 9413 Quantitative Research Methods I
MG 9233 Quantitative Research Methods II
MG 9433 Qualitative Research Methods

4. Independent Research Project
(3 Credits)
MG 9913 Independent Research

5. Comprehensive Examinations Each student must successfully pass two comprehensive examinations before starting the dissertation.

Part One: This examination includes material covered in the master's-level management core and technology management courses. It can be taken after completing 30 graduate credits.

Part Two: This examination includes material from the thematic elective and associated thematic research courses, doctoral seminars and research methods courses. It can be taken after completing required course work.

Students can take both examinations together. Results are provided within one month of the examination. Students have only two chances to pass each examination.

6. Doctoral Dissertation (24 credits): The dissertation is evaluated in two parts: Proposal Defense and Final Defense. For details, contact the PhD-TM Program academic director.

MG 9993 Doctoral Dissertation Research
Total Credits for PhD-TM Program: 75

7. Research training and interaction with faculty Every student participates in formal and informal research seminars each week with departmental faculty and visitors. All members of the program are expected to participate in formal and informal seminars each week with departmental faculty and visitors. Each student is required to present research in progress once a year and works towards publishable papers, usually with a faculty as co-author. The seminar is a key component of the student training. Participation in other research seminars and activities at the department is also required.

Students are expected to work actively with one or more faculty each year. They learn to be researchers by doing research.

8. Advising and evaluating The TM doctoral program faculty director advises all first-year doctoral students. During their first year students have many opportunities to get to know the research interests of all departmental faculty. By the beginning of the second year, students have selected an intermediary adviser who will guide them through the comprehensive exam process and up to the thesis stage. By the middle of the third year students will have selected a thesis adviser. Each year every student submits a statement of intellectual progress to his/her adviser. All faculty meet to review the progress of all students in a day-long meeting each year. At this time, the student's intellectual progress is reviewed and plans for the following year are considered. The results of this review include a formal letter to the student assessing the previous year's work and offering guidance for the following year's work.

9. Prerequisites All PhD-TM students need a fundamental knowledge of probability and statistics. Students without such a background must take MG 5050 Probability and Managerial Statistics. Students without any background in professional writing and communications must take JW 6003 Introduction to Technical and Professional Communications or JW 6313 Proposal Writing. Students who have a master's degree or who are transferring from other institutions (or other departments within Polytechnic) are admitted based on the same qualification standards that apply to new students. For each required MS- or PhD-level course, if students have taken a similar course, they may transfer credits for the course. However, students still have to take and pass both qualifying exams. A minimum of 30 credits, including all dissertation credit, must be taken at Polytechnic. No dissertation credits from other institutions can be transferred.

All students must take the required coursework as assigned and follow the stipulated curriculum. The course work must be finished within the first three years and the dissertation thesis within the next three years. Thus, all students (full-time and part-time) must complete all work for the doctorate within six years of initiation.

COURSE DESCRIPTIONS

The following courses are required or specifically associated with this doctoral program. For course descriptions of other relevant courses, please refer to the Master of Science in Management section of this catalog. Some of these courses can also be replaced by an equivalent from a list of approved courses.

MANAGEMENT CORE COURSES

MG 6013* Organizational Behavior *3:0:0:3*

This course introduces theory, research and practice so students better understand human behavior in organizations. Topics include motivation and job satisfaction; decision-making; group dynamics; work teams; leadership; communication; power, politics and conflict; organization culture, structure and design; impact of technology; management of work stress; organizational change and development; and career management. Also covered: Analysis of organizational behavior problems by self-assessments, case studies and simulations. *Prerequisite: Doctoral standing or instructor's permission. *Online version available.*

MG 6073 Marketing *3:0:0:3*

This course covers marketing concepts, processes and institutions: positioning, segmentation and product life cycles. Topics: Integration of marketing with new product planning, design and development. Strategies for technology-based products, services and processes. Market research, consumer behavior, advertising, promotion and sales. The special character of industrial, governmental and international markets. *Prerequisite: Doctoral standing or instructor's permission.*

MG 6083 Economics *3:0:0:3*

This course examines the fundamentals of microeconomics needed by managers. Topics: Demand theory (theory of the consumer), including models of demand, demand elasticity and demand forecasting. Supply theory (theory of the firm) including diminishing returns, profit maximizing production levels, labor/capital tradeoffs, and long-run vs. short-run issues. Market structures and how they affect optimal production and profit levels. Positive and negative externalities and government intervention including regulation, tariffs and subsidies. Selected applied topics. All topics are presented with emphasis on managerial application in industries that create or intensely use technology. *Prerequisite: Doctoral standing or instructor's permission.*

MG 6093 Accounting and Finance *3:0:0:3*

This course covers the elements of accounting and finance of importance to managers. Topics: Analysis of principles and practices of the finance function. Financing methods for internal and external ventures and innovations; capital budgeting; R&D portfolio analysis. Contrast of strategic perspectives emphasizing innovation and development with those emphasizing short-term return and investment. *Prerequisite: Doctoral standing or instructor's permission.*

MG 6503 Management of Information Technology and Information Systems *3:0:0:3*

This course is for managers needing to understand the role and potential contribution of information technologies in organizations. The focus is on different information technologies and their applications in managing critical business data, information and knowledge. The course concentrates on the current state of IT in organizations; challenges and strategic use of IT; IT infrastructure and architecture; building, implementing and managing IT applications; emerging issues such as intelligent systems; business process reengineering; knowledge management; and group support systems. *Prerequisite: Doctoral standing or instructor's permission.*

MG 6303 Operations Management *3:0:0:3*

This course covers analytical techniques for designing and operating production and service systems, including facility layouts and locations, capacity planning, job sequencing, inventory control and quality control. It introduces linear programming and other formal methods and uses cases and personal computers. *Prerequisite: Doctoral standing or instructor's permission.*

TECHNOLOGY MANAGEMENT COURSES

MG 6313 Organization Theory and Design *3:0:0:3*

The course covers the analysis of theories of large-scale organizations, focusing on their structure and culture. It includes characteristics of bureaucracy, adhocracy, sub optimization, human dynamics and informal systems, influence and control systems and planned change. Students examine formal and informal organizations through case studies and discussion. *Prerequisite: Doctoral standing or instructor's permission.*

MG 6543 Economics for Information Sectors *3:0:0:3*

This course in applied competitive strategy draws upon recent experiences associated with the impact of information technology upon diverse industries. Students master a basic understanding of the economic and competitive implications of information technology. This competence in analysis is arrived at by understanding how availability of information (through technology or otherwise) affects the basic strategic options available and how firms and industries are likely to be affected. In addition, students are introduced to the often poorly structured process of evaluating the economics of potential systems innovations. They then are able to participate in strategic-systems planning from a managerial point of view. *Prerequisite: Doctoral standing or instructor's permission.*

MG 6603 Management of New and Emerging Technologies *3:0:0:3*

This course surveys and explores the business implications of selected new and emerging technologies that have the potential to change business practices and create industries. The technologies discussed include new Internet architectures, Wikis, Open Source, security issues, new Web services, social networking and Web 2.0. This course is for the manager who is interested in staying current with and learning about new technologies in business. No specific engineering background is required. A variety of reference texts, journals, cases and websites are used throughout the course. *Prerequisite: Doctoral standing or instructor's permission.*

MG 8653 Managing Technological Change and Innovation *3:0:0:3*

This course focuses on effectively managing technological change and innovation, which is accomplished with a dual perspective. One perspective is based on individual, group and organizational theory, research and practice. This body of literature, viewpoints and experience provides essential guides for successfully managing the new-technology introduction. Realizing the full potential of new technologies requires managing change effectively to assure 100 percent stakeholder commitment. The second perspective is based on innovation theory, research and practice. This body of literature, viewpoints and experience provide key insights for managing innovation effectively and the impact of innovation on the total enterprise. Specifically, students consider explicitly the need within a firm to manage and inspire people to communicate and innovate effectively. *Prerequisite: Doctoral standing or instructor's permission.*

MG 8693 Special Topics *3:0:0:3*

This course requires Individualized readings on special topics assigned by instructor. *Prerequisite: Doctoral standing or instructor's permission.*

ASSOCIATED DOCTORAL SEMINARS

MG 9203 Seminar in Managing Knowledge-Workers in Innovative Organizations *3:0:0:3*

Knowledge workers, who are primarily in professional and technical occupations, now represent the most important segment of the U.S. labor force. The success of innovative organizations today results largely from the knowledge and skills applied by their professional and technical employees. The effective management of such a work force is one of the most critical problems faced by innovative organizations in the private and public sectors. This seminar closely examines theory and research and various management techniques to improve the use and development of knowledge workers in innovative organizations. *Prerequisite: Doctoral standing or instructor's permission.*

MG 9213 Seminar in Information Systems Management *3:0:0:3*

This course provides PhD-TM students and those in other related fields with a perspective on modern information-systems methodologies, technologies and practices. State-of-the-art research on frameworks for analysis, design and implementation of various types of information systems is presented. Also covered are economic and strategic issues related to information technology; the emphasis is on research in organizational, inter-organizational and strategic settings. The course follows a seminar format, and students are assigned paper-based and Web-based readings. Student's contributions are expected during class sessions, both as participant and, for one class, as moderator. *Prerequisite: Doctoral standing or instructor's permission.*

MG 9223 Seminar in Business Process Innovation *3:0:0:3*

This doctoral seminar explores dimensions and issues pertaining to the technology-business process interface that are critical to superior performance in today's modern networked corporations. Students discuss how technology has affected everything from common business tasks to complex and global supply-chain integration. Qualitative and quantitative aspects in these areas are addressed. The class also discusses articles on leading-edge research and management thought. The underlying objective is to expose the student to the rich and emergent literature in modern supply-chain management, technology integration and business model evolution. Major seminar themes include technology integration, product and process innovation, marketing, logistics, operations, IT and channel management issues in supply chains across various industries. The seminar emphasizes understanding the role of technology in the supply chain and its relation to business processes and innovation. *Prerequisite: Doctoral standing or instructor's permission.*

MG 9233 Seminar in Managing Technological Change and Innovation *3:0:0:3*

The objectives of this seminar are to familiarize students with the key viewpoints in the literature on technological innovation. Readings are selected to highlight the most important contributions to the literature by past and current academics. A critical analysis and review of this body of literature set the stage for future research work in this important management area. *Prerequisite: Doctoral standing or instructor's permission.*

MG 9243 Technology Management and Policy *3:0:0:3*

This course focuses on the research related to macro-environment that influences and that is relevant to technology decision making, strategy and innovation in firms, government agencies, nonprofit institutions and other organizations. Primary concerns include introducing effective approaches for analyzing and evaluating societal-wide factors that influence innovation; assessing various attempts and policies for stimulating innovation in a city, region, nation or globally; exploring the role of technology and innovation in diverse managerial, economic and social contexts (e.g., advanced economies, rapidly emerging economies and Third World economies); the relationship between business-government and NGOs (non-government organizations) in promoting and sustaining innovation; the impact of global rivalry and global cooperation in the technology and innovation arena; and the place of technology and innovation in the post–Cold War era and in the early 21st century. *Prerequisite: Doctoral standing or instructor's permission.*

MG 9253 Technology Strategy, Structure and Decision Making *3:0:0:3*

This course explores the most important and relevant theories and concepts related to technology strategy, structure and decision making. The emphasis is on understanding the useful application of such ideas for modern technology management and for designing effective scholarly research that deals with the strategic, structural and decision-making aspects of innovation and technology management. *Prerequisite: Doctoral standing or instructor's permission.*

MG 9263 Strategic Marketing Seminar *3:0:0:3*

This course examines strategic marketing issues that face firms and industries from theoretical and empirical perspectives. The seminar looks at product design, positioning and strategy, distribution, sales force, design of the marketing organization, competition, market structure, problems of information, signaling and pricing, corporate reputation and branding, advertising and promotion, and recent advances in product and service development. *Prerequisite: Doctoral standing or instructor's permission.*

MG 9273 Doctoral Seminar in Technology Adoption and Diffusion *3:0:0:3*

This seminary familiarizes students with the key viewpoints in the literature of technology adoption and diffusion. Readings are selected to highlight the most important contributions to the literature by past and current academics. A critical analysis and review of this literature sets the stage for future research in this important management area. *Prerequisite: Doctoral standing or instructor's permission.*

MG 9283 Doctoral Seminar on Entrepreneurship *3:0:0:3*

This seminar familiarizes students with key viewpoints in the literature on entrepreneurship. Readings highlight the most important contributions to the literature by past and current academics. A critical analysis and review of this literature sets the stage for future research in this important management area. *Prerequisite: Doctoral standing or instructor's permission.*

MG 9293 Seminar on Content Innovation *3:0:0:3*

Because the Internet has evolved to provide a robust technology platform on which to create content, the notion of what comprises content has expanded to include not only one-dimensional content, (print newspapers, books and music recordings, the core output of traditional media companies) but also multidimensional, nonlinear content that can reside in physical, digital or hybrid (physical and digital) spaces. The popularization and proliferation of this new content has affected profoundly the development of the creative

industries (e.g., publishing, newspapers, video games, fashion and music) and thus significantly challenges managers. This seminar explores the evolution of content innovation and focuses on several major issues, including the restructuring of creative industries and related managerial challenges resulting from developments in content innovation; the impact of restructuring creative industries on the development of urban centers of creativity and technoculture, such as Silicon Alley in New York City and Hollywood, California; the role of technology companies, particularly hybrid telecommunications/content companies and how they intersect with the creative industries and influence content innovation; the media and its symbiotic relationship with politics. *Prerequisite: Doctoral standing or instructor's permission.*

MG 9303 Advanced Topics—Organizational Behavior and Organizational Theory *3:0:0:3*

This course familiarizes students with a broad range of theoretical perspectives in contemporary organization theory and organizational behavior. The course spans levels of analysis. It adopts mostly a practice perspective and focuses on meso-levels of analysis (inter-group collaboration and competition) and micro-levels of interpersonal and social psychological processes within organizations. *Prerequisite: Doctoral standing or instructor's permission.*

MG 9313 Introduction to Behavioral Sciences *3:0:0:3*

This interdisciplinary seminar is limited to doctoral students. The seminar focuses on behavioral sciences, the areas of inquiry relating to the human condition or human behavior. This definition encompasses a wide variety of disciplines, from the social sciences and humanities to a corner of the biological sciences. The fields of study are as diverse as comparative literature, geography, psychiatry and mathematics (to name just a few). The course focuses on sociology, anthropology, history and political science; the emphasis is on sociology. The course explores a number of topics (social order, social solidarity, conflict, social classes, status) that have generated strong interest among social scientists. The course and the final paper pay special attention to the process of developing original theoretical arguments, suitable for empirical exploration. *Prerequisite: Doctoral standing or instructor's permission.*

MG 9321 Special Topics *3:0:0:3*

This course requires individualized readings on special topics. *Prerequisite: Doctoral standing or instructor's permission.*

RESEARCH METHODS SEMINARS

MG 9403 Business Research Methods *3:0:0:3*

This course introduces theory and techniques of business research methods. The course introduces the philosophy of science and the principles of investigation in the social sciences. Students learn to design a study, sample and choose a research design. Also discussed are basic data preparation, measurement and analysis procedures, focusing on univariate and multivariate statistics. *Prerequisite: Doctoral standing or instructor's permission.*

MG 9413 Quantitative Methods Seminar I *3:0:0:3*

The introductory PhD-level course covers quantitative analysis. Topics include specification, estimation and inference in the context of models that start with the standard linear regression framework. After reviewing the classical linear model, students develop the asymptotic distribution theory necessary for analyzing generalized linear and nonlinear models. Students then analyze estimation methods such as instrumental variables, maximum likelihood, generalized method of moments (GMM) and others. Inference techniques used in the linear regression framework (such as t and F tests) is extended to Wald, Lagrange multiplier, likelihood ratio and other tests. Finally, the linear regression framework is extended to models for panel data, multiple equation models and models for discrete choice. *Prerequisite: Doctoral standing or instructor's permission.*

MG 9423 Quantitative Methods Seminar II *3:0:0:3*

In this seminar, students gain an understanding of the theories underpinning economic and quantitative analysis in business. The seminar examines three different but interrelated academic disciplines to achieve this end: the axiomatic foundations of economics, the assumptions and methods that create the basis for game-theoretic analysis and the deviations from the economic rationality required by these methodologies that have been identified by the behavioral decision-making literature. *Prerequisite: Doctoral standing or instructor's permission.*

MG 9433 Qualitative Research Methods *3:0:0:3*

The course covers methods that allow students to enter natural social settings to capture data about human behavior in the actual contexts in which people pursue their daily lives. These methods include observation and interviewing. The emphasis is on studying close-up the worlds of other people. The course helps participants learn to make sense of data inductively, i.e., from the bottom up. This course is not about hypothesis testing. Rather, it is about building grounded theory. The focus is on coding and categorizing qualitative data (observational notes and interview transcripts). Students learn to go beyond journalistic description of data and use the analysis that characterizes good inductive social science. *Prerequisite: Doctoral standing or instructor's permission.*

INDEPENDENT RESEARCH

MG 9913 Independent Research *3:0:0:3*

In this course, students undertake directed individual study or supervised readings in advanced areas of the thematic electives and are advised by the doctoral adviser. Three credits required. *Prerequisite: Doctoral standing or instructor's permission.*

DOCTORAL DISSERTATION

MG 9993 Doctoral Dissertation Research *3:0:0:3*

Students are required to complete 24 credits of doctoral dissertation research. *Prerequisite: Doctoral standing or instructor's permission.*

TELECOMMUNICATIONS NETWORKS PROGRAM

Program Director: Yong Liu

Telecommunications is growing rapidly. From the military-communications networks of the early 1950s, telecommunications technology is used in almost all areas of modern society, from banking, reservation- and office-information systems, to corporate networks, the Internet and World Wide Web. Recent challenges include gigabit optical networks, multimedia communications and wireless network access.

The rapid evolution of telecommunications demands a broad educational background that includes contemporary technological breakthroughs. Polytechnic's telecommunication-networks master's program offers a wide range of courses, from fundamental topics to recent technological advances.

GOALS AND OBJECTIVES

The Master of Science in Telecommunication Networks Program prepares students for telecommunication-networks professions. The program trains students to understand, design, manage and operate such networks.

The Program's unique features are:

- an exceptionally wide range of course offerings in telecommunications technology;
- hands-on graduate laboratory courses in networking;
- professors with extensive research, industry and teaching experience;
- interaction with Polytechnic's New York State Center for Advanced Technology in Telecommunications (CATT), where students have access to cutting-edge research and development projects.

REQUIREMENTS FOR THE MASTER OF SCIENCE

Admission to a Master of Science in Telecommunication Networks requires an undergraduate degree in computer science, computer engineering or electrical engineering with a superior undergraduate record from an accredited institution. The Graduate Record Exam (GRE) is required. Applicants with comparable degrees in other fields are considered individually for admission. Generally, entering students must have a basic knowledge of computer fundamentals, such as programming in C++, data structures and computer architecture. NYU-Poly conditionally admits students with superior academic credentials who lack sufficient background, pending completion of several individually specified preparatory courses. These courses include CS 5303, Introduction to Programming, and CS 5403, Data Structures and Algorithms. However, no credit is allowed for any preparatory courses toward this degree. Other preparatory courses may be required. In some cases, students are interviewed to determine the necessary preparatory courses they need. Successful completion with a GPA of 3.0 or better is required for transfer to regular status. Admission with advanced standing is accepted in accordance with NYU-Poly regulations published in this catalog. Students may transfer a maximum of 9 credits to the MS in Telecommunications Networks from previous graduate work at an acceptable institution. To satisfy the master's degree requirements, students must complete a total of 30 credits as described below, with an overall GPA of 3.0 or above. In addition, a 3.0 average is required in core courses described in Group 1 and Group 2 below.

Students who have satisfactorily completed equivalent courses, as determined by the program director, may replace required courses in Group 1 and Group 2 with other courses, starting with the remaining Group 2 courses. For example, a student who previously took a course equivalent to EL 5373 will be required to take the remaining four courses in Group 2. A student who previously took two or more equivalent courses from Group 1 and 2 can replace these courses with advanced courses. Program-director permission is required for all substitutions.

GROUP 1: Required Core Course (3 Credits)

EL 5363 Principles of Communication Networks

Students who satisfactorily completed a course equivalent to EL 5363—e.g., EE 136, or otherwise as determined by the adviser—can replace this course by one from Group 2.

GROUP 2: Additional Core Courses (12 Credits)

Students are required to take four out of the five course choices listed below.

1. EL 5373 Internet Architecture and Protocols or CS 6843 Computer Network Protocols and Applications
2. EL 6373 Local and Metropolitan Area Networks or EL 6383 High Speed Networks
3. CS 6133 Computer Architecture I or CS 6233 Operating Systems I
4. CS 6273 Performance Evaluation of Computer Systems or EL 7353 Communications Networks I (the latter requires EL 5363 and EL 6303 as prerequisites)
5. CS 6823 Network Security

In certain rare circumstances, and with program-director approval, students may take other computer science and electrical engineering courses to fulfill the core requirement. Students may not take both CS 6843 and EL 5373.

GROUP 3: Project Requirement (3 Credits)

All Telecommunication Networks Program students are required to take a project course, either CS 6873 Project in Telecommunication Networks or EL 9953 Advanced Project I, depending on whether the project adviser teaches in the CS or ECE department. Before registering, students must obtain a project adviser and create an approved project plan. The project should be completed in one semester. After obtaining approval, students may substitute the required 3-credit project with a 6-credit MS thesis. The extra 3 thesis credits will count toward the program elective in Group 4.

GROUP 4: Program Elective Courses (12 Credits)

Students must take four courses (not already counted toward the core requirement) from the following partial course list. Other courses not on this list can be taken with program-director approval.

EL 5013	Wireless Personal Communication Systems
EL 5023	Wireless Information Systems Lab I
CS 5023	Introduction to Java Programming
EL 5143	Multimedia Laboratory
EL 6013	Principles of Digital Communication: Modulation and Coding
EL 6023	Wireless Communications: Channel Modeling and Receiver Design
EL 6033	Modern Wireless Communication Techniques and Systems
EL 6063	Information Theory
EL 6303	Probability Theory
EL 6313	Stochastic Processes
EL 6383	High-Speed Networks
EL 6393	Advanced Network Security
EL 7353	Communications Networks I: Analysis, Modeling and Performance
EL 7363	Communications Networks II: Design and Algorithms
EL 7373	High-Performance Routers and Switches
CS 6033 /6043	Design and Analysis Algorithms I/II
CS 6133 /6143	Computer Architecture I/II
CS 6233 /6243	Operating Systems I/II
CS 6063	Software Engineering I
CS 6083	Principles of Database Systems

MG graduate courses: Relevant management-department graduate courses can be taken with approval from the program director. No more than two MG courses can be counted toward the MSTN degree.

Total credits needed for degree: 30 Credits

Descriptions of electrical engineering, computer science and management courses can be found in this catalog's Electrical Engineering, Computer Science and Engineering, and Technology Management program sections. Information about Graduate Certificate in Telecommunication Network Management can be found in the Electrical Engineering program section.

TRANSPORTATION PROGRAM

Program Adviser: Elena S. Prassas

The Department of Civil Engineering offers graduate degree programs in transportation leading to the following degrees:

- MS in Transportation Planning and Engineering
- MS in Transportation Management
- PhD in Transportation Planning and Engineering

Master of Science programs are practice-oriented with a strong foundation in underlying principles and methods. The PhD is intended for students with a strong research interest and a desire to advance the state-of-the-art as a result of that research.

A number of graduate certificate programs are also available in:

- Traffic Engineering
- Transportation Planning
- Transportation Management

Graduate certificates, which entail completion of 12 focused credits of study, offer the opportunity for students to specialize in one of the areas of transportation planning and engineering. It also allows students not ready to embark on a full Master of Science degree program to receive formal recognition for more focused study.

REQUIREMENTS FOR MASTER OF SCIENCE PROGRAMS

ADMISSION REQUIREMENTS

To be eligible for admission as an MS candidate, applicants must hold at least a baccalaureate degree from an acceptable institution. Students pursuing degrees in transportation planning and engineering must also have a firm background in quantitative analytic skills. If admitted, students lacking such skills must take remedial courses in addition to degree requirements to strengthen their analytic competency.

All foreign students admitted to transportation programs must take an examination in English before registration. Based upon an evaluation of the examination, they may be required to take up to two additional courses in English as a Second Language (ESL) for which no graduate credit is given.

GRADE REQUIREMENTS

To earn Master of Science degrees or graduate certificates, students must have a 3.0 GPA or better in all graduate courses and in all guided studies (readings, projects, theses). Averages are separately computed for courses and guided studies. Transfer credits from other institutions are omitted from this average.

In addition, transportation program students are required to have an overall 3.0 GPA in all courses required for their degree or certificate program. Students may not repeat a course toward any of the transportation-degree programs more than once.

ANALYTIC BACKGROUND

All applicants for MS or graduate certificate programs in transportation must show evidence of quantitative analytic ability, generally including a minimum of two years of college mathematics. A college-level course in statistics is desirable.

ADVISING

Each student in the Master of Science program is assigned a faculty adviser. It is important that students frequently contact their adviser during their studies.

Students must meet with their academic adviser before each registration and at any other time they need advice or consultation. Students must have a detailed program of study formally approved by the adviser before registration. Advisers also handle requests for waiver of certain degree requirements. Such waivers must be approved in writing and must be entered into the student's departmental file. Where specific courses are waived, the permission of the course instructor is also required. When waivers are granted, students may be required to take other specific courses in their place; otherwise additional electives will be selected.

Students registering for any guided studies (readings, projects, theses) are assigned project advisers for each such activity. The project adviser may or may not be the same as the student's academic adviser, depending upon the subject matter. To register for any guided study activity, students must submit written proposals for the topic(s) to be covered to a project adviser before registration. To register, students must obtain the written approval of the project adviser and the academic adviser.

In addition to academic and project advisers, students studying under research or teaching fellowships are assigned fellowship advisers. Normally, these would be either the principal investigator of the research effort funding the fellowship or the director of the academic area in which the teaching fellowship is awarded.

While academic advisers consult and advise students, it is the student's responsibility to fulfill all degree requirements and to submit all proper forms and applications.

TRANSFER CREDITS

The minimum number of credits students must take at Polytechnic for an MS degree is 21 credits. All credits for a graduate certificate must be taken at Polytechnic.

Students may transfer up to 9 credits of acceptable courses toward a MS degree, subject to the approval of the academic adviser. To be transferred, the courses must relate to the transportation program and be from an acceptable institution. A grade of B or better is required to receive transfer credit. Courses graded on a pass/fail basis are not considered for transfer unless accompanied by a detailed written evaluation by the instructor of the course. All transfer requests must be accompanied by an official transcript from the transferring institution. Applications for transfer credits are accepted only after students have earned 12 credits at Polytechnic. Validation credits by examination may not be used toward any transportation degree program.

MASTER OF SCIENCE IN TRANSPORTATION PLANNING AND ENGINEERING

The MS program has a strong foundation in traffic engineering, transportation planning, transportation economics, public transportation systems and intelligent transportation systems. Students are exposed to a learning atmosphere that provides a meaningful combination of theoretical and practical approaches. Courses include a mix of presentations, workshop and project exercises, and practical problem solutions.

The program focuses on (1) material suited to the issues and projects students will face on the job, so that they are immediately productive; (2) material packaged by the course so that each course provides specific skills and knowledge, enabling the student to be immediately productive; (3) project-based learning in multiple courses, as an underlying approach to teaching the courses and the program; (4) modern tools integrated into the courses, including, but not limited to: Synchro and SIM-Traffic and other simulation programs, HCS+, AutoCAD templates for intersection design, and data collection and processing software; (5) design problems taught through a project/case studies approach; (6) statistics integrated into courses, with moderately advanced

skills in Excel and Word expected in all courses (but not explicitly taught).

The program includes a strong focus on the rapidly emerging field of intelligent transportation systems. This field applies telecommunications and information technology to solving a variety of transportation functions, from route guidance systems to automated toll collection systems to the automated highway.

GOALS AND OBJECTIVES

The primary goal of the MS in Transportation Planning and Engineering is to prepare transportation professionals to plan, functionally design, control and operate facilities, systems and services that satisfy the demand for passenger and freight transportation. Specific objectives of the program are to provide the skills necessary to:

- Fundamentally understand the nature and generation of transportation demands;
- Understand the political, policy and economic forces that affect transportation demands and the public framework in which they are addressed;
- Functionally design transportation systems and components;
- Control and operate traffic and other transportation facilities; and
- Apply information technologies to intelligent transportation systems.

PROGRAM REQUIREMENTS

Course No.	Course Title	Credits
TR 6013	Fundamental Concepts in Transportation	3
TR 6113	Forecasting Urban Travel Demand	3
TR 6313	Traffic Control and Signalization I	3
TR 6323	Traffic Control and Signalization II	3
TR 6213	Transportation Economics and Finance	3
TR 6223	Intelligent Transportation Systems and Their Applications	3
Total Required Credits:		**18**

Additionally all students would select 9 to 12 credits from the following list of electives:

Course No.	Course Title	Credits
TR 6023	Analytic Methods in Transportation	3
TR 7123	Transportation Planning and Congestion Management	3
TR 7133	Urban Public Transportation Systems	3
TR 7323	Design of Parking and Terminal Facilities	3
TR 7033	Transportation Safety and Security	3
TR 7233	Transportation Management	3
TR 7243	Intelligent Transportation Systems: Deployments and Technologies	3
TR 7343	Urban Freeways and Intercity Highways	3
TR 8013/8023	Selected Topics in Transportation I, II	3
TR 900X	Readings in Transportation	1-5
TR 9013	Thesis in Transportation	3
Total Elective Credits:		**9-12**

MS students in the Transportation Planning and Engineering program may take 3 credits of free electives from any graduate course offering at Polytechnic, assuming that the student has the necessary prerequisites. Adviser approval is required for all elective selections.

MASTER OF SCIENCE IN TRANSPORTATION MANAGEMENT

The program is for practicing professionals who deal with a public transit system, and agency and/or facility management. It combines basic management skills with a working knowledge of techniques and approaches to optimize transportation system results.

GOALS AND OBJECTIVES

The primary goal of the MS in Transportation Management is to prepare professionals to effectively and efficiently manage various transportation enterprises. The emphasis is on agencies, facilities and services in the public sector. Specific objectives of the program are to provide:

- a basic background in management skills and techniques, specifically as applied to public and private transportation organizations;
- basic understanding of the economic aspects of the transportation sector;
- an understanding of the importance of national, state and local transportation policy on public and private sector organizations;
- fundamental knowledge on some specific issues and problems in managing and operating public transportation facilities.

PROGRAM REQUIREMENTS

The following courses are required of all students:

Course No.	Course Title	Credits
TR 6013	Fundamental Concepts in Transportation	3
TR 6213	Transportation Economics and Finance	3
TR 6223	Intelligent Transportation Systems and Their Applications	3
TR 7223	Transportation Management	3
TR 7133	Urban Public Transportation Systems	3
TR 7233	Management of Transit Maintenance and Operations	3
Total Required Credits:		**18**

Students will take elective courses in the following areas:

MG	General Management Courses (with necessary prerequisites)	6-9
TR	General Transportation Courses (with necessary prerequisites)	3-6
Total Elective Credits:		**12**

DOCTOR OF PHILOSOPHY IN TRANSPORTATION PLANNING AND ENGINEERING

The PhD in Transportation is a research-oriented degree intended for those whose goal is a career in basic transportation research and/or teaching at the Institute level or in private research organizations.

GOALS AND OBJECTIVES

The fundamental goal of the PhD in Transportation Planning and Engineering is to develop professionals with strong research skills capable of advancing the profession of transportation planning and engineering through their work. Specific objectives of the program are to provide the skills necessary to:

- develop a strong and deep fundamental knowledge about the profession of transportation planning and engineering;
- develop the knowledge and skills to perform independent fundamental research in transportation planning and engineering;
- produce fundamental research that meaningfully advances the state-of-the-art of the profession of transportation planning and engineering.

PROGRAM REQUIREMENTS

Students pursuing the PhD in Transportation Planning and Engineering generally specialize in one of the following subject areas:

- Transportation planning
- Traffic engineering
- Intelligent transportation systems
- Transportation safety

Other focus areas are possible and can be developed with the help of faculty advisers. All subject areas, of course, must be relevant to the degree sought and have a faculty member willing and able to guide the student's research.

PROGRAM ADMINISTRATION

All graduate applications are processed through the civil engineering departmental office, which distributes applications to the graduate coordinator. Graduate program coordinators formally implement admission decisions, in accordance with departmental regulations. Coordinators consult with other department faculty as needed. They are also responsible for keeping records for all graduate students in their program areas, and for processing graduation audits for students in their program areas.

The graduate coordinators form the departmental Graduate Committee. All PhD applications are reviewed by the committee, and admissions decisions are made by the committee and implemented by the graduate coordinator.

For each registration, the student's program must be approved by the academic adviser and signed by the transportation program coordinator.

ADMISSION CRITERIA TO PHD PROGRAM

Admission to the PhD in Transportation Planning and Engineering requires an MS in Transportation Planning and Engineering or equivalent, with a GPA of 3.5 or better (on a 0-4 scale).

Admission to PhD program does not require GREs (Graduate Record Examination), but applicants are encouraged to take these examinations. If these examinations are taken, the student must submit the results for consideration.

Foreign applicants must take the TOEFL examination and submit the results for consideration.

The "equivalent" of the MS degree can be achieved in several ways. The candidate may have an MS degree with a different title that covers substantially the same material. More generally, applicants must demonstrate that they have the equivalent of all undergraduate and master's level course work in order to pursue doctoral level work in the major area. Further, "equivalence" is evaluated based on the totality of the student's undergraduate and graduate record, not course-by-course.

Because admission to a PhD program requires a related MS (or equivalent), those applicants who have not yet achieved a master's degree would normally be admitted as MS students. They are expected to earn an MS degree while completing their major and minor course requirements. In rare cases, an applicant with only a BS degree may be directly admitted into the PhD program with the written approval of the department head.

DOCTORAL COMMITTEES

Upon admission, every PhD student is assigned an academic adviser, who is selected by the department head. Any member of the civil engineering faculty can be an academic adviser to a graduate student. In cases where a student is supported on a research contract, the principal investigator of the contract would normally be appointed as the academic adviser for the student. Where a student has a particular research interest and is working with a particular faculty member, the student may request that the faculty member be appointed as academic adviser. In rare cases where a PhD student enters the program without a prior selection of a major area of study, the initial academic adviser will be the Graduate Coordinator of the transportation program.

In fulfilling their academic requirements, PhD candidates will deal with two advisory committees:

Academic Advisory Committee: The student's academic adviser works out a program of courses to fulfill major and minor requirements for the PhD. The Academic Advisory Committee generally will comprise the academic adviser and one faculty member for each minor area of study. The Academic Advisory Committee guides the PhD student's work through the successful completion of a qualifying examination. A letter signed by the academic adviser and approved by the department head is placed in the student's file, indicating the composition of the Academic Advisory Committee.

Dissertation Committee: The Dissertation Committee is formed immediately after the student passes the qualifying examination. It comprises a major adviser, a dissertation adviser and a minor adviser for each minor the student has pursued. Additional faculty members may also be on the Dissertation Committee. The Dissertation Committee may be the same as the Academic Advisory Committee, or may be different. The Dissertation Committee guides the student's course and research work after the student has passed the qualifying examination. The Dissertation Committee must be formally assigned and approved by the department head and filed with the Office of Graduate Academics. The major adviser must be a full-time faculty member of the Department of Civil Engineering. The major and dissertation advisers may be the same individual.

DOCTORAL DEGREE REQUIREMENTS

To earn a PhD in Transportation Planning and Engineering, the following requirements must be met:

- Fifty-one credits of graduate work (not including the PhD dissertation) in relevant major and minor areas of study beyond the bachelor's degree, with an average grade of B or better (cumulative average of 3.0 or better on a 0-4 scale).
- Completion and successful defense of a 24-credit dissertation related to the major area of study. Dissertations must consist of original research that meaningfully advances the state-of-art in the subject area of the research and should result in the publication of at least one paper in a strictly peer-reviewed technical journal related to the subject. A grade of B or better must be achieved for the dissertation.
- Completion of two minor areas of study, each consisting of between 9 and 12 credits of graduate work. At least one minor area must be outside the transportation area.
- Residency requirements for the PhD in Transportation Planning and Engineering include the 24-credit dissertation plus a minimum of 9 credits of applicable graduate course work taken at Polytechnic.

In satisfying the 51-credit course requirement, the student must satisfy all requirements for the major and minor areas selected, or their equivalent.

In satisfying these basic PhD requirements, students must also satisfy one of the two following conditions:

- Thirty-nine credits of approved graduate course work, not including individual guided studies (readings, projects, theses, etc.) beyond the bachelor's degree, with an average grade of B or better (cumulative average of 3.0 or better on a 0-4 scale).
- Twenty-one credits of related graduate course work beyond the master's degree, with an average grade of B or better (cumulative average of 3.0 or better on a 0-4 scale).

Satisfying condition 2 requires that the department accept the student's MS degree *in toto* without regard to its specific content. This requires a recommendation from the department's Graduate Committee and the approval of the department head.

Transfer Credits

Transfer credits for PhD students can be awarded course by course. Alternatively, a MS degree from another institution may be accepted for transfer in toto. In the former case, a maximum of 42 credits of approved graduate work may be transferred. The latter requires a recommendation from the department's Graduate Committee and the approval of the department head. Transfer credits are awarded generally at the time of admission and must be approved by the academic adviser, the transportation graduate coordinator and the department head.

Qualifying Examination

Departmental qualifying examinations for the PhD in Transportation Planning and Engineering are given once a year (usually in June or July) and are coordinated with other qualifying examinations in the department. If sufficient demand exists, a second qualifying examination may be scheduled in December or January. Every PhD student must pass a qualifying examination in the major area of study and in any in-department minor areas of study before becoming a candidate for the PhD. Further:

- No student may register for dissertation credits until the Qualifying Examination is passed.
- A Dissertation Committee cannot be formed until the student passes the Qualifying Examination.
- A student may take the Qualifying Examination twice. A third attempt is permitted only with the written recommendation of the Academic Advisory Committee and the approval of department head. In no case may a student take the examination more than three times.
- Students normally take the Qualifying Examination (for the first time) after successfully completing most of their course requirements in the major and in-department minor areas of study.

The Qualifying Examination consists of a five-hour written portion and an oral portion of approximately one hour. Both written and oral portions of the examination focus on the student's major and in-department minor. The oral portion may also explore higher-level skill areas required to successfully conduct independent research. Students are deemed to have passed the examination based upon an overall evaluation of the written and oral results. While some students may not be invited to the oral examination if they have done poorly in the written portion, invitation to the orals does not imply that the student has "passed" the written portion of the exam.

The Qualifying Examination is either "passed" or "failed." A letter indicating the result of each examination is placed in the student's graduate file. In rare cases, a student may be deemed to have "conditionally passed" the Qualifying Examination. This conditional status occurs in cases where the student does extremely well in all areas except for a single subject area in which weakness has been noted. Such students must follow a prescribed plan to strengthen their knowledge and skills in the area of weakness and must pass a special examination on the area of weakness within one calendar year. A student who has "conditionally passed" the Qualifying Examination may register for dissertation credits and may form a Dissertation Committee.

All transportation faculty members participate in submitting written problems for the qualifying examination, and in the grading process and in the oral examination. All departmental faculty members are welcome to observe any oral examination and to ask pertinent questions. Each student's Academic Advisory Committee will have the opportunity to review the entire exam before it is administered and may suggest changes if it deems that the examination as presented is an inequitable test of the student's abilities. Recommendations on the results of the examination are submitted by each student's Academic Advisory Committee, augmented by any departmental faculty in the subdisciplines tested. The departmental faculty, acting as a whole, votes to accept or reject such recommendations at a meeting scheduled for this purpose.

Dissertation Proposal

Following passage of the Qualifying Examination and the appointment of a Dissertation Committee, the PhD candidate must submit a written Dissertation Proposal, outlining the subject of the proposed research. This proposal should be between 15 and 20 pages long and should address the following specific items:

- Description of the topic
- Literature review sufficient to insure that the work contemplated is original
- Research methodology(ies) to be used
- Data and/or laboratory needs and their availability to the student
- Anticipated outcomes

The Dissertation Proposal must be submitted within one semester of full-time study, or before 9 credits of dissertation credit are completed.

The Dissertation Proposal is orally presented and defended before the Dissertation Committee and other interested departmental faculty. The date of the oral defense and copies of the draft Dissertation Proposal must be made available to department faculty at least two weeks (14 calendar days) before the defense.

When the Dissertation Proposal is formally accepted, the Dissertation Adviser enters a letter into the student's graduate file, indicating this acceptance, with a copy of the proposal. While the Dissertation Committee has reasonable flexibility to modify the proposal during the research, any significant change in focus area or methodology requires that an amended Dissertation Proposal be written and formally accepted following the same procedure noted herein.

DISSERTATION DEFENSE

The culmination of the student's PhD work is the oral presentation and defense of the final draft dissertation. A defense is generally scheduled after the Dissertation Committee has reviewed the draft dissertation and determined that it is complete and of sufficient quality to be presented and defended.

The defense is organized and scheduled by the Dissertation Committee. All Institute faculty members are invited to observe and ask questions at all Polytechnic dissertation defenses. Therefore, the date of the defense must be announced Institute-wide at least one month before the event, and copies of the draft dissertation must be available to any faculty member requesting one in a timely fashion and in no case less than two weeks before the defense.

GRADUATE CERTIFICATE PROGRAMS

The Transportation Program offers graduate certificates to students completing 12 credits of study in specified areas of concentration. This program is for students who do not wish to commit to a full advanced degree. Applicants may be students with bachelor's degrees seeking to specialize in an aspect of transportation or those with advanced degrees wishing additional course work in a highly focused area of the profession.

Students in certificate programs may apply for transfer to degree programs without any loss of credits, assuming they are admitted to the degree program and that the courses are related to the degree.

Admission to a certificate program does not guarantee admission to a full degree program.

The Department of Civil Engineering offers the following certificate programs in transportation, with the following requirements:

CERTIFICATE IN TRAFFIC ENGINEERING

Course No.	Course Title	Credits
TR 6013	Fundamental Concepts in Transportation	3
TR 6313	Traffic Control and Signalization I	3
TR 6323	Traffic Control and Signalization II	3

Select on One of the Following:

TR 7323	Design of Parking and Terminal Facilities	3
TR 7343	Urban Freeways and Intercity Highways	3
TR 7033	Transportation Safety and Security	3
TR 6223	Intelligent Transportation Systems and Their Applications	3

CERTIFICATE IN TRANSPORTATION PLANNING

Course No.	Course Title	Credits
TR 6013	Fundamental Concepts in Transportation	3
TR 6113	Forecasting Urban Travel Demand	3
TR 7123	Transportation Planning and Congestion Management	3

Select One of the Following:

TR 6213	Transportation Economics and Finance	3
TR 7133	Urban Public Transportation Systems	3
TR 6223	Intelligent Transportation Systems and Their Applications	3

CERTIFICATE IN TRANSIT MANAGEMENT

Course No.	Course Title	Credits
TR 6013	Fundamental Concepts in Transportation	3
TR 7133	Urban Public Transportation Systems	3
TR 7233	Management of Transit Maintenance and Operations	3

Select One of the Following:

TR 6213	Transportation Economics and Finance	3
TR 7233	Transportation Management	3

GRADUATE COURSE DESCRIPTIONS

TR 6013 Fundamental Concepts in Transportation *3:0:0:3*

This course provides the contextual foundations to study urban transportation systems, using performance criteria reflecting the perspectives of system providers/owners, users and communities. The connection between transportation supply, travel demand, service volume and level of service is explored and quantified for various travel modes. The impacts of transportation system performance

on travel behavior, communities and the environment is discussed. The role of technology and institutions is examined with case examples. *Prerequisite: Graduate status or permission of instructor.*

TR 6023 Analytic Methods in Transportation *3:0:0:3*

This course introduces transportation students to a variety of analytic techniques as they are commonly applied to transportation issues. The course covers basic statistics and statistical analyses and their application to transportation studies, including traffic characteristics studies and survey instruments. Mathematical techniques for analyzing transportation queues are covered. Statistical tests for significance of improvement impacts are illustrated. Regression analysis applied to developing transportation models is covered. An introduction into traffic simulation is also given. *Prerequisite: TR 6013 or permission of adviser.*

TR 6113 Forecasting Urban Travel Demand *3:0:0:3*

The purpose of this course is to study methods and models used in estimating and forecasting person travel in urban areas. The objective is to understand the fundamental relationships between land use, transportation level of service and travel demand, and to apply methods and state-of-the-practice models for predicting person travel on the transportation system. *Pre-/Co-requisite: TR 6013 or permission of instructor.*

TR 6213 Transportation Economics and Finance *3:0:0:3*

This course provides the basic principles of engineering economic analysis and their application to transportation projects. Half of the course covers the concepts of present worth, capital recovery, sinking funds and annual cost applied to economic comparisons and evaluations of alternatives. The second half of the course delves into financing transportation and how government policy on transportation affects the economy and environs at the local, state and federal levels. Historical perspectives on the financing of highway systems, public transportation systems and transportation agencies are presented. Other subjects include privatization, innovative financing methods, business plans. *Prerequisite: TR 6013 or permission of adviser.*

TR 6223 Intelligent Transportation Systems and Their Applications *3:0:0:3*

This course introduces the concepts and applications of Intelligent Transportation Systems (ITS) and its growing role in the management of transportation systems. The course stresses the role of ITS as national policy, as specified in major transportation funding legislation – ISTEA, TEA21 and SAFETY-LU. A systems engineering approach to overall development of ITS technologies is stressed. Major components of ITS are discussed, and examples of their application treated. Coordination and integration of ITS components are treated. *Prerequisite: TR 6013 or permission of adviser.*

TR 6313 Traffic Control and Signalization I *3:0:0:3*

Traffic controls are imposed to provide for safe, efficient and orderly movement of people and goods on our nation's street and highway systems. Traffic control is examined in the urban context in which both vehicles and pedestrians be accommodated. Techniques for quantifying traffic stream behavior are described. Federal, state and local standards for designing and implementing control devices are presented. Selection of control measures, design and timing of traffic signals at individual intersections and in arterial networks is treated in detail. Use and application of current computer tools – HCS++ and Synchro – are illustrated. *Prerequisite: TR 6013 or permission of instructor.*

TR 6323 Traffic Control and Signalization II *3:0:0:3*

In furtherance of the material covered in TR 6313, emphasis is on the arterial as a facility and on systems concepts such as traffic calming, access management and roundabouts as a design element. Also covered are network problems induced by traffic congestion and remedies such as critical intersection control, network metering, oversaturated control policies and real time sensing, and traffic impacts from growth and development, including assessment and mitigation. The course employs the use of modern tools, including VISSIM, Synchro/SIMTraffic and HCS++, and two projects must be completed by students working in teams. This course should be taken in the student's last or penultimate semester. *Prerequisites: TR 6313 or equivalent and TR 6113 or equivalent.*

TR 7033 Transportation Safety and Security *3:0:0:3*

Technology, legislation and market forces have contributed to improved transportation safety for decades. But one must consider which metrics are most relevant for which modes, the role of demographics and traffic levels and other factors when analyzing and predicting safety trends. The course pays attention to a systems view, to metrics by mode and to both standard field and statistical analyses. Consistent with current priorities, the course addresses security as well as safety issues. *Prerequisite: TR 6013 or permission of adviser.*

TR 7123 Transportation Planning and Congestion Management *3:0:0:3*

This course provides a contextual understanding of urban transportation planning and its component activities. It helps students understand the enabling environment needed to sustain the planning process; to understand the causes of transportation congestion and its impacts on transportation users and communities; to set forth a vision for congestion management; and to develop and evaluate strategies and policies that achieve the vision. *Pre-/Co-requisite: TR 6013 or permission of instructor.*

TR 7133 Urban Public Transportation Systems *3:0:0:3*

This course provides a thorough understanding of policy, planning, operational and technical issues that affect urban public transportation. It includes the historical development of cites and the rise of urban transport. Also covered are the characteristics of various urban transportation modes (their specific operating and infrastructure characteristics), as well as key elements that are critical to service provision, such as service planning, scheduling, fare collection, communication and signaling, station design and customer service. The course offers a broad perspective on regional planning, capital programming and policy matters. Special focus will be on emerging technologies and their practical applications. *Prerequisite: TR 6013 or permission of adviser.*

TR 7213 Transportation Management *3:0:0:3*

This course presents an overview of the transportation management profession. Levels of management and unique objectives of management in the transportation sector are presented and discussed. Management structures for private and public transportation organizations are analyzed. Management practices are treated from the perspective of organizations, optimization of the use of public resources, legislative and legal contexts and operations. *Prerequisite: TR 6013 or permission of adviser.*

TR 7223 Management of Transit Maintenance and Operations *3:0:0:3*

This course provides a comprehensive understanding of modern public transportation systems, emphasizing their technology and operational practices. Planning and management aspects are also covered. Such operational management issues as maintenance practices, scheduling, procurement and labor relations are broadly outlined and discussed. Planning and capital programming issues are also treated. *Prerequisite: TR 6013 or permission of adviser.*

TR 7243 Intelligent Transportation Systems: Deployments and Technologies *3:0:0:3*

Transportation infrastructure deploys a wide range of modern technology to provide service to travelers, the general public and private entities. This technology enables other systems to function effectively and serve societal needs. This course focuses on data communications and applications in intelligent transportation systems: communications alternatives and analyses, emerging technologies, geographic information systems (GIS) and global positioning systems (GPS). *Prerequisite: TR 6223 or permission of instructor.*

TR 7323 Design of Parking and Terminal Facilities *3:0:0:3*

This course covers design techniques and approaches to a variety of pedestrian and vehicular needs in conjunction with access to land functions. Parking serves as the primary access interface to many land facilities, from shopping centers and sports facilities, to medium- and high-density residential developments. The planning and design of parking facilities, and the planning of access and egress from these facilities, is critical to the economic success of a development. Terminals are inter-modal interface facilities involving the transfer of people and/or goods from one mode of transportation to another. This course covers essential elements of terminal planning and design, including transit stations and terminals, major goods terminals at ports and railheads and others. The design of pedestrian space and ways within terminal structures is also treated. *Prerequisite: TR 6013 or permission of adviser.*

TR 7343 Urban Freeways and Intercity Highways *3:0:0:3*

This course focuses on the design, analysis, control and management of urban freeways and intercity highways of all classes. The course covers geometric design standards and principals, the application of highway capacity and level of service analysis methodologies (including HCS++), marking and signing, speed control and modern freeway management systems and approaches. *Prerequisites: TR 6013, TR 6313, or equivalents, or permission of instructor.*

TR 8013, 8023 Selected Topics in Transportation I, II *3:0:0:3*

These courses are given as needed to present material on current topical subjects that are not expected to be given on a regular basis. The topic(s) for each offering are indicated and are listed on the student's transcript. These courses may be taken more than once if the listed topics are different. *Prerequisites: TR 6014 and as approved for the topic(s); to be specified for each offering.*

GUIDED STUDIES AND PROJECTS

TR 900x Readings in Transportation *Variable*

This is an individually guided effort involving research into a topic of interest, usually growing from a course the student has taken. Readings courses should not duplicate material available in a regularly scheduled course, but should involve additional research on a topic or topics of interest to the student that is related to a course or courses. A formal written report is required. The student must have a faculty adviser who agrees to work with them and an agreed-upon topic before registering. The student may register for 1 to 3 credits for a readings effort, in proportion to the effort and as approved by the supervising instructor. *Prerequisite: Permission of supervising instructor.*

TR 9013 Thesis in Transportation *3 Each*

Students electing to take a 6-credit MS Thesis commit to a significant individually guided research effort, resulting in a formally defended thesis report, bound in accordance with Institute requirements. *Prerequisites: MS degree status and permission of thesis adviser.*

TR 999X Dissertation for the PhD (Transportation Planning and Engineering) *Variable (24 Total)*

The dissertation is an original investigation embodying the results of comprehensive research in a specific area of transportation worthy of publication in a recognized, formally refereed transportation journal. Students must defend formally their dissertations and submit a bound written document. Students must complete a minimum of 24 credits of dissertation registration before defending. Once the dissertation is started, the student must maintain a minimum of 3 credits of registration during each semester (not including summer) until the dissertation is complete. During the last semester of registration, the student may be permitted to register for .5 credit with the permission of the Graduate Office and dissertation adviser. *Prerequisite: PhD degree status, passage of the Qualifying Examination in Transportation and permission of the dissertation adviser.*

WALK

URBAN SYSTEMS ENGINEERING AND MANAGEMENT PROGRAM

Program Director: Ilan Juran

The Department of Civil Engineering offers a graduate program in Urban Systems Engineering and Management, leading to the Master of Science. This program was developed as part of the Institute for Civil Infrastructure Systems (ICIS), supported by the National Science Foundation. Polytechnic Institute of NYU is a major partner institution in ICIS, a consortium effort led by New York University.

The primary objective of ICIS and of the Urban Systems Engineering and Management Program is to educate professionals with both engineering and non-engineering backgrounds to understand and manage major urban infrastructure systems and the problems they pose to society and government. It is not sufficient to have a technical understanding of the engineering aspects of urban infrastructure systems and their components. To manage this sector effectively, professionals must also understand the societal and political contexts that affect them. Issues of public policy, finance, monitoring and maintenance must all be understood more clearly.

This Master of Science program attempts to provide a broader exposure to the range of knowledge and skills needed to play a leading role in infrastructure management in an urban setting. Thus, the program includes elements of engineering and technology, management, economics, finance and public policy.

GOALS AND OBJECTIVES

The specific objectives of the Urban Systems Engineering and Management Program are to provide students with the following:

- A broad base of understanding of infrastructure management and policy issues;
- Analytic and decision-making skills that account for the political, economic and social impacts of infrastructure technologies;
- A broad overview of the full range of urban infrastructure systems;
- An integrated knowledge of the interactions and interdependencies of various urban infrastructure systems;
- Specialized management skills and techniques to apply to unique problems of the infrastructure segment.

ADMISSION REQUIREMENTS

Admission to the MS in Urban Systems Engineering and Management is open to professionals with BS or BA degrees and backgrounds in engineering, science, public policy, management, economics and/or finance. Necessary mathematics background, usually including undergraduate calculus, is required, as is an undergraduate GPA of 3.0 or better.

GRADE REQUIREMENTS

To earn graduate degrees or certificates, students must have a 3.0 GPA or better in all graduate courses and guided studies (readings, projects, theses, dissertations). Averages are separately computed for courses and guided studies. Transfer credits from other institutions are not included in this average.

ANALYTIC BACKGROUND

All applicants for this MS program must show evidence of quantitative analytic ability, generally, including a minimum of two years of college mathematics and a college-level course in statistics.

TRANSFER CREDITS

The residency requirement for the MS degree is 21 credits. This is the minimum number of credits that must be taken at NYU-Poly for an NYU-Poly MS degree.

Students may transfer up to 9 credits of acceptable courses toward an MS degree, subject to the approval of the academic adviser. To be transferred, the course(s) must be relevant to the program and from an acceptable institution. A grade of B or better is required for granting of transfer credit. Courses graded on a pass/fail basis are not considered for transfer unless accompanied by a detailed written evaluation by the course instructor. All transfer requests must be accompanied by an official transcript from the transferring institution. Applications for transfer credits are accepted only after the student has earned 12 credits at NYU-Poly.

ADVISING

Each student in the graduate program is assigned a faculty adviser. It is important that students maintain frequent contact with the adviser throughout their studies. Students must meet with their academic adviser before each registration and at any other time they need advice or consultation.

Students must have a detailed program of study formally approved by their adviser before registration. Advisers also handle requests for waiver of certain degree requirements, where warranted. Such waivers must be approved in writing and must be entered into the student's departmental file. Where specific courses are waived, the approval of the course instructor is also required. When waivers are granted, students may be required take other specific courses in their place, or to select additional electives.

Students registering for any guided studies (readings, projects, theses) are assigned project advisers for each such activity. The project adviser may or may not be the same as the student's academic adviser, depending upon the subject matter selected. To register for any guided study activity, students must submit written proposals for the topic(s) to be covered to a project adviser before registration. To register, the written approval of the project adviser is required in addition to the approval of the academic adviser.

While academic advisers consult and advise students, students are responsible for ensuring that all degree requirements are fulfilled and for submitting all proper forms and application.

REQUIREMENTS FOR THE MASTER OF SCIENCE

PROGRAM CORE:

All students must complete the following five courses:

Course No.	Course Title	Credits
CE 7813	Infrastructure Planning, Engineering and Economics	3
CE 7843	Intro to Urban Systems Engineering	3
CE 7853	Concepts and Implementation of Infrastructure Management Systems	3
CE 7673	Environmental Impact Assessment	3
CE 8733	Infrastructure Financing: Structuring of a Deal*	3
Total credits:		**15**

** Course is part of the Exec 21 program; special requirements (see Construction Management Program) or permission of adviser required.*

MINOR, TECHNICAL AND FREE ELECTIVES:

Each minor area of study includes: (1) three minor courses, required for the minor; and (2) two to three technical electives, available to all program students.

Students may elect not to take a specified minor area. They may, instead, take five or six technical electives from the approved list in any specified area. The number of technical electives is influenced by whether the student elects to do a 3-credit case study report or a 6-credit MS thesis, as described in a later section.

MINOR AREAS OF CONCENTRATION

- Transportation Systems Management (TSM)
- Construction Management (CM)
- Environmental Systems Management (ESM)
- Civil Infrastructure Systems Management (CISM)

Because of course content, students selecting the CISM minor should hold a BS in Civil Engineering or the equivalent.

Minor in Transportation Systems Management

Credits required in the minor:

Course No.	Course Title	Credits
TR 7223	Transportation Management	3
TR 6223	Introduction to Intelligent Transportation Systems	3
TR 7133	Urban Public Transportation Systems	3

Approved Technical Electives in Transportation

Course No.	Course Title	Credits
TR 6133	Travel Demand Forecasting	3
TR 7123	Transportation Planning and Congestion Management	3
TR 6213	Transportation Economics and Finance	3

Additional electives may be approved by the adviser.

Minor in Construction Management

Required in Minor:

Course No.	Course Title	Credits
CE 8253	Project Management for Construction	3
CE 8713*	Construction and the Law	3
CE 8723*	How to Succeed in Construction	3

Approved Technical Electives in Construction:

Course No.	Course Title	Credits
CE 8273	Contracts and Specifications	3
CE 8783*	Construction Management and Planning	3
CE 8703*	Managing and Leading in the 21st Century	3

Additional electives may be approved by the adviser.

** Course is part of the Exec 21 program; special requirements (see Construction Management Program) or permission of adviser required.*

Minor in Environmental Systems Management

Credits required in the minor:

Course No.	Course Title	Credits
CE 7753	Environmental Systems Management	3
CE 7533	Hazardous/Toxic Waste Management	3
CE 7563	Environmental Law	3

Approved Technical Electives in Environmental Studies:

Course No.	Course Title	Credits
CE 7473	Stream and Estuary Analysis	3
CE 7523	Air Pollution	3
CE 7543	Hazardous/Toxic Site Management	3

Additional electives may be approved by the adviser.

Minor in Civil Infrastructure Systems Management

Credits required in the minor:

Course No.	Course Title	Credits
CE 7863	Infrastructure Monitoring and Performance Assessment	3
CE 6063	Bridge Engineering	3
CE 8433	Urban Geotechnology	3

Approved Technical Electives in Infrastructure Systems:

Course No.	Course Title	Credits
CE 6143	Steel Structures	3
CE 8433	Instrumentation, Monitoring and Condition Assessment	3
CE 8493	Environmental Geotechnology	3

Additional electives may be approved by the adviser.

CAPSTONE EXPERIENCE

Students fulfill the requirement for a meaningful Capstone experience by completing an independent case study in urban systems management and engineering (3 credits) or a master's thesis on a topic of independent study (6 credits).

All course descriptions for Urban Systems Engineering and Management are found in the Civil Engineering section of this catalog.

PART 4

SPECIAL PROGRAMS

GENERAL STUDIES PROGRAM

The General Studies (GS) Program provides proactive support for students, allowing them an opportunity to matriculate and successfully obtain a science-, engineering, humanities- and management-based education. To ensure student success, the General Studies Program provides a broad variety of services that begin with a mandatory summer program before the start of freshman year and continue throughout the academic year with mandatory weekly tutoring and advisement sessions. Once admitted into NYU-Poly, students must participate successfully in the program for one year before they are allowed to officially declare their major. Advanced Placement (AP) and transfer credits may not be used toward the completion of GS Program requirements.

For further information, visit www.poly.edu/general-studies, or call (718) 260-3882.

ADMISSION AND APPLICATION PROCEDURES

Admission to the General Studies Program is by invitation only. Selected freshmen are invited to submit an application and may be interviewed by an admissions counselor to determine if their goals correspond with program objectives and services. Accepted students who plan to attend the program must take a math-, beginner level physics- and writing-skills assessment tests before the summer program starts.

ACADEMIC SUPPORT SERVICES

GS students have an array of services to help them adjust to the rigorous NYU-Poly curriculum. Services include, but are not limited to, the following:

- A six-week on-campus or online summer program before the start of their freshman year.
  - o On-campus students take a computer skills for engineers class and pre-college math, physics and writing courses. Otherwise, students take an online Math course. The Admissions Office decides whether the student's summer experience will be on-campus or online; regardless of format, student participation in one or the other is required for admission to NYU-Poly in the fall.
- College survival skills course.
- Individualized tutoring and group review sessions.
- Individual and group advisement sessions.

ADVISEMENT

At weekly advisement meetings students discuss questions and concerns about the academic curriculum and general college-adjustment issues. Individual advisement sessions are a more personal continuation of the group meetings. Students meet with a General Studies staff member weekly to discuss a broad range of topics, including academic, financial and personal concerns.

FINANCIAL AID

General Studies students' financial-aid packages are based on the information entered on the Free Application for Federal Student Aid (FAFSA) form. Students are urged to complete the FAFSA forms as early as possible to get the best financial aid package.

COURSES

GS 101 Computer Skills for Engineers

This course focuses on the basic functions and intricacies of AutoCAD, MATLAB and/or Python, Microsoft Word, Excel, Project and PowerPoint. Course requirements: weekly lab assignments, a midterm and final exam, and an individual project synthesizing the course content.

GS 102 Pre-college Writing

This course prepares students for college-level writing. Class time includes reading and writing exercises, grammar quizzes and lessons and a close examination of student writing (workshops).

GS 103 Pre-college Math

This course prepares students for math at NYU-Poly. The math course taken over the summer will be determined by the results of the Math Assessment. Course requirements: daily participation, weekly quizzes, daily homework assignments and a midterm and final exam.

GS 106 Pre-college Physics

This course introduces the foundational concepts and laws of physics and their connection to the engineering disciplines. The subject matter helps students apply scientific methods to physical problems and prepares them for university-level physics. Topics include vectors, kinematics, Newton's Laws, work and energy, momentum and collision theory, rotational motion, and angular momentum. Course requirements: daily participation, weekly quizzes, daily homework and a midterm and final exam.

HIGHER EDUCATION OPPORTUNITY PROGRAM (HEOP)

The Higher Education Opportunity Program (HEOP) is funded by New York State to provide broad and varied educational instruction to capable students who, due to limited academic and financial resources, might otherwise not have the opportunity to attend NYU-Poly. Once admitted to the HEOP program, students receive financial assistance, counseling, tutoring, advisement and other support services throughout their college career. HEOP's goal is to retain and graduate students who are traditionally underrepresented in engineering and science.

ADMISSION AND APPLICATION PROCEDURES

To qualify for the program, applicants must be residents of New York State and demonstrate both academic and economic need. Applicants are referred by an admissions counselor, or may indicate on their application their interest in HEOP. Economic eligibility is determined by income guidelines issued by the New York State Education Department.

Since SAT scores and high school grades may not thoroughly reflect a student's potential for success at NYU-Poly, an interview with each applicant is an essential part of the HEOP admissions process. During the interview, the counselor will discuss the applicant's academic strengths and weaknesses and give a basic overview of what to expect at NYU-Poly.

TRANSFER STUDENTS

Students wishing to transfer into HEOP at NYU-Poly must have been in an opportunity program (HEOP, EOP, SEEK, etc.) at their previous institution. Each applicant must also complete a HEOP transfer application. Transfer applicants are considered based on their academics and individual circumstances. The HEOP Director reviews college transcript(s) and recommendations from counselors or professors, and a decision is sent to the Office of Admissions.

ACADEMIC SUPPORT SERVICES

To help students reach their full academic potential and succeed at NYU-Poly, HEOP provides freshmen and continuing students with academic support services.

These services include the following:

- A mandatory pre-freshman summer program, which includes courses in Pre-Calculus, Chemistry, Computer Science and Physics.
- A Study Skills course offered during the fall semester. Topics include time management, test-taking, note-taking and concentration techniques.
- Monthly group meetings and seminars.
- Individual and group tutoring sessions.
- Individual and group counseling.

COUNSELING

HEOP offers students one-on-one academic, financial, personal and career counseling. Group and individual counseling sessions are scheduled to assist students make the transition to college, as well as to maintain and manage their academic career at NYU-Poly.

FINANCIAL AID

HEOP students receive a financial aid package, including funding from HEOP, Tuition Assistance Program (TAP), PELL, Supplemental Educational Opportunity Grant (SEOG), NYU-Poly grants, College Work Study Program, Stafford Loans and other educational loans. It is important that students complete the Free Application for Student Aid (FAFSA) and the Tuition Assistant Program (TAP) applications as early as possible.

For further information, please visit the HEOP website at www.poly.edu/academics/support/heop, or call (718) 260-3370.

COURSES

CM 1 Pre-college Chemistry *3:0:NC*

The course covers mole concept and stoichiometry, gaseous molecular behavior, gas law equilibrium and Le Chatelaine's principle.

HE 1 Study Skills *1:0:NC*

This skills workshop prepares students for the academic and social challenges of college. Workshop topics include self-exploration and development of skills, such as taking notes, preparing for examinations and evaluating academic goals. This course is offered only in the fall semester.

MA 1 Pre-college Math *3:0:NC*

This coursed reviews trigonometry, quadratic and absolute value questions and inequalities, limits and differentiation of both algebraic and trigonometric functions.

CS 1 Pre-college Computer Science *3:0:NC*

This is an introductory course in engineering problem solving and computer programming for all undergraduate HEOP freshmen without experience in programming in any languages. The course covers the fundamentals of computer programming and its underlying principles and uses the MATLAB programming language.

PH 1 Pre-college Physics *3:0:NC*

This course introduces the foundational concepts and laws of physics and their connection to the engineering disciplines. The subject matter helps students apply scientific methods to physical problems and prepares them for physics at the university level. Topics include vectors, kinematics, Newton's Laws, work and energy, momentum and collision theory, rotational motion, and angular momentum.

HONORS PROGRAM

The NYU-Poly Honors Program offers students of exceptional promise and talent an enriched educational experience that extends beyond the traditional classroom environment. Learning takes place in a collaborative manner, where students are encouraged to critically reflect on their coursework by dialoging with the various constituencies at the Institute. The program offers a superior educational experience by fostering critical thinking and creativity. The program's depth and breadth are comprehensive, rigorous and individualized. Students will enroll in honors courses taught by outstanding faculty and engage in undergraduate research and benefit from presentations by renowned faculty, inventors, innovators and entrepreneurs.

Rigorous intellectual development through active learning and faculty mentoring combine with an interdisciplinary focus and global awareness that prepares students to become leaders in engineering, science, technology and entrepreneurship. As rising scholars, Honors students are a highly enthusiastic and prominent part of the University's alumni population and enhance the overall reputation of the University for delivering excellence in education. As such, Honors Program students are awarded an additional scholarship.

ADMISSION AND APPLICATION PROCEDURES

The Honors Program has a referral-only admissions process. Selected individuals who are admitted to NYU-Poly as first-year students will be referred to the Honors Program by the Admissions Office. Those students referred to the Honors Program will then be asked to complete a short application and personal statement. Applications are reviewed by the Honors Program Admissions Committee. Preference is given to students with outstanding high school GPA and SAT scores; however, files are reviewed in a comprehensive manner and other important criteria are given serious consideration. Among these are the difficulty of course work (AP courses), written submissions such as the personal statement, receipt of prizes and awards, leadership positions, participation in academic clubs, and evidence of self-discipline and persistence as confirmed in the letters of recommendation. Some applicants will be asked to participate in an interview with a member of the Honors Program Admissions Committee.

Students who were not referred to the Honors Program during their initial application to NYU-Poly are not eligible for the Honors Program; there is no transferring into the program. Additionally, transfer students are not eligible for the Honors Program.

REQUIREMENTS

Students admitted to the Honors Program are required to satisfy the following requirements to remain in the program and to retain the honors portion of their scholarship:

1. Enroll in required honors-level courses for their degree. Under rare circumstances and subject to approval by the Honors Program director, students may enroll in a non-honors section of a course such as when the honors section of a course is not offered, or when an honors section conflicts with a departmental required course.

2. Maintain a minimum required cumulative Grade Point Average (GPA) each academic year as follows:
   - *Freshman - 3.5*
   - *Sophomore - 3.5*
   - *Junior - 3.4*
   - *Senior - 3.4*

3. Earn the following specified amounts of credits by the end of each academic year:
   - *Freshman - 32*
   - *Sophomore - 64*
   - *Junior - 96*
   - *Senior - 128*

At the end of each semester, the Honors Program will review each student's academic record. If the student's cumulative GPA and/or credit amount is below the minimum required as outlined above, the student is placed on one-semester probation to improve their academic standing. If the student's cumulative GPA and/or credit amount is still below minimum requirements after the one-semester probationary period, the student will be dismissed from the Honors Program.

To graduate with the "Graduate of the Honors Program" designation,* students must fulfill the BS requirements of the Honors Program. This condition generally requires satisfactory completion of at least three credits of BS thesis in the student's major. Students must submit a bound BS thesis to the Office of Undergraduate Academics, no later than two weeks before graduation, formatted as outlined in the document entitled: "Regulations on Format, Duplication & Publication of Reports, Theses & Dissertations," available in the Office of Undergraduate Academics.

FINANCIAL AID

Students granted admission to the Honors Program receive an Honors Scholarship, allocated in varying amounts. Students must complete the Free Application for Student Aid (FAFSA) to be eligible for other forms of financial aid.

COURSES

Honors Program students take Honors-level courses in their first and second years. These courses cover the material of the typical courses in more breadth and depth and may include different assignments. Honors courses and special sections of courses are typically offered for the following (see the appropriate departmental sections of the catalog for course descriptions):

- CM 1004H
- EG 1003
- EN 1013W
- EN 1203W
- PH 1013H
- PH 2021H
- PH 2023H
- PH 2031H
- PH 2033H
- MA 1024
- MA 1124
- MA 2012
- MA 2132
- MA 2112
- MA 2122

* Students who do not graduate from the Honors Program are still eligible to graduate with Latin Honors (*Cum Laude, Magna Cum Laude* and *Summa Cum Laude* designations) as outlined in the Undergraduate Academic Programs and Policies section of the catalog.

CENTER FOR K-12 STEM EDUCATION

The Center was launched in March 2011 and represents a new approach to early grade and pre-college science, technology, engineering and mathematics (STEM) teaching and learning at the Polytechnic Institute of NYU. The Center builds on several very strong programs already at NYU-Poly that improve student outcomes; these programs provide high-quality professional development in STEM disciplines to K-12 science and mathematics teachers. NYU-Poly's programs further mentor teachers and K-12 students in STEM disciplines through NYU-Poly's human resources of faculty, administrators and students, its physical resources of laboratories and classrooms and Institute initiatives that expose young people to the creative, exciting and academically challenging world of science.

Students that participate in NYU-Poly's K-12 programs gain analytical skills and knowledge by engaging in scientific inquiry, an excitement about the personal possibilities educational attainment provides and a deep appreciation for the inherent creativity embedded in all kinds of scientific and academic pursuits. Achieving these goals puts students on the path to school completion, higher education and economic and social advancement.

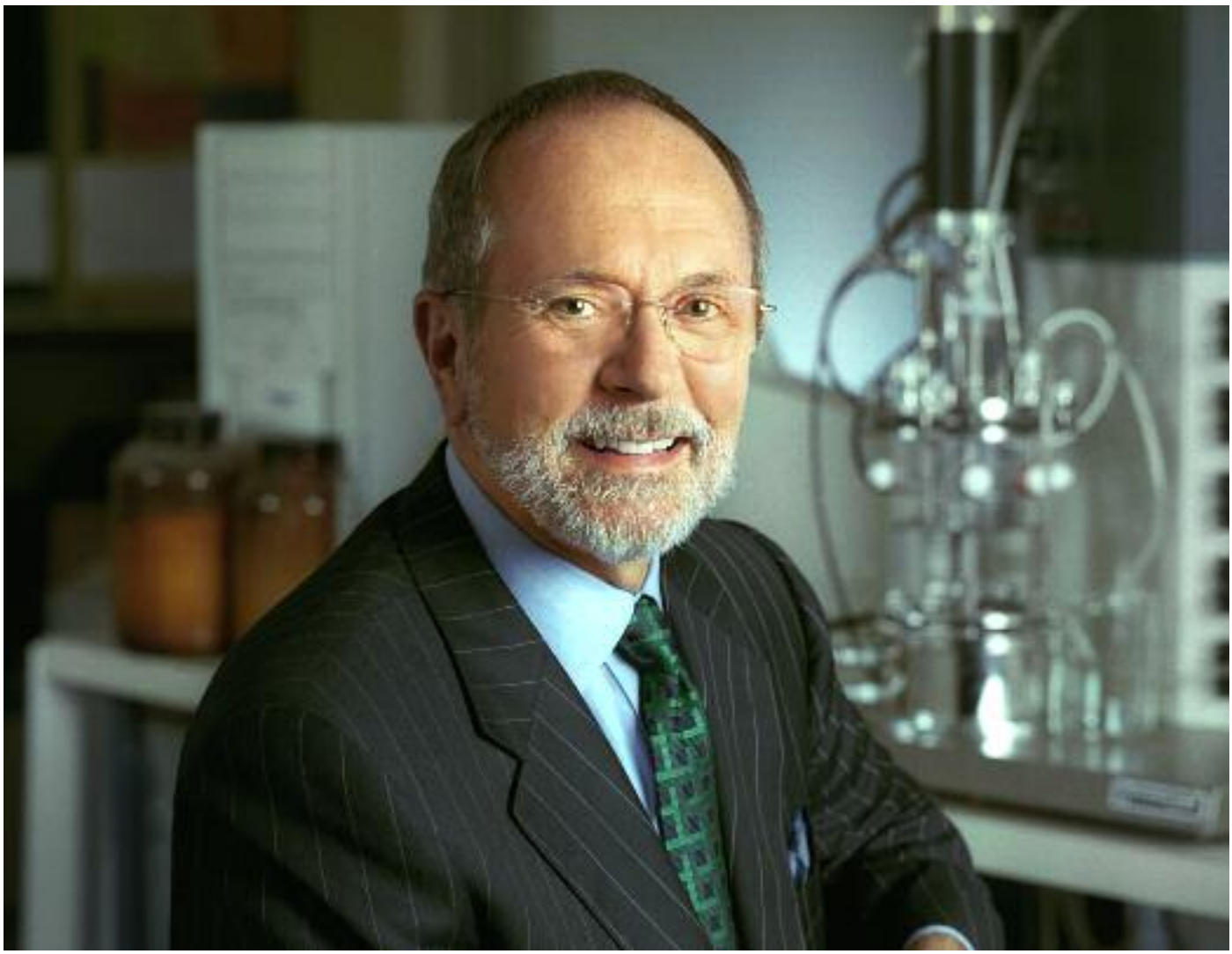
While focused on those groups of students traditionally underrepresented in STEM disciplines and careers and those who teach those students, the Center has a broad reach throughout K-12 schools and systems. The Center's overall objective - to transfer STEM knowledge and the excitement inherent in the pursuit of scientific discovery and innovation from NYU-Poly's faculty and students to K-12 teachers and learners - is met in a variety of settings and through a diversity of means designed to instill inspiration and motivation.

Drawing heavily on the i^2e principle guiding the Institute's growth and development, the Center for K-12 STEM Education creates, pilots, evaluates and scale models programs that advance student learning. It seeks not only to incorporate invention, innovation and entrepreneurship in its K-12 STEM education models, but also incorporates these values in the Center itself. The Center is designed to be entrepreneurial in creating and seizing opportunities, engaging interested people in its work, and is organized to be flexible, responsive, transparent and accountable for results. It is strategic in its decision-making, has the confidence to make mistakes and test ideas and is nimble enough to change models as evidence and data dictate.

There are many existing models and involved faculty and students at NYU-Poly, as well as elsewhere throughout the nation, upon which the Center for K-12 STEM Education is grounded. The Youth in Engineering and Science (YES) Center as well as the work of the former David Packard Center will combine with the Center's model programs which will reside at the nexus of hands-on-science, evidence-based practice in teaching and learning, and research that enhance the field of K-12 STEM education. Working with faculty, the Center develops and reengineers initiatives to enhance the K-12 experience such as summer research opportunities, sophisticated professional development models for K-12 teachers, in-depth engagement with science and scientists for students in classroom and after-school settings, the use of technology in STEM education and others yet to be conceived.

PART 5

THE BOARD OF TRUSTEES
THE ADMINISTRATION



THE BOARD OF TRUSTEES

Chairman
Ralph C. Alexander, Managing Director, Riverstone Holdings LLC

Vice Chairman
Jeffrey H. Lynford, Co-Managing Director, Wellsford Strategic Partners LLC

Secretary/Treasurer
Patrick A. Garzillo, VP-Service Costs (ret.), Verizon

President
Jerry M. Hultin, President, Polytechnic Institute of NYU

MEMBERSHIP TRUSTEES

Walter C. Bell, *Consultant*

Daniel H. Berry, *Chief Executive Officer NDS Surgical Imaging*

Bonnie Brier *(ex-officio), Sr. Vice President, General Counsel & Secretary, NYU*

Aviva D. Budd, *Esq., Aviva Realty*

Mario W. Cardullo, *Managing Director, The Belfield Group*

Gerald W. Dawes, *Director, Government Liaison, Consolidated Edison of NY, Inc*

Richard Fishbein, *Partner Emeritus, Cortec Group, Inc.*

Randy W. Frey, *Chief Executive Officer, LensAR, Inc.*

William L. Friend, *Former Treasurer, National Academy of Eng.*

Leila Heckman, *Sr. Managing Director & Head of International Equity, Mesirow Financial*

Charles J. Hinkaty, *President & CEO (ret.), Del Laboratories, Inc.*

Paul M. Horn, *Sr. Vice Provost for Research & Distinguished Scientist in Residence, NYU*

Linda K. Jacobs, *Trustee Emerita*

Michael H. Kappaz, *Chairman & CEO, K & M Engineering and Consulting Corp.*

Lawrence W. Katz, *Advisor, Katz Family Financial Adv.*

John R. Kirksey, *President & CEO, National Multicultural Institute*

William K. Kramer, *Partner (ret.), SJ Realty Associates LLC*

Craig G. Matthews, *Vice Chairman & COO (ret.), KeySpan*

David McLaughlin *(ex-officio), Provost, NYU*

Mark H. Ronald, *Chairman (ret.), BAE Systems, Inc.*

John P. Schaefer, *President, LSST Corporation*

John Sexton *(ex-officio), President, NYU*

James M. Smith, *Chairman, President & CEO (ret.), EDO Corporation*

Joseph S. Steinberg, *President, Leucadia National Corp.*

Rudolph L. Wynter, *Sr. Vice President, Customer & Markets, National Grid*

THE ADMINISTRATION

OFFICE OF THE PRESIDENT

Jerry MacArthur Hultin, JD
President

E. Dianne Rekow, DDS, PhD
Provost

Ji Mi Choi, MS
Chief of Staff/Vice President of Strategic Initiatives

Dennis Dintino, BA
Vice President, Finance and Administration/Business Affairs

Barbara Noseworthy, BS
Vice President, Development and Alumni Relations

Richard S. Thorsen, PhD
Vice President Emeritus/Senior Advisor to the President

Robert N. Ubell, BA
Vice President, Enterprise Learning

David C. Chang, PhD
Chancellor

PROVOST'S OFFICE

E. Dianne Rekow, DDS, PhD
Provost

Bethany Jankunis, JD, MSW
Chief of Staff to Provost

Kurt Becker, PhD
Associate Provost, Research and PhD Programs

Mary Cowman, PhD
Associate Provost for Programs, Planning and Development

Barbara Hall, BA
Associate Provost, Enrollment Services

Iraj M. Kalkhoran, PhD
Associate Provost, Undergraduate Academics

Walter Zurawsky, PhD
Associate Provost, Graduate Academics

Joy Colelli, MS
Dean, Admissions and New Student Services

Jana Richman, MS
Director, Library Services

ACADEMIC DEPARTMENTS

Lorcan M. Folan, PhD
Head, Applied Physics

Walter Zurawsky, PhD
Head, Chemical and Biological Engineering

Bruce Garetz, PhD
Head, Chemical and Biological Sciences

Lawrence Chiarelli, JD
Head, Civil Engineering

Keith Ross, PhD
Head, Computer Science and Engineering

H. Jonathan Chao, PhD
Head, Electrical and Computer Engineering

Charles Tapiero, PhD
Head, Finance and Risk Engineering

Erwin Lutwak, PhD
Head, Mathematics

George Vradis, PhD
Head, Mechanical and Aerospace Engineering

Kristen Day, PhD
Head, Technology, Culture and Society

Bharat Rao, PhD
Head, Technology Management

DIVISION OF STUDENT AFFAIRS

Anita Farrington, MA
Dean, Student Affairs

Daniel Aniello, BA
Director, Residence Life

Suraiya Baluch, PhD
Team Leader, Counseling and Psychological Services

Maureen Braziel, MS
Director, Athletics

Michael Gendel, MA
Director, International Student and Scholars

James Sillcox, MA
Director, Career Management

OFFICES OF THE INSTITUTE

Eizabeth Kienle-Granzo, MA
Registrar

Haang Fung, MS
Associate Dean, Undergraduate Academics

Melissa Barnes, PhD
Director, General Studies

Michael Campbell, MA
Director, Undergraduate Academic Affairs

Frank Cassara, ADD, PhD
Director, Long Island Graduate Center

Ben Esner, BA
Director, K-12 STEM Education

Yona Jean-Pierre, MS
Director, Center for Faculty Innovations in Teaching and Learning

Nicole L. Johnson, MS, MBA
Director, Special Services

Ardis Kadiu, MS
Director, Web and Media Services

Michael Mainiero, MEd
Director, Assessment and Institutional Research

Alison Mann, MA
Director, Polytechnic Tutoring Center

Melinda Parham, MSW
Director, Freshman Programs

Jana Richman, MS
Director, Library Services

Teresina Tam, MS
Director, Higher Education Opportunity Program (HEOP)

Christine Villani, BS, CMFO
Director, Sponsored Research

OFFICE OF MARKETING AND COMMUNICATIONS

Kathleen Hamilton, BS
Director, Marketing

Ardis Kadiu, MS
Director, Web and Media Services

Michelle Kerr, BA
Director, Communications

OFFICE OF DEVELOPMENT AND ALUMNI RELATIONS

Barbara Noseworthy, BS
Vice President, Development and Alumni Relations

Anthony Kapp, MS
Director, Alumni Relations

Melissa Lloyd, MA
Director, Advancement Services

Erica Marks, MA
Director, Development

Jennifer Cho, AB
Senior Development Officer

Amy Lei, MPA
Major Gifts Officer

OFFICE OF FINANCE AND ADMINISTRATION

Dennis Dintino, BA
Vice President, Finance and Administration/Business Affairs

Annie Carino
Director, Facilities Management

Suong Ives, SPHR, MS
Director, Human Resources

Christine Villani, BS, CMFO
Director, Sponsored Research

OFFICERS OF THE POLYTECHNIC INSTITUTE OF NEW YORK UNIVERSITY ALUMNI (2009–2010)

Christine Ianuzzi ’87 ’94
President

George Likourezos ’92 ’92
Immediate Past President

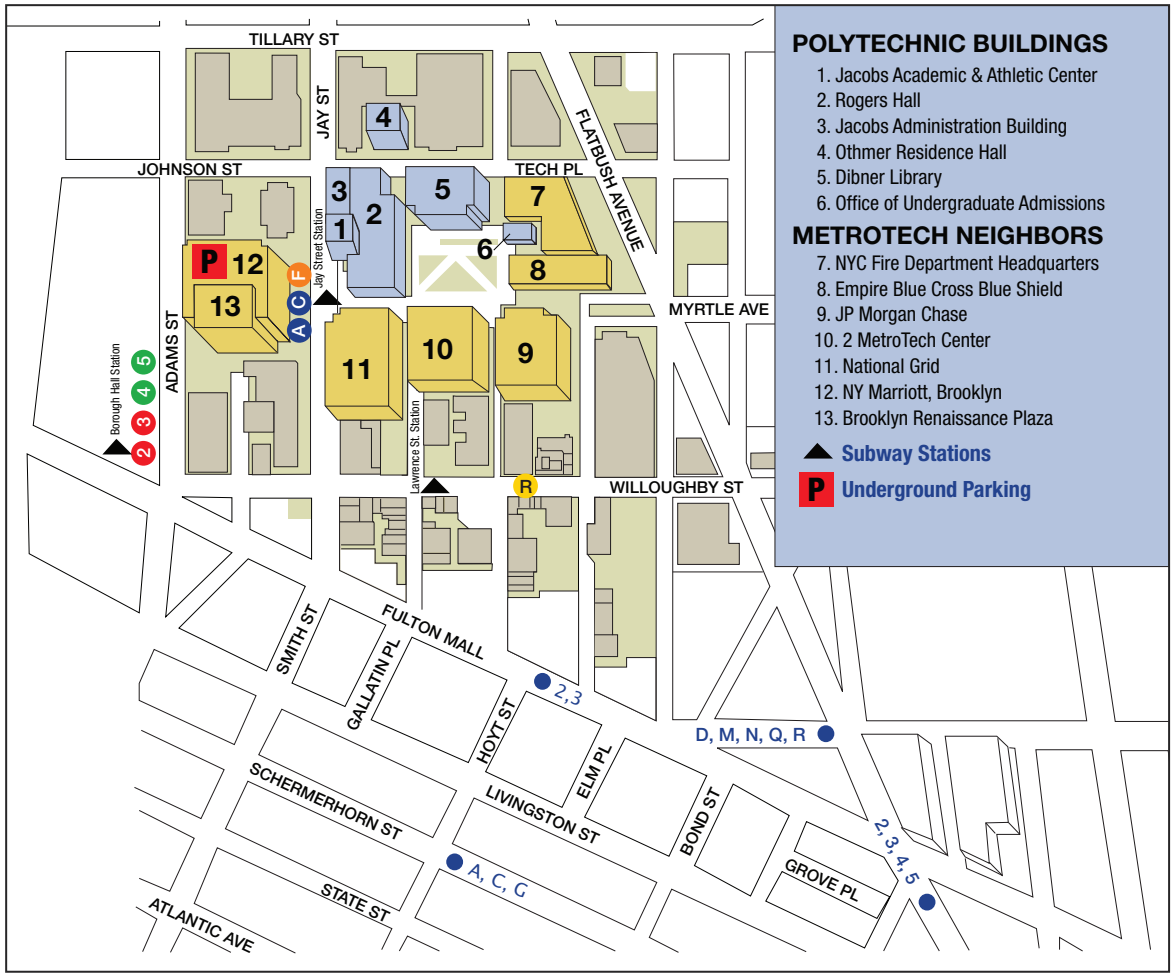
Josiane Arbouet ’96 ’99
Executive Vice President

Gerald Dawes
Vice President

Michael A. Urmeneta ’92 ’00
Treasurer

Christopher Clinton ’09
Secretary

BROOKLYN CAMPUS



By Subway from all Boroughs:
A, C or F train to Jay Street-Borough Hall; or the 1, 2, 4 or 5 subway to Borough Hall (walk to Fulton Street and make a left onto Jay Street); or the R or M to Lawrence Street.

By Car from Manhattan:
Take the FDR Drive to the Brooklyn Bridge. Make the first left after the bridge onto Tillary Street and a right onto Jay Street.

By Car from Queens or the Bronx:
Take the Brooklyn-Queens Expressway to Tillary Street and then left onto Jay Street.

By Car from Staten Island:
Take the Verrazano Narrows Bridge to the Brooklyn-Queens Expressway to the Tillary Street exit. Make a left onto Jay Street.

By Car from New Jersey:
From the George Washington Bridge, take the Harlem River Drive to the FDR Drive or Holland Tunnel to Brooklyn Bridge. (Continue as from Manhattan)

By Train from Brooklyn or Long Island:
Take the Long Island Rail Road to Atlantic Avenue (last stop in Brooklyn). Then take a taxi or Bus #B67 to MetroTech on Jay Street, or the R or M subway to Lawrence Street. It's about a one-mile walk from the LIRR station: go to the Fulton Mall and make a left, then a right onto Jay Street.

By Car from Brooklyn or Long Island:
Take the Brooklyn-Queens Expressway to the Tillary Street exit. Go left onto Jay Street.

By Car from Westchester:
Take the Major Deegan or Cross Bronx Expwy. to FDR Drive to Brooklyn Bridge or the Triborough, Whitestone or Throgs Neck Bridge to Brooklyn-Queens Expwy. to Tillary St. From there take a left onto Jay St.

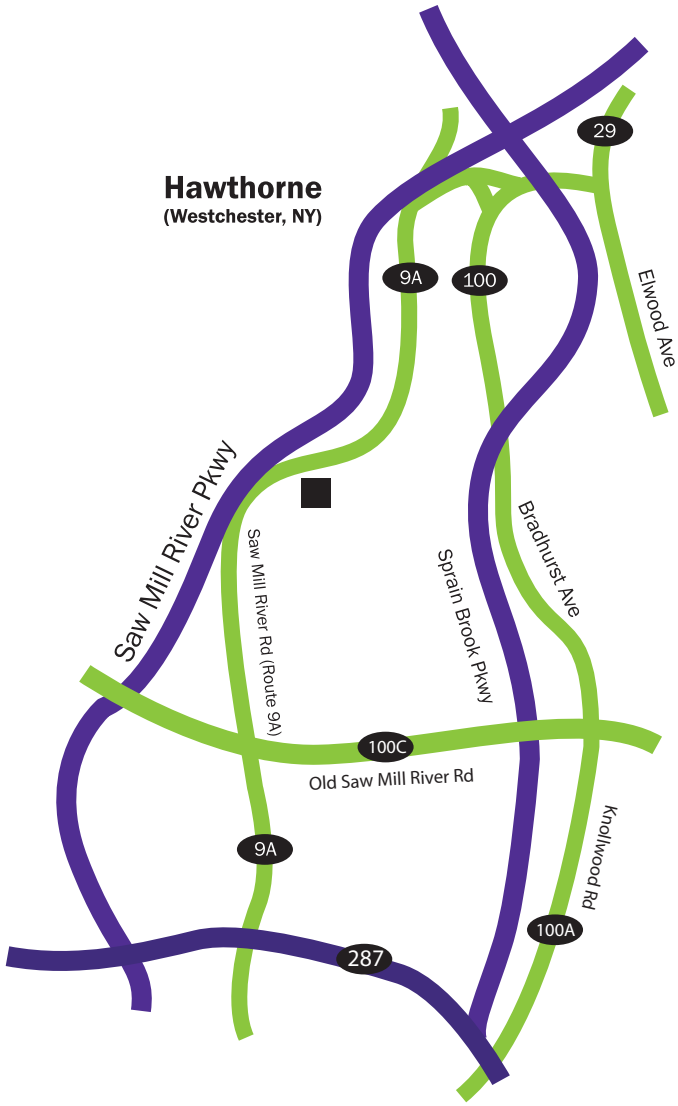
PUBLIC PARKING is available at the Marriott Hotel

LONG ISLAND GRADUATE CENTER

From New York City & Long Island:
Take the Long Island Expressway (I-495) East to exit 49S (Rt. 110 S/Amityville). Merge onto the S. Service Rd. and turn right onto NY-110 S. (approximately half a mile). Turn left onto Baylis Rd. (approximately half a mile). Turn left onto Maxess Rd. (The Long Island Graduate Center is on the right within 150 yards. Enter through North entrance of 105 Maxess Road).

From Westchester:
Take the Hutchison River Parkway South to the I-95 S/Stillwell Ave exit. Keep right at the fork in the ramp. Merge onto New England Thruway. New England Thruway becomes Bruckner Expressway. Take the I-695 Exit 7A (on the left) toward I-295/Throgs Neck Bridge/Long Island. Merge onto Throgs Neck Expressway. Take I-695 S. I-695 S becomes Throgs Neck Expressway. Throgs Neck Expressway becomes I-295 S. Take the Cross Island Parkway exit toward Eastern Long Island. Merge onto Cross Island Parkway S. Take I-495/Long Island Expressway exit 30 toward Eastern Long Island. Merge onto Long Island Expressway. Take Exit 49S toward NY Route 110 S/Amityville. Merge onto South Service Road and cross over New York Route 110. Drive approximately one-half mile to Maxess Road and turn right. The Long Island Graduate Center is at 105 Maxess Road, Suite 201N, inside the Melville Corporate Center. Enter through the north entrance at the rear of the building.

WESTCHESTER GRADUATE CENTER



From New York City: Take New York 9A / West Side Highway to Saw Mill River Parkway North. Or I-278 to the Triborogh Bridge to I-87 North, exit at I-287 East to Saw Mill River Parkway North (Exit 1). Travel north on Saw Mill River Parkway for 3 miles after the interchange for I-287 to Exit 25 for Hawthorne (Route 9A). Turn left at light onto Route 9A northbound. Polytechnic Institute is on the right side of road.

From New Jersey and Downstate New York: Take I-87 South (New York State Thruway) to the Tappan Zee Bridge. After the bridge, take I-287 East to Saw Mill River Parkway North (Exit 1). Travel north 3 miles to Exit 25 for Hawthorne (Route 9A). Turn left at light on to Route 9A northbound. Polytechnic is on the right side of road.

From Northern Westchester and the Hudson Valley: Take the Taconic State Parkway South or Saw Mill River Parkway South to the Sprain Brook Parkway. Exit at Route 100C. Make a right onto Route 100C westbound and travel 3/4 mile to Route 9A North, entrance on right. Travel north on Route 9A for 2 miles. Polytechnic is on the right.

From Connecticut and Southern Westchester: : Take I-95 to I-287 West (Cross Westchester Expressway) to Route 9A (Exit 2) North. Travel north 3 miles. Polytechnic is on the right.

INSTITUTE POLICIES

Polytechnic Institute of NYU complies with the laws, regulations and orders that provide for and impose obligations on employers with respect to the management of their equal employment opportunity and affirmative action programs.

Accordingly, Polytechnic Institute of NYU will conduct its business and practices in a manner that fully complies with and supports Presidential Executive Order 11246, as amended. The Institute prohibits discrimination against any employee or applicant for employment based on race, color, religion, sex, national origin, age, disability, sexual orientation, marital status, genetic predisposition or carrier status, military status, veteran status including disabled veterans, veterans of the Vietnam era, recently separated veterans, other protected veterans, and Armed Forces service medal veterans, or any other status protected by law. The Institute takes affirmative action to employ, advance in employment and otherwise treat qualified individuals without discrimination based on their status as required by Executive Order 11246, as amended.

Inquiries about the above policies may be directed to the Office of Affirmative Action, Polytechnic Institute, Six MetroTech Center, Brooklyn, New York 11201.

The Institute is authorized under federal law to enroll nonimmigrant alien students.

This catalog is not intended to be, and should not be regarded as, a contract between Polytechnic Institute and any student or other person.

i2e