

# CONTENTS

## **PART I—GENERAL AND INSTITUTIONAL INFORMATION.....5**

Administrative Offices.....	6
Academic Calendar .....	10
Polytechnic University Profile .....	11
Academic Programs and Policies .....	17
Campus Life and Supporting Services .....	25
Admissions .....	31
Financial Aid .....	35
Registration.....	42
Tuition and Fees .....	43
Placement Statistics.....	45
Statistics on Enrollment and the Student Body .....	46
Degrees Offered at Polytechnic .....	47
Academic Departments and Degrees.....	48
University Degree Requirements .....	49

## **PART II—ACADEMIC DEPARTMENTS AND PROGRAMS, DEGREE REQUIREMENTS AND CURRICULA ...55**

A Brief Guide to Course Descriptions.....	57
Department of Chemical Engineering, Chemistry and Materials Science .....	58
Chemical Engineering Program.....	61
Chemistry Program .....	67
Environmental Science Program.....	77
Polymer Science and Engineering Program .....	79
Department of Civil and Environmental Engineering.....	81
Civil Engineering Program .....	84
Environmental Engineering and Environmental Science Programs .....	97
Transportation Program .....	101
Department of Computer and Information Science .....	107
Computer Science Program .....	110
Information Management Program.....	121
Information Systems Engineering Program .....	124
Telecommunication Networks Program .....	126
Department of Electrical Engineering .....	127
Computer Engineering Program .....	131
Electrical Engineering Program.....	136
Electrophysics Program .....	158
Systems Engineering Program.....	159
Telecommunication Networks Program .....	160
Department of Humanities and Social Sciences.....	161

Environment–Behavior Studies Program.....	164
History of Science Program .....	167
Humanities Program .....	169
Technical and Professional Communication Program ..	173
Social Sciences Program .....	184
Department of Management .....	192
Financial Engineering Program .....	197
Management Program .....	203
Management of Technology Executive Program .....	211
Organizational Behavior Program .....	216
Telecommunications and Information Management Executive Program.....	218
Department of Mathematics.....	223
Mathematics Program .....	225
Department of Mechanical, Aerospace and Manufacturing Engineering .....	233
Aerospace Engineering Program .....	236
Industrial Engineering Program.....	241
Manufacturing Engineering Program .....	245
Materials Science Program .....	249
Mechanical Engineering Program .....	253
General Engineering Program .....	263
Physics Program.....	265

## **PART III—SPECIAL PROGRAMS.....274**

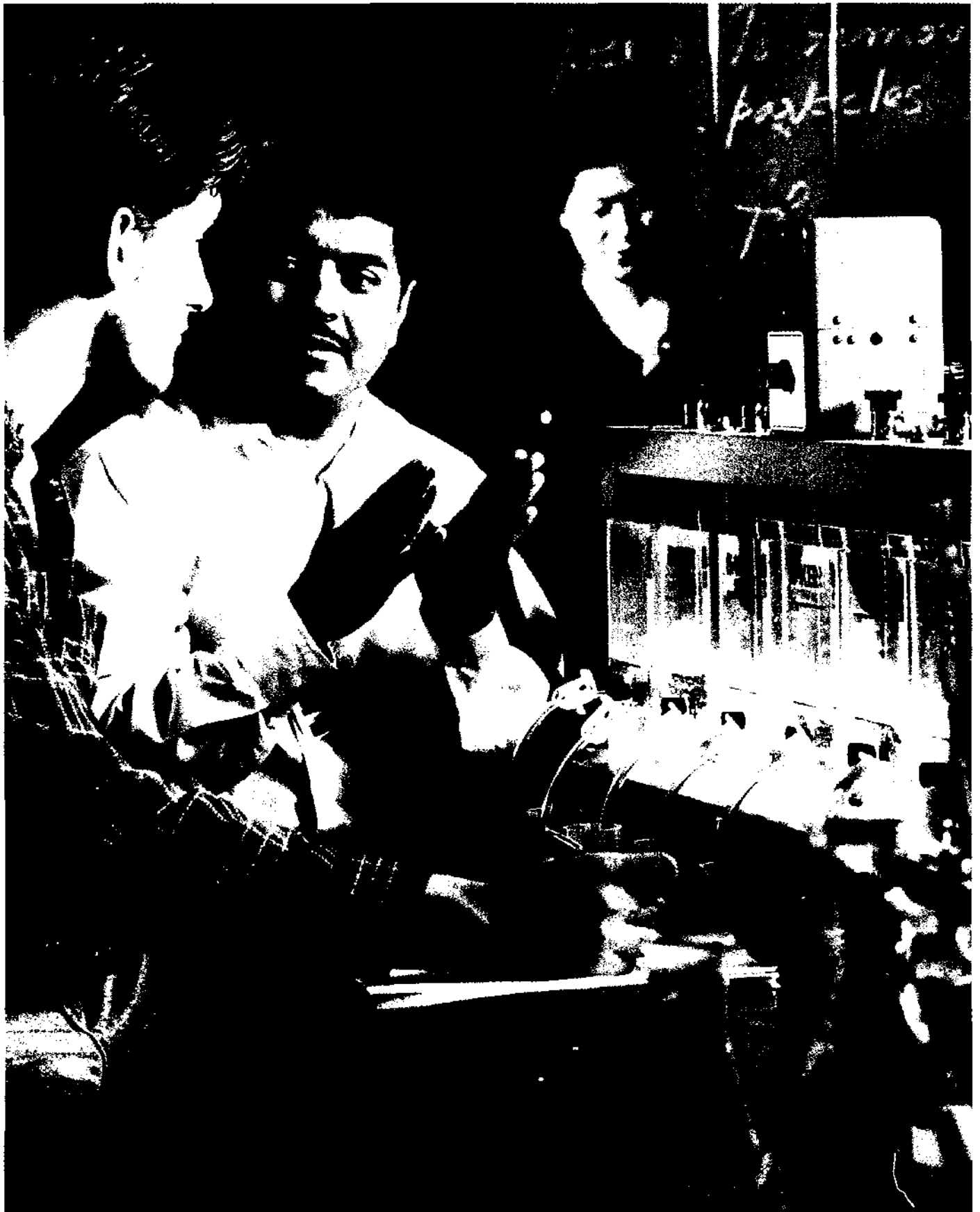
Cooperative Education Program .....	275
Higher Education Opportunity Program (HEOP).....	277
Physical Education and Athletics.....	279
The YES Center .....	280
The David Packard Center for Technology and Educational Alliances.....	282

## **PART IV—THE CORPORATION THE ADMINISTRATION THE FACULTY .....283**

The Corporation .....	284
The Administration .....	285
The Faculty.....	287

## **ROUTES TO POLYTECHNIC .....291**

## **INDEX.....294**



# PART I

## GENERAL AND INSTITUTIONAL INFORMATION



The Polytechnic University Catalog is an official publication of the University. The catalog provides information about academic programs and is intended to provide a helpful summary of University 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 catalog that is as complete and as accurate as possible, but requirements, deadlines, tuition, fees, curricula, courses and staffing are subject to change at any time without advance notice or obligation. This catalog was prepared well in advance of its effective date; therefore some course descriptions may vary from actual course content due to advancements in the discipline, interests of individual instructors, or decisions of the faculty to change the scope and/or content of the course. The *Schedule of Classes* supplements this catalog and is issued for each semester and summer sessions. It includes updated information about course offerings, tuition, fees, registration and academic procedures.

# ADMINISTRATIVE OFFICES

## EXECUTIVE OFFICES

### Office of the President

Room 555, Jacobs Bldg.  
Tel: 718/260-3500  
Fax: 718/260-3755  
E-mail: chang@poly.edu

### Office of the Chancellor

Room 551D, Jacobs Bldg.  
Tel: 718/260-3330  
Fax: 718/260-3974  
E-mail: gbugliar@poly.edu

### Office of the Provost

Room 555, Jacobs Bldg.  
Tel: 718/260-3990  
Fax: 718/260-3755  
E-mail: ifrisch@poly.edu

### Office of Finance & Administration

Room 555, Jacobs Bldg.  
Tel: 718/260-3770  
Fax: 718/260-3755  
E-mail: gsmith@poly.edu

### Office of Student Affairs

Room 356, Jacobs Bldg.  
Tel: 718/260-3137  
Fax: 718/260-3197  
E-mail: chartiga@poly.edu

### Office of Academic Affairs

Room 217, Rogers Hall  
Tel: 718/260-3550  
Fax: 718/260-3063  
E-mail: bmcsbane@poly.edu

### Office of Development and University Relations

Room 555, Jacobs Bldg.  
Tel: 718/260-3880  
Fax: 718/260-3755  
E-mail: rhorsen@poly.edu

## ADMISSIONS

### Graduate Admissions

All campus general information  
Tel: 718/260-3200  
Fax: 718/260-3136  
E-mail: admngb@poly.edu  
Hours: Monday & Thursday, 9AM-6PM  
Tuesday, Wednesday, Friday, 9AM-5PM

### Undergraduate Admissions

#### Brooklyn Campus

Room 158, Jacobs Bldg.  
Tel: 718/260-3100  
Fax: 718/260-3136  
E-mail: admitme@poly.edu  
Hours: Monday & Thursday, 9AM-6PM  
Tuesday, Wednesday, Friday, 9AM-5PM

#### Long Island Campus

Room A105, Bassett Bldg.  
Tel: 516/755-4200  
Fax: 516/755-4229  
E-mail: admitme@poly.edu  
Hours: Monday & Thursday, 9AM-6PM  
Tuesday, Wednesday, Friday, 9AM-5PM

#### Westchester Graduate Center

Administration Bldg.  
Tel: 914/323-2000  
Fax: 914/323-2010  
E-mail: westinfo@west.poly.edu  
Executive Programs  
Tel: 914/323-2023  
Hours: Monday-Thursday, 9AM-8PM  
Friday, 9AM-5PM

## ALUMNI RELATIONS

### All Campuses

Room 468, Jacobs Bldg.  
Tel: 1-800-FON-POLY  
Fax: 718/260-3114  
E-mail: lbowie@poly.edu  
Hours: Monday-Friday, 9AM-5PM

## ATHLETICS

### Brooklyn Campus

Goldsmith Student Activities  
Union/Wunsch Hall  
Fitness Center  
Tel: 718/637-5900  
Fax: 718/637-5959  
E-mail: mbraziel@poly.edu  
Office: Monday & Thursday, 9AM-6PM  
Tuesday, Wednesday, Friday, 9AM-5PM  
Fitness Center:  
Monday-Thursday, 9AM-8PM  
Friday, 9AM-5PM

### Long Island Campus

Gymnasium  
Tel: 516/755-4287  
Hours: Monday-Thursday, 9AM-Midnight  
Friday, 9AM-6PM  
Saturday, 12PM-6PM  
Sunday, 12PM-Midnight

**BOOKSTORE**

**Brooklyn Campus**

1st Floor Rogers Hall  
Tel: 718/260-3778, 3882  
Fax: 718/246-4166  
E-mail: nybooks@aol.com  
Hours: Monday–Thursday, 8AM–7PM  
Friday, 8AM–5PM

**Long Island Campus**

1st Floor Bassett Bldg.  
Tel: 516/755-4367  
Fax: 516/694-8915  
Hours: Monday–Friday, 9AM–3PM

**Westchester Graduate Center**

Administration Office  
Tel: 914/323-2000  
Fax: 914/323-2010  
E-mail: westinfo@west.poly.edu  
Hours: Monday–Friday, 9AM–5PM

**BUDGET OFFICE**

**All Campuses**

Room 452, Jacobs Bldg.  
Tel: 718/260-3089  
Fax: 718/260-3202  
E-mail: jmcgrisk@poly.edu  
Hours: Monday–Friday, 9AM–5PM

**CAFETERIA**

**Brooklyn Campus**

Metro Café @ Poly  
1st Floor, Rogers Hall  
Tel: 718/260-3271  
Hours: Monday–Thursday, 7AM–8:30PM  
Friday, 7AM–4PM

**Long Island Campus**

Weeping Willow Cafeteria  
1st Floor, Main Building  
Tel: 516/755-4337  
Hours: Monday–Thursday, 7:30AM–8:30PM  
Friday, 7:30AM–6PM  
Saturday & Sunday, 10AM–6PM

**CAREER SERVICES/COOPERATIVE EDUCATION**

**Brooklyn Campus**

Room 359, Jacobs Bldg.  
Tel: 718/260-3650  
Fax: 718/260-3325  
E-mail: dgillett@poly.edu  
Hours: Monday & Thursday, 9AM–6PM  
Tuesday, Wednesday, Friday, 9AM–5PM

**Long Island Campus**

Room 118, Main Bldg.  
Tel: 516/755-4270  
Fax: 516/755-4697  
E-mail: jgiord@poly.edu  
Hours: Monday & Thursday, 9AM–6PM  
Tuesday, Wednesday, Friday, 9AM–5PM

**DAVID PACKARD CENTER FOR TECHNOLOGY AND EDUCATIONAL ALLIANCES**

**All Campuses**

Room 358, Jacobs Bldg.  
Tel: 718/260-3524  
Fax: 718/260-3733  
E-mail: nkrift@poly.edu  
Hours: Monday–Friday, 9AM–5PM

**FACILITIES**

**Brooklyn Campus**

Room 100, Rogers Hall  
Tel: 718/260-3020  
Fax: 718/260-3136  
E-mail: acarino@poly.edu  
Hours: Monday–Friday, 8AM–5PM

**Long Island Campus**

Administration Office  
Tel: 516/755-4300  
Fax: 516/755-4404  
E-mail: jqinn@poly.edu  
Hours: Monday–Friday, 9AM–5PM

**FINANCIAL AID**

**Brooklyn Campus**

Room 256, Jacobs Bldg.  
Tel: 718/260-3300  
Fax: 718/260-3052  
E-mail: vlukas@poly.edu  
Hours: Monday & Thursday, 9AM–6PM  
Tuesday, Wednesday, Friday, 9AM–5PM

**Long Island Campus**

Room 121, Main Bldg.  
Tel: 516/755-4345  
Fax: 516/755-4404  
E-mail: ggee@poly.edu  
Hours: Monday & Thursday, 9AM–6PM  
Tuesday, Wednesday, Friday, 9AM–5PM

**Westchester Graduate Center**

Administration Office  
Tel: 914/323-2000  
Fax: 914/323-2010  
E-mail: westinfo@west.poly.edu  
Hours: Monday–Friday, 9AM–5PM

## ADMINISTRATIVE OFFICES

### FINANCIAL OPERATIONS

#### All Campuses

Room 454, Jacobs Bldg.

Tel: 718/260-3750

Fax: 718/260-3752

E-mail: rbarnick@poly.edu

Hours: Monday–Friday, 9AM–5PM

### HUMAN RESOURCES

#### All Campuses

Room 104, Rogers Hall

Tel: 718/260-3840

Fax: 718/260-3981

E-mail: ekilcomm@poly.edu

Hours: Monday–Friday, 9AM–5PM

### INTERNATIONAL

#### STUDENT OFFICE

#### All Campuses

Room 158, Jacobs Bldg.

Tel: 718/260-3805

Fax: 718/260-3446

E-mail: sweit@poly.edu

Hours: Monday & Thursday, 9AM–6PM

Tuesday, Wednesday, Friday,

9AM–5PM

### LIBRARY

#### Brooklyn Campus

3rd Floor, Bern Dibner Library

Tel: 718/260-3530

Fax: 718/260-3756

E-mail: blibrary@poly.edu

Hours: Monday–Thursday, 9AM–9PM

Friday, 9AM–6PM

Saturday, 1PM–5PM

Sunday, Closed

#### Long Island Campus

1st Floor, Main Bldg.

Tel: 516/755-4320

Fax: 516/755-4379

E-mail: llibrary@poly.edu

Hours: Monday–Thursday, 9AM–10PM

Friday, 9AM–5PM

Saturday, 1PM–6PM

Sunday, 3PM–10PM

### MAILROOM

#### Brooklyn Campus

Room 151, Jacobs Bldg.

Tel: 718/260-3396

Fax: 718/260-3136

Hours: Monday–Friday, 9AM–5PM

#### Long Island Campus

Room 121, Main Bldg.

Tel: 516/755-4383

Fax: 516/755-4404

Hours: Monday–Friday, 9AM–5PM

### PRINTING SERVICES

#### All Campuses

Room 150, Jacobs Bldg.

Tel: 718/260-3392

Fax: 718/260-3136

E-mail: prost@poly.edu

Hours: Monday–Friday, 9AM–6PM

### RESIDENCE LIFE

#### Brooklyn Campus

Room 356, Jacobs Bldg.

Tel: 718/260-3137

Fax: 718/260-3197

E-mail: jswanson@poly.edu

Hours: Monday & Thursday, 9AM–6PM

Tuesday, Wednesday, Friday, 9AM–5PM

#### Long Island Campus

Room 2E, East Hall

Tel: 516/755-4325

Fax: 516/755-4404

E-mail: jnorthru@duke.poly

Hours: Monday–Sunday, 7AM–12AM

### SECURITY

#### Brooklyn Campus

Rogers Hall, Front Entrance

Tel: 718/260-3537

Rogers Hall, Rear Entrance

Tel: 718/260-3213

Dibner Library/CATT

Tel: 718/260-3727

Wunsch Hall

Tel: 718/637-5901

#### Long Island Campus

Administration Bldg.

Tel: 516/755-4353

#### Westchester Graduate Center

Administration Bldg.

Tel: 914/323-2000

### SPECIAL SERVICES

#### Brooklyn Campus

Room 341, Jacobs Bldg.

Tel: 718/260-3560

Fax: 718/260-3136

E-mail: ssbkc@poly.edu

Hours: Monday & Thursday, 9AM–6PM

Tuesday, Wednesday, Friday, 9AM–5PM

#### Long Island Campus

Room 114, Main Bldg.

Tel: 516/755-4340

Fax: 516/755-4404

E-mail: sslie@poly.edu

Hours: Monday & Thursday, 9AM–6PM

Tuesday, Wednesday, Friday, 9AM–5PM

### STUDENT ACCOUNTS/BURSAR

#### Brooklyn Campus

Room 256, Jacobs Bldg.

Tel: 718/260-3700

Fax: 718/260-3052

E-mail: ctigar@poly.edu

Hours: Monday & Thursday, 9AM–6PM

Tuesday & Wednesday, 9AM–5PM

Friday, 9AM–2PM

#### Long Island Campus

Room 112, Main Bldg.

Tel: 516/755-4225

Fax: 516/755-4404

E-mail: ccampbell@poly.edu

Hours: Monday & Thursday, 9AM–6PM

Tuesday, Wednesday, Friday, 9AM–5PM

#### Westchester Graduate Center

Administration Bldg.

Tel: 914/323-2000

Fax: 914/323-2010

E-mail: westinfo@west.poly.edu

Hours: Monday–Friday, 9AM–5PM

**STUDENT ACTIVITIES**

**Brooklyn Campus**

Goldsmith Student Activities Union/  
Wunsch Hall  
Tel: 718/637-5920  
Fax: 718/637-5959  
E-mail: divanoff@poly.edu  
Hours: Monday–Friday, 8AM–11PM  
Saturday, 9AM–6PM  
Sunday, 12PM–5PM

**Long Island Campus**

Gymnasium  
Tel: 516/755-4325  
Fax: 516/755-4404  
E-mail: jnorthru@duke.poly.edu  
Hours: Monday & Thursday, 9AM–6PM  
Tuesday, Wednesday, Friday, 9AM–5PM

**STUDENT AFFAIRS**

**All Campuses**

Room 356, Jacobs Bldg.  
Tel: 718/260-3137  
Fax: 718/260-3197  
E-mail: chartiga@poly.edu  
Hours: Monday & Thursday, 9AM–6PM  
Tuesday, Wednesday, Friday, 9AM–5PM

**STUDENT DEVELOPMENT**

**Brooklyn Campus**

Room 352, Jacobs Bldg.  
Tel: 718/260-3800  
Fax: 718/260-3197  
E-mail: cmcnear@poly.edu  
Hours: Monday & Thursday, 9AM–6PM  
Tuesday, Wednesday, Friday, 9AM–5PM

**Long Island Campus**

2nd floor, Gymnasium  
Tel: 516/755-4325  
Fax: 516/755-4404  
E-mail: jnorthru@duke.poly.edu  
Hours: Monday & Thursday, 9AM–6PM  
Tuesday, Wednesday, Friday, 9AM–5PM

**STUDENT RECORDS/REGISTRAR**

**Brooklyn Campus**

Room 256, Jacobs Bldg.  
Tel: 718/260-3486  
Fax: 718/260-3052  
E-mail: register@poly.edu  
Hours: Monday & Thursday, 9AM–6PM  
Tuesday, Wednesday, Friday, 9AM–5PM

**Long Island Campus**

Room 112, Main Bldg.  
Tel: 516/755-4450  
Fax: 516/755-4404  
E-mail: mflcury@poly.edu  
Hours: Monday & Thursday, 9AM–6PM  
Tuesday, Wednesday, Friday, 9AM–5PM

**Westchester Graduate Center**

Administration Bldg.  
Tel: 914/323-2000  
Fax: 914/323-2010  
E-mail: westinfo@west.poly.edu  
Hours: Monday–Friday, 9AM–5PM

**YES CENTER**

**Brooklyn Campus**

Room 356, Jacobs Bldg.  
Tel: 718/260-3033  
Fax: 718/260-3136  
E-mail: bjohnson@poly.edu  
Hours: Monday & Thursday, 9AM–6PM  
Tuesday, Wednesday, Friday, 9AM–5PM

**Long Island Campus**

Room A105, Bassett Bldg.  
Tel: 516/755-4200  
Fax: 516/755-4229  
E-mail: admitme@poly.edu  
Hours: Monday & Thursday, 9AM–6PM  
Tuesday, Wednesday, Friday, 9AM–5PM

# ACADEMIC CALENDAR

1999–2000

## FALL 1999

Mon–Thurs. Aug. 30–31. Sept 1–2

Registration

Mon, Sept. 6

SCHOOL CLOSED—Labor Day

Tues, Sept. 7

CLASSES BEGIN

Mon, Sept. 20

NO CLASSES—Yom Kippur

Tues, Sept. 21

Monday classes meet—No Tuesday classes (Make-up for Yom Kippur)

Mon, Oct. 11

NO CLASSES—Columbus Day

Wed, Oct. 13

Monday classes meet (make-up for Columbus Day)

Wed, Nov. 17

Last day to withdraw from course with a W grade

Thurs–Fri, Nov. 25–26

SCHOOL CLOSED—Thanksgiving Recess

Fri, Dec. 10

CLASSES END

Mon–Tues, Dec. 13–14

Reading days

Wed–Thurs, Dec. 15–23

Final exams

Fri–Fri Dec. 24–31

SCHOOL CLOSED—Christmas recess

Mon–Fri, Jan. 3–14

Winter mini-session

## SPRING 2000

Mon–Thurs, Jan. 10–13

Registration

Mon, Jan. 17

SCHOOL CLOSED—

Martin Luther King Jr. holiday

Tues, Jan. 18

CLASSES BEGIN

Mon–Fri, Feb. 21–25

NO CLASSES—President's Week

Mon, Apr. 3

Last day to withdraw from course with a W grade

Mon–Fri, Apr. 17–21

NO CLASSES—Spring break

Mon, May 1

CLASSES END

Tues–Wed, May 2–3

Reading days

Thurs–Mon, May 4–15

Final exams

Tues–Tues, May 16–30

Summer mini-session

## SUMMER 2000

Wed–Thurs, May 24–25

Registration

Mon, May 29

SCHOOL CLOSED—Memorial Day

Wed, May 31

Classes begin for X and Z sessions

Tues, June 27

Last day to withdraw from X session course with a W grade

Tues, July 4

SCHOOL CLOSED—July 4

Wed, July 5

Tuesday classes meet—No Wednesday classes (Make-up for July 4)

Wed, July 12

Classes end for X session

Thurs, July 13

Classes begin for Y session

Wed, July 26

Last day to withdraw from Z session course with a W grade

Wed, Aug. 9

Last day to withdraw from Y session course with a W grade

Wed, Aug. 23

Classes end for Y and Z sessions



# POLYTECHNIC UNIVERSITY PROFILE

## INTRODUCTION

Polytechnic is a coeducational, independent, private university 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 program in computer science is accredited by the Computer Science Accreditation Board (CSAB), and 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.

The student body includes over 1,600 undergraduates and 1,700 graduate students. The graduate enrollment in engineering is among the largest in the nation. The majority of its students live in the New York metropolitan area, but many students come from throughout the U.S. and the world to study at Polytechnic as well. Thirteen percent of the student population are women; 14 percent are black, 10 percent Hispanic and 39 percent Asian. Polytechnic is among the leading private universities in the nation in awarding engineering degrees to underrepresented minorities.

Undergraduate programs at Polytechnic prepare students in engineering and science equally for immediate entry into the professional practice of their specialties or for continued graduate study at Polytechnic or other leading graduate institutions. Polytechnic enjoys a high national ranking in the percentage of its graduates who go on to receive a PhD in engineering or science, and has an excellent placement record for students entering the job market.

Beginning in their first semester, Polytechnic students are taught by a world-class faculty. Polytechnic believes that the primary mission of its faculty is undergraduate and graduate education. Even its most prestigious researchers teach regularly, exposing students to leading professionals who are engaged in advancing the state-of-the-art in their specialties.

Polytechnic graduates enjoy an outstanding reputation with both public and private employers, and many have achieved remarkable success. Approximately 1 of every 30 Polytechnic graduates is a company president or high-level executive. Four Polytechnic alumni are currently the presidents of prestigious universities in the U.S. and abroad. There are more than 165 Polytechnic alumni who have been named fellows of the Institute of Electrical and Electronics Engineers, and numerous others who are fellows of other professional organizations.

## HISTORY

Polytechnic is the second oldest private institution of science and engineering in the United States. It was founded in 1854 as the Brooklyn Collegiate and Polytechnic Institute. In 1869, the Board of Regents authorized Polytechnic's collegiate department to confer Bachelor of Science and Bachelor of Arts degrees, the first of which were conferred in 1871. In 1889, the institution adopted the name "Polytechnic Institute of Brooklyn" and in 1901 offered its first Master of Science degree. An evening graduate program was instituted in 1920, and Polytechnic's first PhD was granted in 1935.

In 1961, Polytechnic opened its Long Island campus at Farmingdale as a graduate and research center. In 1974, it began offering undergraduate programs at Farmingdale. In 1975, the Westchester Graduate Center at White Plains was opened and moved to its current location in Hawthorne in 1987.

In 1973, the New York University School of Engineering and Science merged with the Polytechnic Institute of Brooklyn to form the Polytechnic Institute of New York. The new institution was granted university status by the NYS Board of Regents and was officially renamed Polytechnic University in 1985. To this day, the University is often referred to by its historic nickname, "Brooklyn Poly."

## ACADEMIC PROGRAMS

Polytechnic offers Bachelor of Science degrees in 14 disciplines, covering engineering, the physical sciences, mathematics and liberal arts. Master of Science degrees are offered in 29 disciplinary specialties. The PhD is offered in eight disciplines.

Bachelor of Science programs prepare students for entry level employment in the various professional disciplines, as well as for study at an advanced level. Master of Science programs are oriented towards 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 seeking careers in industrial or academic research. It 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 III of this catalog.

**ACADEMIC DEPARTMENTS**

Faculty in the University are 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 two cooperating departments). Instructional laboratories and some research laboratories are managed by academic departments.

Part II of this catalog contains descriptions of the faculty and facilities of the following eight academic departments, as well as identification of the degrees that each department supervises.

- Chemical Engineering, Chemistry and Materials Science
- Civil and Environmental Engineering
- Computer and Information Science
- Electrical Engineering
- Humanities and Social Sciences
- Management
- Mathematics
- Mechanical, Aerospace and Manufacturing Engineering

**RESEARCH PROGRAMS AND CENTERS**

Polytechnic University maintains major programs in experimental, theoretical and applied research, making significant contributions to the advancement of the state-of-the-art in many areas of technology. Polytechnic faculty have been and continue to be among the world's leaders in such diverse areas as electromagnetics and wave propagation, telecommunications, polymer chemistry and engineering, condensed matter and plasma physics, chemical and electronic imaging, materials science and engineering, transportation and traffic engineering, geotechnical engineering, software engineering and development and others.

In 1997, Polytechnic University conducted over 15.2 million dollars of sponsored research under contracts and grants, of which 74% were funded by the federal and state governments and 26% by private industry. Over 80 faculty members were involved in these efforts, which also provided support for over 60 research fellows.

Research at Polytechnic is conducted either through academic department structures, or through one of eight major interdisciplinary research centers, each of which is briefly described below.

Many of these research centers sponsor continuing education efforts in areas related to their research mission. CATT developed two executive format MS programs offered jointly by the Departments of Electrical Engineering, Computer and Information Science, and Management. In addition, PRIDE offers an informatics course via the Internet drawing the participation of students in their homes or offices. WRI, PRI and TRI sponsor colloquia and/or continuing education programs as well. Significant research efforts also occur outside these centers within academic departments. The Department of Civil and Environmental Engineering is developing a strong base in infrastructure research and the Department of Chemical Engineering, Chemistry and Materials Science has a number of efforts not related to polymers that are administered in the department.

**CENTER FOR ADVANCED TECHNOLOGY IN TELECOMMUNICATIONS (CATT)**

This center was created in 1983 as one of the State of New York's four original Centers for Advanced Technology. CATT continues to maintain as its mission technology transfer in the areas of telecommunications and distributed information systems. CATT houses 30 experts who work in cooperation with telecommunication-provider and telecommunication-user businesses in the areas of networking, distributed information systems, imaging and wireless communications.

**CENTER FOR FINANCE AND TECHNOLOGY (CFT)**

This Department of Management center is a unique resource, addressing the evolving financial—and technology-enabled—innovation needs of the financial services industry. The center is a hub for research, and a laboratory for generating new ideas and tools for the industry. The center also undertakes collaborative research projects, providing ideas, methods and tools with scholarly and practical applications.

For further information please contact Frederick Novomestky, Executive Director CFT, 718/260-3436, e-mail: fnovmcs@poly.edu

**INSTITUTE FOR TECHNOLOGY AND ENTERPRISE (ITE)**

The Institute for Technology and Enterprise, supported by the Department of Management, is New York City's premier research and education hub for bridging management and innovation. Through a highly interactive portfolio of learning materials, programs and research activities, the institute nurtures and builds managerial knowledge based on the lessons of high-quality scholarship and pacesetter business practices.

Essentially, the institute functions both as a high-level research and development "engine" for the entire department, and as a unique starting point for firms embarking on major managerial changes or transformation required in the increasingly competitive space defined by modern, especially digital-based, innovation and electronic business.

Strategically located in the heart of Manhattan's high technology and financial districts at the coveted New York Information Technology Center at 55 Broad Street, the institute also acts as a "jump-gate" for companies and managers into the famed Silicon Alley.

For further information, please contact the institute, telephone: 212/547-7030, fax: 212/547-7029, e-mail: ite@poly.edu. Please visit ITE's Website at <http://www.ite.poly.edu>.

**INSTITUTE OF IMAGING SCIENCES (IIS)**

Imaging sciences are concerned with all aspects of information presented in visual form. Founded in 1981, the Institute of Imaging Sciences is involved in three major areas: image processing, optics and devices and photoactive materials. Participating faculty include those from computer and information science, electrical engineering, chemistry and physics.

**POLYMER RESEARCH INSTITUTE (PRI)**

The Polymer Research Institute was founded by Dr. Herman Mark in 1942 and continues to be an internationally recognized leader in the synthesis, characterization, structure, processing, properties and applications of polymeric materials. In addition to its role in fostering interdisciplinary interest and work in polymers, PRI sponsors symposia, conferences and professional educational programs. The institute provides a focal point for the research of over 25 faculty members in chemistry,

chemical engineering and physics. PRI is actively involved with industry in regard to outsourcing, problem solving and education. In addition to the traditional chemical-related areas, PRI has recently expanded its interests in macromolecular technology to health-related areas.

### **PRIDE**

PRIDE is a unique institute within the Polytechnic community. It was established in 1995 to create links with international bodies interested in the development and transference of technology for mutual benefit.

Throughout its history, PRIDE has conducted research and developed information technology, especially educational and commercial systems, for industry institutes in Taiwan, educational institutes in Japan and at Polytechnic University. This technology is also applicable to other educational and commercial interests within the United States.

Since 1996, PRIDE has created and continues to develop the award-winning I-CARE system, which provides Polytechnic educators and other institutes with powerful tools for distance learning in an integrated environment for administering, developing and serving education to students regardless of time or location.

PRIDE has also developed a thesaurus-based intelligent search engine for a variety of implementations, including a demonstration system providing powerful information technology searches.

PRIDE has had a number of significant innovative achievements. It has the distinction of creating software for conducting the first-ever Web-based international conference using its own Internet Realtime Conference System. It has, since 1996, provided a live Internet camera using push technology and has recently developed an Internet Telephone system, which will be available in version two of the I-CARE system.

It is also committed to the integration of multimedia on the World Wide Web, and thus has established a multimedia laboratory to remain current with the state-of-the-art in Web-based multimedia technology. This laboratory is available to interested faculty to develop 3-D graphics and audiovisual technology for educational purposes.

PRIDE is also responsible for the Polytechnic Website, for its technical reliability and its mission to carry effectively Polytechnic's important educational message to the public.

### **TRANSPORTATION RESEARCH INSTITUTE (TRI)**

Created in 1975, TRI develops and transfers the knowledge base in transportation systems and policy through research and educational programs to improve the mobility and safety of persons, freight and services in metropolitan areas. The institute has conducted a variety of landmark studies involving capacity analysis of freeways and signalized intersections and led the development of the 1985 Highway Capacity Manual, which is used throughout the world as a design and analysis standard. The institute conducts Intelligent Transportation Systems (ITS) research in New York City involving technical, institutional and private-public issues. Through the Urban ITS Center, it provides technical and policy analysis assistance to the New York City Department of Transportation to facilitate the deployment of ITS technologies in the New York metropolitan area. Other areas of research include travel demand management, policy studies, transportation models, operational analysis, highway construction materials and pavement management. The institute involves faculty from civil engineering, mechanical engineering, chemical engineering, social sciences and transportation engineering.

### **URBAN INFRASTRUCTURE INSTITUTE**

The Urban Infrastructure Institute is a federation of centers and researchers linked together to establish an integrated framework emphasizing crossdisciplinary opportunities with relevant agencies. The Urban Utilities Center and the Urban ITS Center address specific components of the urban infrastructure initiative. These centers are members of the City Construction Consortium, established in 1993; in addition, they conduct related initiatives in polymers in infrastructure and in data management.

### **WEBER RESEARCH INSTITUTE (WRI)**

Founded as the Microwave Research Center, the center was renamed in 1985 in honor of its founder, Dr. Ernst Weber. The institute played a key role in WWII in the development of electromagnetic and microwave defense and communication systems. Research continues to focus primarily on electromagnetics, from power frequencies through microwave to submil-

limeter waves and electro-optical phenomena. Studies in electromagnetic, acoustic and lightwave propagation, scattering and detection, together with electromagnetic waves and the environment in communication and signaling systems, such as cellular telephony, are also pursued. Research also includes areas of device technology related to telecommunications and high-power electromagnetic pulse phenomena.

## FACULTY

The heart of Polytechnic is its distinguished teaching and research faculty. Numbering some 120, the Polytechnic faculty is committed to providing the best possible educational environment in the classroom, in the laboratory, through individual guided studies and projects, through advising and through the strong one-on-one relationship most faculty members develop with their students.

The faculty originates, organizes and approves all curricula taught at the University and also establishes the academic standards for student performance. Polytechnic undergraduates interact with faculty from their first day of classes. Class sizes are relatively small, and all faculty members maintain regular office hours for consultation with individual students. Because many faculty members are actively involved in on-campus research, they are easily accessible outside of the classroom. All formal academic advising after the first semester is done by the faculty.

The Polytechnic faculty is one of the most distinguished in the world. Polytechnic faculty members were among the founders of the National Academy of Engineering, the Institute for Electrical and Electronics Engineers, the American Institute of Chemical Engineers and the American Society of Engineering Education. The faculty includes members of the National Academy of Engineering and numerous fellows of the various professional disciplinary organizations. Polytechnic faculty members have authored numerous undergraduate and graduate textbooks used throughout the U.S. and abroad and edit leading professional journals. They are frequently honored with prestigious awards.

## ALUMNI

The POLYTECHNIC ALUMNI fosters fellowship and sponsors activities for the alumni and students, including continuing education programs, professional career placement, new-student recruiting and fundraising to support University programs. The organization sponsors a mentoring program linking students with alumni volunteers around the world and offers other opportunities for students to meet prominent alumni.

Scholarships are provided annually by the alumni for students making unusual contributions to the quality of campus life. Special awards are presented each year to the outstanding senior and to the student who is most proficient in each Polytechnic sport.

Periodically, the POLYTECHNIC ALUMNI publishes a roster of the location and occupation of all known alumni. *Cable*, the publication of the POLYTECHNIC ALUMNI, is published four times yearly to provide alumni with recent information concerning the activities of the alumni and Polytechnic.

Alumni residing in the New York City region as well as elsewhere have formed various chapters, providing opportunities for formal and informal alumni gatherings, and providing an opportunity to represent Polytechnic to the community. Fourteen chapters now exist throughout the U.S. and in several foreign countries.

Alumni are offered a special, noncredit, reduced-tuition audit option on all courses and access to the Dibner Library. Beginning with the class of 1995, graduating students have been provided an e-mail account on the alumni server.

## CAMPUSES

The campuses and accompanying facilities are described in greater detail in the sections which follow, along with the types of programs offered at each.

**The Brooklyn Campus**  
**Six MetroTech Center**  
**Brooklyn, NY 11201**  
**Phone: 718/ 260-3600**  
**Fax: 718/ 260-3136**  
**E-mail: admitmc@poly.edu**

The Brooklyn campus is the focus of an exciting new environment with the arrival of MetroTech, a joint University-industry development. After over 12 years of planning, MetroTech is now a reality. Major industrial companies share a common campus with Polytechnic University, with the University as its core. This new urban campus is surrounded by seven new corporate, municipal and university buildings:

- **Dibner Library/Center for Advanced Technology in Telecommunications** Polytechnic's new academic building houses a new state-of-the-art library; a prestigious research center, CATT; and the Departments of Electrical Engineering and Computer and Information Science. The new building, which opened in January of 1992, provides 128,000 square feet of new academic space and anchors the north end of the new campus.
- **Securities Industry Automation Corporation (SIAC)**, which operates the computer information networks of the New York and American Stock Exchanges and their transaction clearing operations, has moved its headquarters to MetroTech. The new 533,000-square-foot office and data processing complex opened in September of 1990 and anchors the south end of the new campus.
- **KeySpan Energy** (formerly Brooklyn Union Gas Company) has also moved its headquarters to MetroTech. The new 845,000-square-foot office facility is now complete and occupied. Bear Stearns, a major brokerage house, became a major cotenant of this building in June 1992.
- **Chase Manhattan Bank** has built two major office facilities totalling approximately 1.5 million square feet of office/data processing space. Occupancy of these buildings began in the spring of 1992.
- **Other MetroTech companies** include the Marriott Hotel, Renaissance Plaza corporate offices, the New York City Fire Department Headquarters and the New York City Data Center.

These new buildings, as well as Polytechnic's existing academic buildings and student center building, surround a three-acre joint campus area. A closed

pedestrian environment was created on the campus by closing all streets formerly running through the MetroTech area. As of spring 1992, all of the buildings noted above and the joint campus area were completed, bringing to fruition a dramatic concept in university-industry cooperation introduced by Polytechnic University over a decade ago.

In addition to a radically new environment and a new building, Polytechnic has developed interactions with its MetroTech neighbors. These corporations, all major employers, are heavily involved in communications technology. Polytechnic is a leader in research and education in this critical area.

The Brooklyn campus at MetroTech is located at a major junction of public transportation routes and is easily accessible by car from the Brooklyn or Manhattan Bridges or the Brooklyn-Queens Expressway. All of the new commercial buildings of MetroTech have parking facilities, and Polytechnic continues to maintain a small parking facility of its own. The Brooklyn center is easily accessible from all parts of New York City, Long Island, New Jersey and Connecticut.

The Brooklyn campus consists of several significant buildings:

- **Rogers Hall**, named after Dr. Harry Stanley Rogers, Polytechnic's fifth president, is the main academic building. It houses faculty and administrative offices, classrooms, research and teaching laboratories and student areas. The Offices of the Vice Provost for Academic Development and Academic Operations are located in Rogers Hall.
- **The Jacobs Building** is named after Dr. Joseph Jacobs, the former chairman of the Polytechnic Board of Trustees and a major benefactor to the University. It houses primarily administrative and faculty offices. Offices of the President, Provost, and Vice Presidents are located in the Jacobs Building. Most student service offices are also located here, including the Office of Admissions, Student Accounts and Records, Financial Aid, Student Development and Career Services, as well as Alumni, University Relations and Development. Business-related functions of Polytechnic are also housed in Jacobs.

- **The Clifford H. Goldsmith Student Activities Union/Joseph W. and Samuel Wunsch Student Center Building**, Polytechnic University's new student center, is housed in the former home of the African Wesleyan Methodist Church, a historic landmark. The building, which became a stop on the underground railroad for slaves in search of freedom, has undergone a complete exterior restoration and interior renovation.

The student center is home to the student government, student publications and cultural and social organizations. In addition, the building provides Poly students with fitness facilities, a television room and a lounge. The Offices of Athletics and Physical Education and Student Activities and Leadership Development are located in this building.

The Brooklyn campus represents a major renaissance in which Polytechnic is the center of one of the most unusual and successful joint university-industry-public ventures in the nation. For Polytechnic students, it means a new urban campus, markedly improved surroundings, a dramatic new library, a new student center, new homes for electrical engineering, computer engineering, and computer science programs, and the opportunity to interact with major information industries.

**The Long Island Campus**  
**901 Route 110**  
**Farmingdale, NY 11735**  
**Phone: 516/755-4200**  
**Fax: 516/755-4404**  
**E-mail: admitme@poly.edu**

The Long Island campus is located on 25 acres on Route 110 near the Nassau-Suffolk border, at the economic centroid of the two suburban counties. Polytechnic has educated generations of Long Island's technical leaders and entrepreneurs and serves both graduate and undergraduate populations at this campus.

Twenty-five percent of Polytechnic's undergraduates are located at this campus, and one-third of those live in the three residence halls. The undergraduate programs are in several engineering disciplines, computer science, and information management at this campus.

Approximately one-sixth of Polytechnic's graduate students pursue their degrees in engineering, computer science and technology-related management at this campus.

The Long Island Campus Advisory Board includes members from Symbol Technologies, Computer Associates, Spectrum Information Technologies, Shah Associates, Long Island Business News and Marketspan. Polytechnic is active in the Long Island Forum for Technology (LIFT), the Long Island Association (LIA) and other organizations dedicated to the high-tech future of Long Island.

From its Long Island campus, Polytechnic interacts with Long Island industry through its Center for Advanced Technology in Telecommunications (CATT), its Weber Research Institute (WRI) and other research efforts. The aerospace research facilities, unique in the region, are located on the campus.

The primary facilities are the following:

- **The Main Building** houses administrative and faculty offices, support services, the classrooms, the library and several undergraduate laboratories. The distance learning facilities are located in this building, as are the wireless communications laboratory and the controls/robotics lab. The library stresses global access, using Internet search capability and specialized computer services, as well as a collection matching the academic concentrations.
- **The Bassett Building** houses the admissions office, the Weber Research Institute, the Department of Mechanical, Aerospace and Manufacturing Engineering and laboratories. Several student societies and clubs have their offices in the Bassett Building, and the Jasik Undergraduate Lounge is located there as well. It also includes the electric vehicle laboratory, the civil/environmental laboratory, the bookstore and spaces for incubator businesses in electronics and software.
- **The Three Residence Halls** are located at different points on the campus. West Hall primarily houses freshmen, in two distinct areas (by gender), with two persons per room. North Hall primarily houses sophomores, also with two persons per room. East Hall houses others in suites accommodating 4-5 persons. The cafeteria is in the main building. All residence halls have in each room or suite cable TV, campus phones and fiber-optic connections to the computer network.

- **The Gymnasium** serves as a recreational facility for the students on the campus and the home court for a number of Polytechnic's intercollegiate teams. It includes a weight room, ping pong and pool tables and a basketball court.

Other facilities include a baseball field, a soccer field, two tennis courts, a beach volleyball court and an outdoor basketball court.

**The Westchester Graduate Center**  
**36 Saw Mill River Road**  
**Hawthorne, NY 10532**  
**Phone: 914/323-2000**  
**Fax: 914/323-2010**  
**E-mail: westinfo@west.poly.edu**

The Westchester Graduate Center serves scientists, engineers, managers and others working in high-technology companies located in the lower Hudson Valley, southern Connecticut and northern New Jersey. To serve this unique population the center offers graduate level courses in two convenient formats as well as short courses and seminars in current subjects.

The part-time evening program offers graduate courses in chemistry, computer science, electrical engineering, management and telecommunication networks. In the Executive Degree Program format, the classes meet on alternate weekends (Friday and Saturday) over four semesters. Students complete their degree in a total of 28 weekends over a 20-month span. The following Master of Science degrees are offered exclusively in the Executive Degree Program format: MS in Telecommunications and Computing Management; MS in Information Systems Engineering; and MS in Management of Technology.

This modern facility has comfortable classrooms, computer laboratories linked to the Internet, satellite download facilities and ample free parking.



The Brooklyn campus' new Dibner Library of Science and Technology, a state-of-the-art electronic facility, opened in January of 1992 and serves as the hub for all three Polytechnic campus centers. This \$15 million library and advanced information center provides access to information both electronically and

through traditional media, from resources throughout the nation and the world.

The library at the Long Island campus was completely remodeled in 1994. The professionally staffed Long Island center is committed to providing a "library without walls" and utilizes cutting-edge technology, along with more traditional approaches, to insure that all information service needs are met. The Long Island library is connected electronically to the Brooklyn campus library.

The Richard Laster Library at the Westchester Graduate Center is also connected electronically to the Brooklyn campus library. All Westchester services are channeled through the Dibner Library.

The goal of the Polytechnic libraries is to satisfy the information needs of the students, faculty, staff and administration at the Brooklyn, Long Island and Westchester campuses. Highly skilled librarians and information specialists support the following services:

- An in-house collection of more than 250,000 books and journals supporting undergraduate and graduate programs in engineering, the sciences, management and other fields.
- Professional assistance in meeting users' information needs. Library services are enhanced by the use of the latest digital technology.
- In-house services augmented by regional and national cooperative activities. The University library is an active member of the Academic Libraries of Brooklyn (12 participating libraries), the Long Island Library Resource Council (180 participating libraries) and the New York Metropolitan Reference and Research Library Agency (251 participating libraries). The library is also a member of OCLC, an international bibliographic database with over 4,000 libraries participating.
- Specific needs for articles and reports not available at Polytechnic University may also be met through the libraries' document delivery programs. A combination of traditional interlibrary loan functions and online commercial vendor services, such as Uncover and OCLC FirstSearch, assure speedy delivery of these resources.
- A new Integrated Library System (ILS) running on a client/server platform.

Functioning in a Windows-based environment, the system permits onsite, Internet or dial-in access to resources within and outside the library.

- Digital Information Bank Network Retrieval (DIBNR), an innovative component of the ILS, that further expands the libraries' resources. Included are course-related material supplied by faculty and presented online, with links to journals and courseware for users at the Brooklyn, Long Island and Westchester campuses.
- Internet access via Netscape or Microsoft Internet Explorer available at no cost to library users at the Brooklyn and Long Island campuses. The libraries maintain their own World Wide Web pages, keeping patrons abreast of library information and providing access to relevant Internet sites in every major science and engineering field.
- CD-ROM resources available onsite. CD-ROM databases, available to patrons at all three campuses, cover information in engineering, science and social science fields. Both the Brooklyn and Long Island libraries are equipped with multimedia workstations, which provide access to resources in CD-ROM format.
- Database searching capability through DIALOG of more than 300 computerized databases, some of which provide abstracts of relevant papers and articles. DIALOG is available for detailed author, title or subject searches in virtually any area of interest.
- Support and training to all users, enabling them to utilize fully the potential of digital technology.

### POLYTECHNIC COMPUTING FACILITIES

Polytechnic University is continually improving the computing support for students, faculty and staff. Every student has access to a variety of powerful computers, an e-mail account and access to the Internet. Students may use the computers in the central computer labs and various specialized labs, or they may dial in from home. Every residential student on the

Long Island campus has an individual ethernet connection to the University's networks. The library offers a variety of online and other services for every student on every campus. The librarians can provide advice and guidance on searching via the Internet.

Polytechnic has a World Wide Web site at <http://www.poly.edu> with descriptions of the courses, academic departments, research centers, student activities and other features. Many academic departments, research centers, student organizations and individual courses have websites as well. Each student may also have an individual website linked to Polytechnic's site.

The central computer laboratories undergo upgrades and enhancement each year during the summer. The Brooklyn and Long Island campuses have central computer labs consisting of a collection of top-end Pentium II and Pentium Pro PCs running the Windows NT operating system. In addition, the central labs also have SUN SpareCenter servers running the Solaris (UNIX) operating system, giving students exposure to the most widely used computing environments. Both campuses also have UNIX X-terminals for direct connection to the UNIX servers. All computers are networked, allowing students to take full advantage of our heterogeneous computer environment.

Professional software tools are used routinely in courses. Students are encouraged to interact with their instructors either in person, via e-mail or, in some cases, via video conferencing. This allows students to have questions answered at almost any time from any location.

The computer facilities are managed by Grumman Systems Support Corporation (GSSC), which is guided by a team of faculty, staff and students.

Several departments and laboratories have their own subnetworks, which are part of the overall University network. These include the Electrical Engineering Wireless Communications Labs, the Mechanical Engineering Controls and Robotics Labs, the Computer Engineering Microprocessor Design Labs, the Computer Science Distributed Systems Lab and the Freshman Engineering Labs.

The student chapters of the Association for Computing Machinery (ACM) provide support for students with questions as a volunteer service consistent with their mission.

Access to the computer network is available extensively during the week and weekends in the central labs and at all hours through dial-in or residential connections.

# ACADEMIC PROGRAMS AND POLICIES

## PROGRAM AREAS

Polytechnic is a university uniquely focused on the world of technology and its interactions with society. To fulfill its mission, Polytechnic offers degree programs in five general academic areas:

- Computer and information science
- Engineering
- The sciences and mathematics
- Management
- Liberal arts

### **COMPUTER AND INFORMATION SCIENCE**

Computer and information science is a recent important and expanding field as the world moves into the Information Age. Computer and information science includes the design of systems (computer hardware and software) and the development of principles for applying computers to new uses. It requires a high level of theory and practice and often involves the development and/or integration of high-quality software.

A multidisciplinary focus is required for computer and information science, since computers are everywhere in our society. Computer and information science is a major element in modern information technology, allowing information to be used in analyzing and solving problems in diverse fields, such as telemedicine, health care, finance, entertainment, manufacturing, telecommunications, transportation and biomedicine.

The computer and information science curriculum is an integrated program of basic science, computer science, mathematics, humanities and social science. Opportunities in electives allow for flexibility and breadth in course selections of both technical and nontechnical electives within the environment of Polytechnic.

The current faculty works in such state-of-the-art fields as high-speed imaging classification, software virus protection, high-speed graphics, text and data mining,

faulty 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, integrating theory and practice, allows the Polytechnic graduate to be well positioned for the 21st century.

### **ENGINEERING**

Engineering is perhaps best described as the creation of devices and implements that can control or manipulate nature to produce a desired effect. It is the application of science to the building of the infrastructure, devices, tools and other implements of society in a way that will improve the quality of life and environment for all.

The modern engineer must have a firm background in the sciences, as well as in mathematics, the language with which scientists describe nature and through which engineers manipulate it. The engineer must also have a background in the liberal arts, as no one can hope to improve society without understanding its character, needs and desires. The modern engineer must also develop excellent communications skills, both to deal with fellow professionals as well as with decision-makers and the public.

Engineering programs at Polytechnic build on a firm foundation of mathematics and science to develop the engineering analysis and design skills required of a practicing professional. Undergraduate programs prepare students equally for entry into the profession and for continued education at the graduate level.

Above all, an engineering education from Polytechnic prepares the graduate for a lifetime of education and growing knowledge. The ability to continue learning is perhaps the most lasting gift of education, particularly in the rapidly developing field of technology. By giving its students a comprehensive education in the principles of science and engineering, and by developing the creative skills required for engineering design and analysis, Polytechnic provides its graduates with the ability to continue to learn and grow as their careers progress.

Just as current Polytechnic faculty and alumni are advancing the state-of-the-art in such varied fields as telecommunications, microwaves, space electronics, imaging sciences, quantum electronics, pulse power, materials, aerospace, geotechnology, software engineering, earthquake performance of structures and numerous others, the Polytechnic engineer is equipped to carry this tradition forward to the next generation of technological breakthroughs.

### **THE SCIENCES AND MATHEMATICS**

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

Undergraduate science and mathematics programs at Polytechnic give the student a unique opportunity to study basic theory, while at the same time interacting with design disciplines. The structure of undergraduate programs in these areas allows students to select concentrations of elective courses in technology areas, and students are encouraged to do so.

Students are exposed to modern laboratories and interact with faculty who are world-class researchers. As many junior and senior classes are quite small, students in these areas develop one-on-one relationships with faculty and have the opportunity to work with them in their appropriate research areas.

The future of technology critically depends on our 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 analytic and logical processes through which we can extend and apply that which we discern. Polytechnic programs prepare scientists and mathematicians for this vital role, enabling them to lead us to a better future.

## MANAGEMENT

The Department of Management at Polytechnic University represents a major education gateway and opportunity. It is the premier learning, research and development hub in the New York City/tri-state region, explicitly devoted to the critical arenas of innovation, information and technology management.

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

The research and development conducted within the Department of Management is varied, including scholarly books and articles in the most 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's Institute for Technology and Enterprise functions as an "engine" for high-level research and development for the whole department and for relevant firms and fields at large.

The Department of Management is also committed to integrating technology into all educational programs to enhance learning. Because all managers must now understand how technology and innovation are essential for delivering value to organizations and the market, the department offers a portfolio of educational programs dealing with the broad spectrum of innovation and technology management in the modern economy.

The Department of Management's Master of Science programs include:

- Management of Technology (MOT)
- Telecommunications and Information Management (TIM)
- Evening programs in Financial Engineering (FE), Management and Organizational Behavior

The Department of Management offers short-term, nondegree programs, including programs tailored to the needs of specific firms and industries that are related in some fashion to the broadly defined technology and information management field.

## LIBERAL ARTS

It is through the study of the liberal arts that we learn to understand human society, its development, its needs, its desires and the means through which it makes these known. No one can adequately address technology, or its creation and development, without an adequate understanding of the human and societal needs which it seeks to serve. On the other hand, no humanist can adequately understand society and its development without a knowledge and understanding of how it interacts with and is affected by technology.

While studying traditional programs in social sciences and humanities, liberal arts majors at Polytechnic also take a curriculum specifically addressing the interactions between society and technology.

## SELECTION OF A MAJOR (UNDERGRADUATE STUDENTS)

Undergraduate students admitted to Polytechnic are permitted to declare their major immediately, should they so desire. Incoming freshmen may initially enter as "undeclared" majors. Freshmen who wish to consider several program options are encouraged to use the first semester to explore major fields.

Polytechnic's freshman year is uniform for all engineering majors and very similar for other majors. Thus, students may delay their selection of a major until the end of the freshman year if they so desire. Such students will follow the "Core Curriculum for Engineering Majors" during their first year. This curriculum is detailed under "General University Degree Requirements" in Part II of this catalog.

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. Students entering Polytechnic with an undeclared major may declare any currently offered undergraduate major by the end of their first year. It should be noted that changes in major may involve some loss of credit if done later than the end of the first year. Advisers will work with any student wishing to change majors to minimize the loss of credit and disruption to the student's educational program.

## SELECTION OF A MINOR (UNDERGRADUATE STUDENTS)

A minor is an approved coherent concentration of academic study within a single discipline. A student may select a minor, in a field distinct from or related to his or her major, with approval of advisers in both the major and minor fields. The name of the minor will appear on the student's transcript if the approved 15 credits in the minor field have been completed with at least a 2.0 grade-point average. Some of the courses used to satisfy the minor requirements may be courses that are either required or electives in the student's major program. The names and associated requirements for minors are listed in the sections of this catalog that are devoted to related major programs.

## ACADEMIC POLICIES

### OUTCOMES ASSESSMENT

As part of Polytechnic's commitment to student academic achievement, effective teaching and continuous improvement of the institution, Polytechnic conducts outcomes assessment activities. To obtain periodic measurements of student perceptions and intellectual growth, students will be expected to participate in surveys, focus groups, interviews and related activities. While individual input is collected, the data resulting from these assessments will be published only in aggregate form.

### DEFINITION OF CREDITS AND UNITS

Undergraduate semester credits are based upon the number of 55-minute periods scheduled each week during one semester. Normally, 1 credit signifies a minimum of either one 55-minute period of classwork, or three hours of undergraduate laboratory, over a period of 15 weeks. In a few cases, more time per credit is given. The final examination period is an integral part of the semester.

Graduate studies are expressed in terms of units. One 55-minute period of graduate classwork for a single semester carries 1½ graduate units. A standard graduate



course meeting for 2½ 55-minute periods per week would be equivalent to 3 units. This is the most common format for graduate courses. Graduate laboratories involve approximately twice this amount of time per graduate unit. Courses meeting more or less than 2½ periods each week are assigned units in the appropriate proportion.

### **CREDITS FOR COURSES TAKEN ELSEWHERE (TRANSFER CREDITS)**

#### **Residency**

To earn a Polytechnic University degree, students must complete a minimum number of credits at Polytechnic University. The minimum number of credits which must be completed at Polytechnic University to satisfy residency requirements is:

- Bachelor of Science: 34 credits in approved junior and senior subjects
- Master of Science: 27 units
- PhD: 30 units including dissertation
- Graduate Certificate: 12 units

#### **Undergraduate Students**

Students who have completed some undergraduate courses at other colleges or universities are encouraged to consider transferring into Polytechnic programs. Polytechnic will award transfer credit for appropriate courses satisfactorily completed elsewhere. Students transferring to Polytechnic from other universities must have transcripts of their courses examined by the Office of Admissions 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 records are complete. All evaluations of transfer credits must be completed by the end of the student's first semester of registration at Polytechnic.

Transfer credit is not given for any course in which a grade less than C has been earned. In addition, any student completing a course at Polytechnic for which transfer credit has already been given automatically forfeits the transfer credit for that course.

The contents and standards of courses vary from school to school. Thus, a transfer student may find after a semester's work at Polytechnic that he or she will be better prepared for advanced courses if he or she re-enrolls in a course at

Polytechnic for which he or she has been given transfer credit. A student may be required to do this in consultation with his or her adviser. In some instances, course requirements may be waived for students who demonstrate sufficient knowledge of a specific course content through either written or oral examination given by the appropriate academic department. In such cases, no credit is awarded, but the student will be permitted to submit a more advanced course to satisfy degree requirements.

Grades of courses for which transfer credit is given are not included in the computation of the student's cumulative or current semester grade-point average.

Polytechnic will also grant students credit for appropriate Advanced Placement courses taken in high school, given acceptable performance on AP examinations. Students must request evaluation of AP credits no later than the end of their first semester of matriculation. Credit may also be granted for college preview courses taken at Polytechnic or other universities while a high-school student, if these courses are relevant to the student's degree program and acceptable grades have been achieved. Grades for such courses are also not included in the computation of the cumulative or current semester grade-point averages.

#### **Transfer Agreements**

To provide students with alternative pathways to a degree in engineering and to facilitate the transfer process, Polytechnic University has developed cooperative programs with other liberal arts and two-year institutions. Qualified students completing pre-engineering programs at these institutions are guaranteed admission to Polytechnic University. Students interested in learning more about the cooperative programs are urged to contact the Office of Admissions at Polytechnic.

#### **Transfer Credits While in Residence (Graduate and Undergraduate Students)**

Students enrolled at Polytechnic are expected to take all course work at Polytechnic University. Exceptions can be made in cases where Polytechnic does not offer courses of importance to the attainment of the student's academic goals.

To obtain credit/units for courses taken elsewhere while enrolled at Polytechnic, written permission must be obtained from the major academic adviser, the department head of the course for which transfer credit is requested, and the Office of

Academic Affairs. This must be done before registering for the course at another institution. Forms for such permission are available in the Office of Student Records. The following requirements apply:

- The other institution must be accredited.
- Grades earned must be C or better for undergraduate courses and B or better for graduate courses.
- Pass/Fail courses are not acceptable under any conditions.
- Only credits/units will be granted; grades are not included in the computation of cumulative or current semester grade-point averages.

#### **Graduate Students**

A limited number of units, consistent with residency requirements, for graduate courses completed with honor grades (A or B) from accredited institutions may be allowed towards meeting the requirements for MS, PhD or graduate certificate programs. Courses must be acceptable at the transferring institution for similar degree programs and must usually have been taken after receipt of a bachelor's degree. Evaluation of graduate transfer units is done by the student's major academic department.

Graduate courses taken at Polytechnic while a student is pursuing an undergraduate degree may be subsequently applied towards a graduate degree, provided that they were not submitted in fulfillment of an undergraduate degree and a grade of B or higher was earned. Such courses are not subject to the 9-unit maximum transfer limitation for the MS degree and the grades are not figured into the cumulative grade-point average.

### **CREDIT BY EXAMINATION (UNDERGRADUATE STUDENTS)**

Undergraduate students with an outstanding record or with specialized competence may establish a maximum of 18 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 Academic Affairs.

A grade of B+ or better is required to achieve credit by examination. Students who register for or attend a course at Polytechnic may not subsequently take the

## ACADEMIC PROGRAMS AND POLICIES

examination for credit for this course or for a course with similar content. No examination may be taken more than once.

A specified fee is paid to the Office of Student Accounts in advance of each examination. The course and credits are posted on the permanent record without a grade and do not count toward the minimum residence requirement for the bachelor's degree or for a degree with honors or towards the grade-point average.

In the area of foreign languages, those presenting their native tongue or the language in which they were educated are excluded from credit for the first four semesters of work in that language.

### **VALIDATION CREDITS (UNDERGRADUATE AND GRADUATE STUDENTS)**

When it is unclear whether a course taken outside Polytechnic is suitable for transfer credit, a student 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. 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 Polytechnic. A grade of C or better is required to validate course credits for undergraduate students; 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 units, special student units and transfer units is limited to a maximum of nine units for the Master of Science degree.

### **CLASS STANDING FOR UNDERGRADUATES**

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

<i>Freshman</i>	1–27 credits
<i>Sophomore</i>	28–61 credits
<i>Junior</i>	62–94 credits
<i>Senior</i>	≥ 95 credits

### **MAXIMUM CREDITS PERMITTED AND REGISTRATION STATUS**

#### ***Undergraduates***

**Full Time:** A student who takes 12 or more credits is categorized as full time. The maximum course load for full-time undergraduate students is normally 18 credits. Students in special situations (such as graduating seniors, or students accepted into dual major, dual undergraduate degrees or BS/MS Accelerated Honors Programs) may register for up to 20 credits, with permission from the head of their major department. Students who register for more than 18.5 credits will be charged the per credit rate for additional credits beyond 18.5.\*

**Part Time:** Students registered for less than 12 credits per semester (except summer) are considered part-time students. Part-time students pay tuition at the prevailing per credit rate and are not eligible for most financial assistance programs.

**Summer and Intersessions:** Students may register for up to 7 credits during each six-week summer term, and for no more than 14 credits for the combined 12 week summer term. Six credits for a given summer term is considered full-time status, particularly for financial aid purposes. Courses taken during intersession are treated as if they were taken during the subsequent semester or summer session for the purposes of student records and credit.

#### ***Graduates***

**Full Time:** Registration for 9 units or more categorizes graduate students as full time. Graduate students pay tuition at the per-unit rate.

**Part Time:** Students registered for less than 9 units per semester (except summer) are considered to be part-time students. Part-time students pay the per unit tuition rate and do not qualify for most financial assistance programs.

**International students** (undergraduate and graduate) on F-1 or J-1 visas are required to enroll in a full-time program of study each semester.\*

*\*For certain types of attendance and enrollment certifications, some students who are registered for less than 12 (undergraduate)/9 (graduate) credits or units may be certified as full time: specifically, undergraduates who are pursuing University-authorized full-time, full-semester Co-op work assignments; and graduate students pursuing research projects which their department head certifies in writing to the Registrar as full time. A form to establish full-time equivalency is available from the Office of Student Records.*

### **FULL-TIME EQUIVALENCY FOR INTERNATIONAL STUDENTS**

A full course of study for all students consists of 12 credits on the undergraduate level and 9 credits on the graduate level for each fall and spring semester. To maintain nonimmigrant student status, an international student must be enrolled on a full-time basis. A student 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 the International Student Adviser *prior to the last day of late registration each semester*, so that courses can be added to the student's schedule if necessary.

Students in F-1 and J-1 status must also obtain written permission from the International Student Adviser to withdraw from classes, if the withdrawal will result in less than a full course load, or to take a leave of absence. The process of withdrawing or taking an official leave of absence through the Office of the Registrar keeps a nonimmigrant student in good standing with the University only, *but not with the United States Immigration and Naturalization Service.*

Failure to comply with the full course of study rule is a violation of the nonimmigrant student status and makes a student ineligible for any of the benefits of that status including Optional Practical Training. According to the INS, lack of compliance can also result in deportation.

### **POLICIES ON GRADING AND GRADES**

#### ***Computing the Grade-Point Average for Undergraduate Students***

The weighted grade-point average of an undergraduate student is determined by the Office of Student Records on the basis of the following numerical values assigned to the various 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
NR		Not Received**
P		Passing***

\*\* Grade not received by Office of Student Records in time to report it.

\*\*\* Only used in optional PE courses. SL 101 and SL 102.

In the computation of the grade-point averages, courses graded W, I, S, or U are not considered, nor do they count towards the computation of total credits passed or earned. Grade-point averages 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 the total number of credits represented by the courses considered.

The W and I grades are described in greater detail in subsequent sections. Grades of S or U are used to indicate progress in multisection research projects or theses, or for noncredit-bearing remedial or other courses. Undergraduates enrolled in graduate courses may not receive plus or minus grades.

### Computing the Grade-Point Average for Graduate Students

For the purposes of computing grade-point averages for graduate students and graduate courses, the following schedule is used. Note that the range of grades for graduate students is limited to A, B, C and F.

Grade	Point Value	Description
A	4.0	Excellent
B	3.0	Good
C	2.0	Deficient, but Passing
F	0.0	Failing
W		Withdrawal
I		Incomplete
AUD		Audit
S		Satisfactory
U		Unsatisfactory
NR		Not Received

Grades S and U are used to reflect progress on continuing research efforts until they are completed, at which time the appropriate letter grade is entered on the transcript. Noncredit seminar courses are also graded S or U. Grades S, U, I, W and AUD are not included in the computation of the grade-point average, which is computed as indicated for undergraduate students.

### Repeating Courses

**Undergraduates:** If an undergraduate takes a course two or more times, only the second and subsequent grades will count towards the student's grade-point average. 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 not available to repeat within one year.

**Graduates:** The first time a graduate student repeats a course, the lower grade will not be counted towards the grade-point average. All subsequent grades in a course repeated more than once will be included in the grade-point average, although degree credit is earned only once.

### Course Withdrawal—the W Grade

Students may withdraw from a course or courses without academic penalty through the 10th week of the normal fall or spring semester. Approval by the instructor of the course is not required, but the withdrawal form must be signed by the student's major academic adviser. When the duration of the course varies from the norm, such as in 6-/9- or 12-week courses, withdrawal must be filed before two-thirds of the sessions are completed. Withdrawals must be filed with the Office of Student Records by 5pm of the day indicated in the current *Schedule of Classes*. In the case of a two-week course, withdrawal must be filed by 5pm of the seventh class day. Students who file a course withdrawal form with the Office of Student Records by the scheduled deadline will automatically receive a grade of W. Once entered on the student's record, the grade of W may not be changed to any other grade. A grade of F will be 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)

Graduate students have the option of auditing courses instead of receiving units 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 six weeks of the semester of their selections of audit status. Under no circumstances may an audit status be changed to credit status once elected.

### Incomplete Grades

When for valid reasons, such as illness or other critical emergency, a student is unable to complete the course work at the usual time, the instructor may give a grade or incomplete, I. The date for completion will be inserted next to the I grade on the grade sheet and will be communicated directly to the student by the instructor when possible. Whenever feasible, this date will not extend beyond the intersession, in fairness to students who finish course requirements on time and to insure that students complete prerequisites necessary for taking advanced courses. On no account will this date be later than one year after completion of the semester for which the I was awarded.

The grade of I is used sparingly and only in cases with valid reasons, not merely because students have planned poorly or overloaded themselves. The I grade signifies that upon successful completion of the work, a passing grade will be issued.

An I grade lapses into a grade of F if the student fails to complete the course work within the specified completion date. If the student reregisters for a course in which an I grade was given, the I grade lapses to an F. All I grades must be converted prior to graduation.

### Continuation of Studies from MS to PhD

Students who plan 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 hand it in 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.

**ACADEMIC STANDING AND PROBATION**

**Undergraduate Students**

To remain in good standing, undergraduate students must maintain term and cumulative grade-point averages of 2.00 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 points at which 12 or more credits are undertaken. Thus, the first semester of study ends when 12 credits are accumulated; the second 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 below in Table 1:

**Table 1: Minimum Credits to Be Earned vs. Semester of Full-Time Study**

SEMESTER	Minimum Credits Successfully Completed
I	6
II	15
III	27
IV	40
V	54
VI	68
VII	83
VIII	98
IX	113
X	128

In calculating the number of successfully completed credits:

1. Courses with F grades do not count toward the criteria of Table 1.
2. Credits bearing the grade F and repeated within one academic year will be recalculated using the second grade earned, thus entering into the number of credits successfully completed (assuming that the second grade is not also F) during the semester in which it is repeated.
3. Credits with the grade of I will be counted toward enrollment for one year. At the end of that time, any grade of I that has not been changed by the instructor on record will automatically lapse to a grade of F.
4. Credits assigned a grade of W do not appear in the calculation of credits undertaken, earned or successfully completed.

5. Transfer students will enter the standard as calculated from the point at which transfer credits place them.

A second requisite for enrollment is the maintenance of a grade-point average of 2.00 or above, or performance approaching 2.00 in a steady and realistic fashion. Table 2 contains the absolute minimum cumulative grade-point average to be achieved by the close of each semester of full-time or full-time equivalent enrollment.

**Table 2: Minimum Required Cumulative Grade-Point Average by Semester of Full-Time Study**

SEMESTER	Minimum Cumulative GPA
I	1.30
II	1.40
III	1.50
IV	1.67
V	1.78
VI	1.88
VII	1.95
VIII	2.00
IX	2.00
X	2.00

The Office of Academic Affairs provides regular academic monitoring of all undergraduate students to review each student's academic record after each semester and inform the student's academic adviser or other representatives from the student's major department of the results of that review. Students who are identified as being in academic difficulty may not register for more than 13 credits per semester unless otherwise approved by their adviser. Students in academic difficulty will be placed on academic probation following the steps and actions described below.

**Academic Warning:** Students whose grade-point averages approach 2.00 are placed on "academic warning." Letters are sent to these students warning them of potential problems, urging them to make use of the support services available to them, encouraging them to take whatever measures are necessary to maintain good standing and inviting them to meet with their academic adviser.

**Academic Probation:** Students are placed on "academic probation" when their semester and/or cumulative grade-point averages fall below 2.00, but remain above the minimum standards of Table 2, or when their number of successfully completed credits falls below the minimum standards of Table 1. Students falling into this cate-

gory are notified by letter and are directed to meet with their advisers.

All first-year, first-time probationary students are required to enroll in and attend the Academic Skills Seminar (SL 102). The seminar consists of eight one-hour sessions, which meet once per week, and is taken on a pass/fail basis. The purpose of this seminar is to help students develop and enhance an awareness of their individual learning styles, study skills and time management techniques so they may become more successful students and return to good academic standing. Topics include establishing a mindset for success, career opportunities, setting goals, time management, overcoming procrastination, study skills, test-taking strategies and honest self-assessment. The seminar is structured in small, interactive group sessions designed to support students as they develop strategies for academic success.

**Final Probation:** Students whose academic records indicate an unacceptable level of academic progress may be placed on "final probation." Notified by letter of their standing, these students are required to meet with their adviser to determine a program of study geared towards improving their performance. Failure to improve their performance will result in disqualification. Students on final probation may not register before completing current courses.

**Disqualification:** The Committee of Standing, comprising the Office of Academic Affairs and a representative of the student's major department, shall jointly disqualify from the University any student whose cumulative average or number of credits successfully completed falls below the appropriate minima shown in Tables 1 and 2. A disqualified student may not apply for readmission for at least one year.

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. Unless accepted into another department, a student so disqualified will not be permitted to reapply to the University for at least one academic year.

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

**Dean's List:** Undergraduate students who perform at a level of demonstrated excellence are recognized by placement on the Dean's List. Undergraduate students who achieve a semester grade-point average of 3.40 or better, with no grades of F, I or U for the semester, and are otherwise in good academic standing, are commended by the Office of Academic Affairs 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. Noncredit courses HU 008 or HU 009 may count toward the 12-credit requirement as three credits. The Dean's List notation appears on the student's permanent record. 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 Office of Academic Affairs.

**Graduate Students**

A graduate student is expected to progress in the studies pursued and to maintain a B (3.0) average. Failure to do so may result in being placed on "academic probation" or "disqualified" based upon the guidelines set in the Graduate Academic Standing Table (see below). There is a written policy on graduate probation and disqualification available from the Office of Academic Affairs.

**Grade-Point Average Required to Avoid Disqualification (All Graduate Students)**

After "N" Credits Taken at Polytechnic	Matriculated or Visiting Status Transfer Credits			
	none	3	6	9 or more
N= 6	2.00	2.00	2.50	2.50
12	2.50	2.50	2.50	2.50
18	2.50	2.50	2.66	2.66
24	2.75	2.75	2.87	2.87
30	2.90	2.90	3.00	3.00

N>36, GPA≥3.00 required (check every 6 credits)

Notes:

1. Students with GPA below the entries in above table are disqualified and cannot be readmitted;
2. Students with GPA equal to or above the entries in the above table, but less than 3.00, are notified that they are on "Graduate Probation" and informed that they will be disqualified if they fall below the entries in the above table;
3. Students admitted and taking courses prior to the fall 1999 semester will receive a warning; but if such students do not meet the schedule shown in the table or attain a GPA≥3.0 for all courses taken in fall 1999, they may be disqualified for further study at the end of the fall 1999 semester;
4. 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.

At the end of the spring semester grades, graduate students whose cumulative grade-point average is below 3.0 will be notified that they are on academic probation or disqualified. Copies of probation/disqualification notices will go to each department, where the accuracy of grade-point average determinations will be checked. Students with GPAs lower than 3.0 will be notified in August by the Office of Academic Affairs.

A major department may request that a graduate student be placed on academic probation at any time that it finds a student falling below a 3.0 cumulative GPA. The request must be signed by the department head and sent to the Office of Academic Affairs.

A graduate student on academic probation may not register for further courses without the written permission of the department head and the concurrence of the Office of Academic Affairs. When a student is permitted to register, the department will provide the student with a written statement of the academic performance required for the next academic year or semester to retain permission to register in future semesters. The statement will be kept on file in both the Office of Academic Affairs and the major department office. A student may be denied permission to register by the academic department or the Office of Academic Affairs at any time while on academic probation. Students are cautioned that failure to maintain a 3.0 cumulative GPA may

result in loss of regular status and/or in refusal of permission to register.

No indication of academic probation will appear on the student's transcript, but a record will be kept on file.

**WITHDRAWAL FROM THE UNIVERSITY**

**Voluntary**

Students who withdraw completely, prior to the deadline in the schedule of courses, during a semester in which they are registered must notify the Office of Academic Affairs. No withdrawal is official unless a written form is approved and submitted to the Office of Student Records. Mere absence from courses does not constitute official withdrawal, but will lead to grades of F recorded for courses not completed. To receive grades of W for the semester, the withdrawal must be completed by the withdrawal deadline indicated in the *Schedule of Classes*.

**Involuntary**

Polytechnic University is concerned about the health, safety, and well-being of its students. Therefore, a student who is judged to be a threat to himself or herself, or to others, may be involuntarily withdrawn from Polytechnic. The University seeks, whenever possible, for such a student to be allowed to continue as an active student if he or she agrees to involve himself or herself in appropriate care from a professional. Full details concerning this policy are available from the Office of Student Development.

**LEAVES OF ABSENCE AND READMISSION**

**Automatic Withdrawal**

Students who have not formally filed a leave of absence and who do not register for two consecutive semesters or two consecutive semesters beyond the authorized leave will be automatically withdrawn. Students placed 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.

**Undergraduate Students**

An undergraduate student wishing a leave of absence must obtain permission from the Office of Academic Affairs. A student desiring to re-enter after a period of absence of one year or more must submit a request for readmittance by filing an application for readmission with the Office of Admissions.

## ACADEMIC PROGRAMS AND POLICIES

### *Graduate Students*

Full-time or part-time students who desire to interrupt their studies may request a leave of absence for a specified period of time, usually not exceeding one year. Such requests, when approved by the Office of Academic Affairs, will constitute assurance of readmission to the degree program from which the leave was taken. If the period of absence exceeds the approved leave of absence, the student must apply for readmission.

Only if a part-time or full-time student has received an approved leave of absence will the time limitation on earning a graduate degree be extended by the period of the leave. Forms for requesting a leave of absence are available from the Office of Academic Affairs.

Once a PhD student has begun the dissertation, registration must be continuous, and a leave of absence is required for semesters in which the student will not be registering for dissertation units. Students failing to obtain a leave of absence who subsequently wish to be readmitted may be required to register retroactively for those semesters not attended.

### **THE FAMILY EDUCATIONAL RIGHTS AND PRIVACY ACT (THE BUCKLEY AMENDMENT)**

The Family Rights and Privacy Act of 1974 (FERPA), as amended (also known as the Buckley Amendment), grants to students certain rights, privileges and protections relative to individually identifiable student education records which are maintained by the University. Specifically, these include the right to:

- inspect and review the student's education records;
- request the amendment of such records to ensure that they are not inaccurate, misleading, or otherwise in violation of the student's privacy or other rights;

- consent to disclosure of personally identifiable information contained in the student's education records, except to the extent that Polytechnic's disclosure policy and directory information permits;
- obtain a copy of the Polytechnic's policy on meeting the requirements of FERPA, which is made available through the Student Records Office on each campus; and
- file with the U.S. Department of Education a complaint concerning alleged failure by the University to comply with FERPA.

FERPA permits the release of directory information to third parties outside the Polytechnic without written consent, provided students have been given the opportunity to withhold such disclosure.

Polytechnic reserves the right to disclose the following information related to a student, which is considered "directory information:" the student's (1) name, (2) class year, (3) date/place of birth, (4) major field of study, (5) participation in officially recognized activities and sports, including weight and height of members of athletic teams, (6) dates of attendance at Polytechnic, (7) degrees and awards received, (8) the most recent previous educational institution attended by the student, (9) home and local addresses and telephone numbers and (10) any other similar information (e.g., the title of the student's MS project or doctoral dissertation, distinguished academic performance). Currently registered students who wish to withhold directory information may do so by following the directions in the "Regulations on Privacy Rights for Students" brochure available from the Office of Student Records.

### **TRANSCRIPTS**

The issuance of transcripts and generally the release of any information about a student is subject to the provisions of Public Law 93-380, The Family Rights and Privacy Act of 1974 as amended. Polytechnic has adopted regulations to implement the Act, and these can be found in the previous section.

Unless Polytechnic's disclosure policy permits otherwise, official transcripts of the scholastic record will be issued only upon the submission of a written request or upon the submission of a signed release from the student. Official transcripts will be sent directly to a school or other properly authorized parties. In no case can a student receive an official copy of his or her own transcript, unless specifically authorized by the Registrar. Such exceptions are strictly monitored and are rarely given. Unofficial transcripts are available to any student upon written request. The first transcript will be issued without charge. There is a fee for each subsequent transcript issued.

Polytechnic reserves the right to withhold the issuance of a transcript due to the student's failure to meet financial indebtedness to Polytechnic.

Upon graduation, a student's transcript should be reviewed carefully and any errors immediately reported to the Office of Student Records before the record is sealed.

### **INTELLECTUAL PROPERTY**

The University has a written policy on intellectual property, available in the Office of Academic Affairs, which governs faculty and student project work, in terms of rights, benefits and releases.

# CAMPUS LIFE AND SUPPORTING SERVICES

## DEPARTMENT OF STUDENT DEVELOPMENT

The Department of Student Development is concerned with the holistic education and development of all Polytechnic students, both inside and outside the classroom. Responsible for the operation and maintenance of many student-oriented and student support programs and services, the Department of Student Development seeks to assist students in achieving success and enrichment in their endeavors at Polytechnic. Students needing assistance in resolving difficulties are encouraged to speak with a Student Development staff member. Some of the areas handled by this office include:

- Freshman programs, such as the New Student Overnight and the freshman seminar (SL 101)
- Student activities
- Residence life and housing
- Student leadership development
- Counseling, advising and student advocacy
- Health insurance coordination
- Disciplinary policy administration
- Services for students with disabilities

## OFFICE OF SPECIAL SERVICES

Addressing the counseling and tutoring needs of the Polytechnic student is the primary goal of the Office of Special Services. The Office of Special Services is, in part, a TRIO program funded by the United States Department of Education. Therefore, some students requesting assistance must first meet eligibility guidelines. All tutorial, educational and support services are provided free of charge.

To enable the Polytechnic students to maximize their potential, the Office of Special Services offers a variety of counseling services. Interested students may take advantage of individualized study skills advisement or workshops dealing with note taking, time management and test taking. These academically related skills assist students in successfully mastering the technical curriculum at Polytechnic. The Office of Special Services also provides personal counseling and career guidance. On-site visits and tours are arranged to help students explore the various opportunities available to them when they leave school.

An individualized tutoring program is available to students who meet TRIO requirements. The Office of Special Services staff will assign tutors to meet with students one-on-one for the entire semester. Qualified upperclassmen serve as physics, calculus, chemistry and science tutors.

## THE LEARNING CENTER

The Learning Center offers assistance to all students who are having difficulty in the freshman and sophomore level courses in chemistry, physics, calculus and computer science. The Learning Center provides drop-in tutoring to all Polytechnic students. Since there is no long-term commitment with drop-in tutoring, students may come in when they wish for as long as is needed and have their immediate needs addressed. A staff of upperclassmen will assist the students who have specific problems with their studies. All of the services offered by the Learning Center are free.

## OFFICE OF CAREER SERVICES AND COOPERATIVE EDUCATION

The Office of Career Services and Cooperative Education is available to assist students in meeting their varied career needs. Polytechnic students are encouraged to begin taking an early and active role in planning for their career development. For this reason, the goals of the Office of Career Services are to assist students in:

- becoming better informed of their career options
- identifying and pursuing their abilities and interests
- providing experiences and services which will allow students the opportunity to apply their skills and academic background in paid and nonpaid work assignments
- deciding whether to pursue graduate study or full-time employment
- making a successful transition from the academic setting to the business, government and industrial sectors

Students at every academic level are encouraged to speak with professional staff concerning both their career development and job placement needs. Ongoing developmental career services include career fairs; career exploration workshops and seminars; and individualized counseling concerning job skills (résumé writing, job search and interviewing techniques) and career decision making.

Job placement services help students gain valuable work experience in both engineering and non-engineering positions. Full-time and part-time job banks, summer job assistance and our extensive recruiting program meet the needs of job-seeking students. The demand for Polytechnic graduates is great, as evidenced by the more than 200 companies that recruit on campus each year. These companies conduct more than 1,500 interviews yearly, resulting in

## CAMPUS LIFE AND SUPPORTING SERVICES

employment for many of our graduates. During 1998, the placement rate for Polytechnic BS graduates was 93.7%.

Alumni are welcome to use the resources of the office when planning or making career or job changes. In addition to the corporate library, job bank and other reference periodicals and literature, individualized counseling is available on a limited basis.

### COOPERATIVE EDUCATION

Beginning in the sophomore year, students may participate in the Cooperative Education Program. Students, whose academic programs permit, may take a semester off from classes and work full-time with a Co-op employer. Students may also apply for part-time positions with local employers. Co-op gives students the advantage of gaining needed job experience *before graduation* while exploring their career goals. This experience contributes to a student's ability to make career decisions, motivates academic performance and provides a competitive advantage in the workplace. Please see "Cooperative Education Program" in this catalog for more details.

### EXECUTIVE SCHOLARS PROGRAM

The Executive Scholars Program is a four-year developmental program designed for entering freshmen who have the leadership and academic potential to pursue top-level management positions in business, government and other nonprofit organizations. This program is designed to promote academic excellence and valuable work experience.

Executive scholars are required to participate in activities that will nurture their leadership potential, guide them in their career decisions and support their success in academic studies. A cooperative education experience is an integral component of the program.

The University is confident that a student who successfully completes the Executive Scholars Program and graduates with a 3.0 GPA will obtain one or more job offers related to their major. If an offer of employment is not received within six months of

graduation, the executive scholar will receive tuition remission for 15 graduate credits at the University, assuming that all admission criteria have been met.

### COUNSELING SERVICES

At times, students can find themselves dealing with a range of situational or personal roadblocks which may interfere with their ability to succeed academically. The University is committed to assisting students in addressing these concerns. Free, confidential counseling is available on-site through the Office of Special Services. Typical areas of concern include study habits, adjustment problems, stress management, relationship difficulties and depression.

If deemed necessary, referrals to off-site services are made. Fees are charged by these external organizations, with many agencies offering sliding-scale rates to match the student's ability to pay. In addition, many agencies will accept payments from insurance carriers if the student's policy covers counseling and evaluation services. Students seeking an off-campus referral can receive assistance from the Office of Special Services.

### NEW STUDENT ORIENTATION

Polytechnic seeks to ease the new student's transition to his or her new environment with a variety of programs designed to orient and welcome new students every semester. These programs include an overnight orientation program in the fall, on-campus new student orientation days in the fall and spring semesters, programs for parents of freshmen and other social activities in addition to the Freshman Seminar—SL 101 (see following section).

We encourage every new student to attend all orientation events. These programs provide a vital link for securing a strong relationship with the Polytechnic community. For example, in August of every year the New Student Overnight, which takes place at an off-campus facility, brings together Polytechnic faculty, administrators, staff, alumni, upperclass students and new students. This unique

interaction allows new students to become familiar with faces in the Polytechnic community before they begin classes. The event is offered at no additional cost and is open to both undergraduate transfer students and freshmen.

### FRESHMAN SEMINAR (SL 101)

SL 101\* is required for all entering first-year college students with fewer than six transfer credits. It is an extended orientation to the academic and social challenges of higher education and a preparation for the critical choices and decisions college students must make.

SL 101 is designed to introduce freshman students to Polytechnic University and to support their efforts to achieve success in this environment. New academic challenges and responsibilities, new people and situations, new time demands and commitments are among the factors in the transition to college. This seminar provides students with opportunities to develop new skills and resources which may enhance their chances for success. SL 101's educational experience incorporates the richness of resources from both inside and outside the Polytechnic community. The seminar consists of a variety of guest lecturers, small group workshops, presentations and sessions reserved for small group discussion on topics of particular interest to each group. This diversified experience sets the stage for each new freshman at Polytechnic to explore why he or she has chosen Polytechnic and how he or she can get the best out of his or her Polytechnic education.

#### Topics covered in the course include:

- Study skills—(including note taking, test taking, effective reading)
- Time management and goal setting
- University resources and support services
- Campus involvement and student activities
- Effective library research skills
- Career awareness
- Effective communication techniques
- Health and wellness (including stress management and alcohol and drug issues)

\*SL 101 is a zero-credit course that counts toward bachelor's degree requirements.



**OFFICE OF  
ACADEMIC AFFAIRS**

The Office of Academic Affairs directs the review of students' progress each semester to determine academic standing. Decisions regarding the Dean's List and probation are made and notifications are sent to the students and their respective academic departments. Students are directed to meet regularly with their advisers to discuss academic progress and address questions concerning their academic standing. Students who are undecided about a major are advised by the Office of Academic Affairs until such time they declare a major.

**UNDERGRADUATE  
ADVISERS**

Undergraduate students are assigned advisers in their respective major departments. Undecided or undeclared majors are advised by the Office of Academic Affairs. These departmental advisers are available for individual appointments to discuss academic and related matters. A student's adviser must sign all registration, program adjustment and course withdrawal forms.

**GRADUATE ADVISERS**

Representatives of the various departments are assigned as advisers to assist graduate students in the selection of courses to meet their individual needs, to aid them in planning a program for an advanced degree and to guide them in their professional advancement.

**INTERNATIONAL  
STUDENTS**

All international students and scholars are *required* to contact the international student adviser in the Office of Admissions immediately upon arrival. Students must bring their immigration documents and passports with them for their check in.

Polytechnic University has enrolled international students in both graduate and undergraduate studies for many years. Students holding visas make up nearly 15% of the Polytechnic population and are an integral part of the University. Faculty and administrators are sensitive to the needs of international students and strive to meet them. Services for international students are coordinated by the international student adviser, who is primarily located on the Brooklyn campus. International students on the Long Island and Westchester campus may contact the adviser by telephone or go to the Office of Admissions on the Brooklyn or Long Island campus for assistance.

Information regarding immigration compliance, housing, health insurance, special events and referrals is available through the International Student Office. For further information, consult those sections dealing with graduate and undergraduate admissions.

**STUDENTS WITH  
DISABILITIES**

Polytechnic University fully 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. Likewise, the University does not discriminate in its admissions practices and bases acceptance decisions primarily on academic records.

Polytechnic is committed to assisting students with disabilities in developing the personal, as well as academic, skills necessary to fully participate in student programs. To that end, services are provided to students with disabilities based on their individual needs. The University is particularly interested in working with these students so they may become effective self-advocators.

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

Although not every student with a disability requires services, registering with the Department of Student Development is advised.

**REQUIRED  
IMMUNIZATION**

New York State law requires students to show proof of immunity to measles, mumps and rubella. Polytechnic will comply 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 will be checked as part of the registration process. Students who are not in compliance with the law (1) will be barred from attending class (and will not be entitled to any tuition refund); (2) will not receive grades; and (3) will be denied further registration.

For forms or information on this requirement, or to submit the required proof, please contact the Department of Student Development in Brooklyn or Farmingdale, or the Administration Office in Westchester.

**ALCOHOL AND  
DRUGS**

In conformity with New York State law, Polytechnic prohibits the unlawful possession, manufacture, use or distribution of illicit drugs and alcohol on its property or as part of any of its activities. Violations of this policy will result in disciplinary actions pursuant to the University Code of Conduct. Furthermore, Polytechnic will not protect those who violate these laws, nor will it interfere with law enforcement agencies that may pursue violators of these laws.

Students may not possess, consume or distribute alcohol on University premises or at University-sponsored activities. Exceptions apply to the following circumstances: consumption or possession by students over the age of 21 in their residence hall rooms, unless prohibited by residence hall policy; consumption by students over the age of 21 at a University-sponsored activity where express permission to serve alcohol has been obtained from the Director of Student Development.

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

## ACCIDENT AND SICKNESS INSURANCE

Currently, all full-time students (graduate and undergraduate) are covered by accident insurance, at no additional charge. Complete health insurance coverage is mandatory for all students and may be provided through a private policy or the University's insurance program.

Information on the Polytechnic accident insurance (free for all full-time students) and sickness insurance (additional fee) policies is sent annually to full-time students. If you do not receive these materials, or need further information, contact the Department of Student Development. Spouses and dependents of full-time students are eligible for insurance coverage.

Polytechnic does not maintain health facilities on its campuses. In a health emergency, students should contact security and/or the Department of Student Development to arrange for emergency transportation to a hospital.

## GUIDELINES ON STUDENT RELIGIOUS OBSERVANCES

The faculty of the University 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.

- No student will be expelled or refused admission to the University because he or she is unable to participate in any examination, study or work requirement because of his or her religious obligations and practices.
- The University will accept the responsibility of making available to each student who is absent from school because of his or her religious obligations and practices an equivalent opportunity to make up any examination, study or work

requirement which may have been missed because of such absence on any particular day or days.

- The University requires students to notify the instructor in writing, no later than the fifteenth day after the first day of the semester, of each class scheduled for a day on which the student will be absent because of his or her religious obligations and practices.
- In effecting these provisions, the University's administration and faculty agree to exercise the fullest measure of good faith and agree that no adverse or prejudicial effects should result to any student who avails himself or herself of these guidelines on religious observances.

## STUDENT RETENTION

As required by the New York State Education Department Higher Education Data System, Polytechnic conducts a yearly cohort survival analysis. This study is designed to collect data for a group or cohort of first-time, full-time freshmen (never attended college before) who enter Polytechnic. The data measure retention patterns and indicate the amount of time needed to complete undergraduate degrees at Polytechnic.

For the 1998 cohort study of first-time, full-time students, the fall 1994 entering class had a four-year graduation rate of 39 percent, while 45.2 percent of the entering class of fall 1993 graduated within five years and 47.8 percent of the entering class of fall 1992 graduated within six years.

## ATHLETICS

For information on intercollegiate and intramural athletics, please refer to the section titled "Physical Education and Athletics," featured toward the end of this catalog.

Recreational activities are offered at the gymnasium located on the Long Island campus, and at the Wunsch Student Center

and Rogers Hall lower level on the Brooklyn campus (specified hours only). Contact the Department of Physical Education and Athletics for more information.

## COCURRICULAR STUDENT ACTIVITIES

Student activities are an integral part of the educational process. Participation in student activities fosters the development of leadership and interpersonal skills. Polytechnic believes that involvement in student activities broadens the academic experience of students who participate.

## ORGANIZATIONS AND ASSOCIATIONS

There are more than 50 student organizations, honors societies and fraternities on the Brooklyn and/or Long Island campuses. Each group is responsible for fulfilling the purposes of the organization as set forth in a constitution or charter. Student organization documents are filed with the appropriate student governing body on the Brooklyn and Long Island campuses.

## STUDENT GOVERNMENT

The student government is the student voice at Polytechnic. It is responsible for administering student activities fees, social and cultural programming and other co-curricular activities. There are separate student governing bodies on the Brooklyn and Long Island campuses—the Student Council (Brooklyn) and the Student Government Organization (Long Island). Student government officers are undergraduate students elected by their peers.

## PROFESSIONAL AND DEPARTMENTAL SOCIETIES

Professional and technical societies are established in conjunction with the various departments to enhance the curricula at Polytechnic. The 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.

**Professional and Departmental Societies**

- American Institute of Aeronautics and Astronautics
- American Institute of Chemical Engineers
- American Society of Civil Engineers
- American Society of Mechanical Engineers
- Association of Computing Machinery
- Institute of Electrical and Electronics Engineers
- National Society of Black Engineers
- National Society of Professional Engineers
- Society of Automotive Engineers
- Society of Hispanic Professional Engineers
- Society for Human Resource Management
- Society of Physics Students
- Society of Women Engineers

**HONOR SOCIETIES**

On the basis of their superior academic record and cocurricular achievement, students are selected during their junior and senior years to one of the Polytechnic chapters of a national honorary fraternity. Closely allied to the professional and technical societies, these honorary fraternities encourage and recognize outstanding scholarship and leadership.

**Honor Societies**

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

**FRATERNITIES AND SORORITIES**

Polytechnic has four social and service fraternities and one social sorority. One of them owns property in the Brooklyn area and offers live-in accommodations. The fraternities and sorority hold an impressive array of social functions for their own members and provide service to the University community. They coordinate blood donation drives, annual charity drives, athletic tournaments, parties and more.

**Fraternities**

- Alpha Phi Omega (service)
- Lambda Chi Alpha (social)
- Omega Phi Alpha (social)
- Tau Delta Phi (social)

**Sorority**

- Sigma Phi Lambda (social)

**SOCIAL, CULTURAL, RELIGIOUS, MEDIA AND OTHER ORGANIZATIONS**

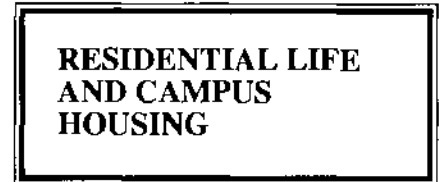
There are student organizations at Polytechnic to suit almost every interest, whether social, intellectual, religious, musical, cultural or athletic. Many of the organizations have a long and distinguished history.

**Social, Cultural, Religious and Other Organizations**

- Art Club
- Asian Student Association
- Association of Latin American Students
- Association of Russian Students
- Biomedical Engineering Society
- Chess Club
- Chinese Student Society
- Chinese Students and Scholars Association
- Construction Management Association
- Demokritos (Greek Club)
- Financial Engineering Association
- Graduate Chinese Student Association
- Haitian Student Association
- Hong Kong Student Association
- Indian Pakistani Organization
- Jewish Student Union
- Korean Student Association
- Malaysian Student Association
- Media Arts Club
- Muslim Student Association
- Polytechnic Animation Club
- Polytechnic Electronics & Robotics Club
- Polytechnic Engineering Society
- Polytechnic Gamers Association
- Polytechnic Intersivity Christian Fellowship
- Polytechnic Italian Cultural Club
- Polytechnic University Radio
- Programming Advisory Board
- Resident Hall Association
- Society of Human Resource Management
- South Asian Student Association
- Vietnamese Student Association
- Weightlifting Club

**PUBLICATIONS**

- Counterweight  
(Brooklyn campus literary magazine)
- The Fusion  
(Long Island campus newspaper)
- Innovations  
(Long Island campus yearbook)
- Polywog  
(Brooklyn campus yearbook)
- Reporter  
(Brooklyn campus newspaper)



A residential life program is an integral part of college life and can greatly enhance your college experience. Resident students become members of a supportive peer community in an academic environment which offers the opportunity to more fully develop academically and socially. The residential life experience helps students to develop personal responsibility as it supports them in meeting their academic goals. Polytechnic is committed to providing safe and affordable housing for students who are interested in a residential life experience.

Campus housing is available for matriculated, full-time, undergraduate and graduate students. It is not appropriate for married students seeking housing for their families. Inquiries about campus housing should be made to the Office of Student Development on the appropriate campus.

### ***CAMPUS HOUSING AT THE LONG ISLAND CAMPUS***

There are three residence halls on the Long Island campus, accommodating approximately 145 students. West Hall primarily houses freshmen, in two distinct areas (by gender), with two persons per room. East Hall houses others in suites accommodating 4–5 persons.

All residence halls have laundry facilities and a common area. Students participate in a meal plan; small refrigerators for convenience items are allowed in each room; the common area has a microwave. The cafeteria is in the main building.

All residence halls have in each room or suite cable TV, campus phones and fiber optic connections to the computer network, with basic service provided at no additional cost.

### ***CAMPUS HOUSING SERVICE AT THE BROOKLYN CAMPUS***

At the Brooklyn campus, housing is offered to students in cooperation with the Richard L. Conolly Residence Hall at Long Island University. This facility has trained professional and student staff, who work and live in the residence halls. In addition to providing 24-hour security, both residence halls are well maintained.

**Richard L. Conolly Hall** is just five blocks, and a 10-minute walk, from Polytechnic. It houses undergraduate students; however, graduate students may choose to live at Conolly Hall as well. First-time residents are usually placed in standard double occupancy rooms. A standard 12' x 20' room has two wardrobes, chests of drawers, desks, and beds. Conolly Hall, which houses up to 600 students, is open year-round. All rooms, and most floors, are single-gender. Common bathroom and shower facilities are located on each floor. Where floors are coed, separate facilities are provided. The meal plan is mandatory. Other facilities within the residence hall include a personal computer laboratory equipped with IBM personal computers and a multipurpose game room with pool table, vending machines and television. Dining room and coin-operated laundry facilities are conveniently located on the premises.

### ***CAMPUS HOUSING REQUIREMENTS***

All resident students are required to have a Health Examination Form completed by their physician certifying their good health. Additionally, resident students must have medical insurance coverage.

### ***OFF-CAMPUS HOUSING OPPORTUNITIES***

Students interested in off-campus housing may take advantage of announcements made available through the off-campus housing postings on bulletin boards at each campus. An off-campus housing fact sheet is available for the Brooklyn campus.

## **UNIVERSITY CODE OF CONDUCT**

The University Code of Conduct is distributed regularly to all students by the Department of Student Development. This document gives notice of prohibited behavior and outlines the procedures to be followed in the event of a breach of this code. This document is dedicated to the protection and promotion of the academic enterprise.

# ADMISSIONS

The course of studies at Polytechnic is academically rigorous and intellectually challenging; therefore, admission to Polytechnic is highly competitive. 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 Admissions according to criteria established in concert with the University's Undergraduate Enrollment Council.

## GRADUATE

To be eligible for admission as a graduate student, an applicant must first hold a bachelor's degree from an institution acceptable to Polytechnic. Attention will be given to listings by the Accreditation Board for Engineering and Technology, the American Chemical Society, the Computer Science Accreditation Board and the 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 must anticipate the need to take additional courses for which graduate credit may not be given. (See "Conditional Status.")

The previous program of study must be acceptable, in quality and quantity, to Polytechnic. Reprints of published articles, copies of scientific patents, photostats of professional reports and other evidence of superior attainment and aptitude for graduate study and research are welcomed.

Graduate admission information can be obtained from the Office of Graduate Admissions, Polytechnic University, Six MetroTech Center, Brooklyn, New York 11201, 718/260-3200 or e-mail: [admitme@poly.edu](mailto:admitme@poly.edu).

### ADMISSIONS PROCEDURES

In addition to the application form and fee, an applicant must have transcripts of any previous undergraduate (and graduate) records sent directly to the Office of Graduate Admissions. An application

should be supported by letters of recommendation from persons qualified to comment on the applicant's aptitude for graduate study and research, and standardized admission test results where required. Action on an application will be taken as soon as possible after all supporting documents have been received.

### EXAMINATIONS

The Graduate Record Examination (GRE) or Graduate Management Admission Test (GMAT) is required for admission to some graduate programs. Consult the departmental section of this catalog for specific requirements about the degree program to which you are applying.

Information about GRE and GMAT may be obtained from The Educational Testing Service, 20 Nassau Street, Princeton, New Jersey 08541.

### INTERNATIONAL APPLICANTS

An international student must complete an application for admission by May 1 (fall admission), October 15 (spring admission) or March 1 (summer 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.

The Test of English as a Foreign Language (TOEFL), administered by the Educational Testing Service, is required of all international applicants who have earned a bachelor's degree from an institution in a non-English speaking country and/or speak English as a second language. The Test of Spoken English (TSE) is required of all teaching fellowship applicants from non-English speaking countries.

Certification of ability to meet financial obligations is also required.

### STATUS

Within the full-time and part-time classifications of graduate admission are four status groups: regular, conditional, provisional and special. A change in status from conditional to regular should be applied for when the conditions of admission are satisfied. A special or provisional 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*

A graduate degree or certificate applicant who is required to demonstrate additional ability to pursue the program applied for is assigned conditional status. Conditions may include introductory level or undergraduate courses, or attainment of a specified grade-point average.

#### *Provisional Status*

A graduate degree applicant whose file is lacking documents necessary for academic evaluation may be permitted to register for one semester with provisional status. The applicant must provide all required admission documents to the Office of Graduate Admissions before the sixth week of the semester. If the applicant is not accepted for admission, the semester can be completed or a withdrawal with full refund may be requested. Subsequent registration will not be permitted.

#### *Special Status*

An individual requesting permission to register for one or two courses in a specific semester is assigned special admission status. A formal application for admission may or may not have been filed with the Office of Graduate Admissions. Included in this status are individuals who want 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 six units or two courses may be taken in one semester and no more than nine units 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

## ADMISSIONS

the individual remains in this status. Permission to take courses as a special student does not imply admission to a degree program. Special (graduate) students must hold a bachelor's degree from an institution acceptable to Polytechnic. Proof of that degree may be required.

### **Readmission**

Part-time students who last attended Polytechnic within a one-year period before the semester in which they seek to be readmitted need no formal readmission and are automatically permitted to register. Part-time students who have not attended within the past year must file an application for readmission, which is available from the Office of Graduate Admissions.

Full-time students who desire to interrupt their studies must request a leave of absence for a specified period of time, usually not exceeding one year. Such requests, when approved by the Office of Academic Affairs, and the Office of International Students and Scholars, will constitute assurance of readmission to the degree program from which the leave was taken. When the period of absence exceeds the approved leave of absence, the student must apply for readmission.

### **EARLY GRADUATE ADMISSION**

A Polytechnic undergraduate student within 18 credits of completing the BS degree and otherwise meeting all criteria for graduate admission may apply for admission to graduate study in a given department. If accepted, the student will be pursuing two degrees simultaneously, taking both graduate and undergraduate courses for no longer than one year. Graduate courses taken during that year and not used to satisfy undergraduate degree requirements are counted towards the master's degree program, and the grades are recorded on the graduate transcript. A formal application for graduate admission must be filed through the Office of Graduate Admissions.

## UNDERGRADUATE

### **THE APPLICATION PROCESS**

Application materials and information about undergraduate admissions may be obtained by telephoning or writing the Office of Undergraduate Admissions at either of the following locations:

#### **BROOKLYN**

Polytechnic University  
Six MetroTech Center  
Brooklyn, NY 11201  
718/260-3100  
718/260-3446

#### **FARMINGDALE**

Polytechnic University  
Route 110  
Farmingdale, NY 11735  
516/755-4200  
516/755-4229

e-mail: [admitme@poly.edu](mailto:admitme@poly.edu)  
[www.poly.edu/admissions](http://www.poly.edu/admissions)

Undergraduate applicants should complete the application for admission and forward it to the Office of Admissions with either the non-refundable application fee or a fee waiver request form. Applicants should request that their secondary school and/or college forward official copies of transcripts to the Polytechnic Office of Admissions. All freshmen applicants and transfer applicants with less than two complete years of college are required to submit test scores of the Scholastic Assessment Test (SAT) or the American College Testing Program (ACT).

Polytechnic's admission process operates on a rolling basis; however, applicants are encouraged to apply early. Preference will be given to applicants who submit all of their documents according to the following timetable:

Full-time undergraduate study:

November 1 – for the spring semester

February 1 – for the fall semester

Candidates for freshman admission to the fall term who submit their applications and all of their documents before January 15 will receive a decision by February 1. Freshman candidates for the fall term who apply after February 1 will receive an admission decision within two weeks after submission of all documents. Admission of fall freshman applicants who apply after February 1 will, of course, depend upon the availability of space at that time.

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, nor after June 1 for the fall semester. All official records, together with notarized translations, must also be received by these dates. (See "Admission as an International Student" for additional information.)

If accepted for admission, the applicant should submit an enrollment deposit of \$250 in order to reserve a place in the entering class. This fee will be applied to tuition and fees for the first semester. This deposit is not refundable after May 1 for the summer or fall semester, nor after January 1 for the spring 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**

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 A FRESHMAN**

#### **Examinations**

Applicants for admission as freshmen are required to take the Scholastic Assessment Test (SAT). The American College Testing Program may be substituted for the College Board examinations. Students who are admitted to Polytechnic and plan on enrolling will be required to take two placement examinations prior to registration.

The preferred secondary school course of study is:

(course)	(years)
English	4
Foreign Language	2
Science	4
(Physics and chemistry strongly recommended)	
Mathematics	4
(Sequential I, II, III, precalculus, calculus)	
Social Studies	3
Electives	2

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 the University.

#### ***Interviews and Campus Tours***

Prospective students are strongly encouraged to visit the campus of their choice. Arrangements can be made by calling the Office of Admissions at the appropriate campus. If arrangements are made in advance, prospective students are welcome to have an interview with a member of the admissions staff during their visit to Polytechnic.

#### ***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. Similar consideration will be given to those with exceptionally good scores on the Higher Level of the International Baccalaureate Exam, the French Baccalaureate or General Certificate Exam A level.

Specific requirements for administering college credit, for the Advanced Placement and the International Baccalaureate Exam, French Baccalaureate or General Certificate Exam "A" levels, etc., vary from department to department. Students will be required to take a placement exam in order to determine their freshman course selection.

#### ***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. 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 remedial work during the summer prior to beginning the freshman year, to make up prerequisites and courses in which weakness 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.

HEOP is available at the Brooklyn and Long Island campuses. For further information, contact the Director of HEOP at 718/260-3370 (Brooklyn) and 516/755-4252 (Long Island).

#### ***ADMISSION AS AN INTERNATIONAL STUDENT***

International students must meet four basic criteria for admission to Polytechnic and receipt of a valid I-20 or IAP-66:

- Academic credentials (grades, certificates, degrees) must be assessed as suitable for entry to the appropriate University program.
- The Test of English as a Foreign Language (TOEFL) is required of all students whose native language is not English.
- The Polytechnic Declaration and Certification of Finances (Affidavit of Support) must be duly signed and accompanied by a bank statement signed by a bank official.
- 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 when 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 who have not completed two years of college work should submit official transcripts of previous college and high school grades, and SAT I or ACT scores. Students who have completed two or more years of college need only submit official college transcripts.

If accepted, transfer students should meet with a member of the admissions staff and a departmental adviser to determine which credits are transferable. Students are required to submit their college catalog describing courses under consideration for transfer credit.

Transfer students accepted under the Undergraduate Waiver of Admissions Credentials Plan must submit official transcripts within 30 days of their first registra-

tion, or further registration will be prohibited.

Transfer credits will be evaluated prior to the end of the first semester the transfer student is enrolled at the University. Core courses are evaluated by the Office of Admissions. Upper level courses are evaluated by individual major and technical 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 a specific course content through either oral or written examinations given by the appropriate 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 the computation of the Polytechnic grade-point average. New transfer students may be admitted on a part-time or full-time basis and may be required to take placement examinations in writing and/or math.

The minimum residence requirement for transfer students who wish to qualify for a Polytechnic bachelor's degree is 34 semester hours in approved upper division subjects taken at Polytechnic.

#### ***TRANSFER AGREEMENTS***

To provide students with alternative pathways to a bachelor's degree and to facilitate the transfer process, Polytechnic University has developed cooperative programs with other liberal arts and two-year institutions. Qualified students completing pre-engineering programs at these institutions are guaranteed admission to Polytechnic University. These students may fulfill the requirements for a bachelor's degree in a variety of designated fields.

Students participating in cooperative 2-2 programs in pre-engineering complete a specified two-year academic program. Upon satisfactory completion of curriculum requirements, the student then transfers

## ADMISSIONS

and completes the bachelor's degree at Polytechnic University.

Cooperative 3-2 programs provide students the opportunity to complete both a bachelor's degree in liberal arts and a degree in engineering, reasonably, within a five year period. Students register at cooperating liberal arts institutions for three years of study and then transfer to Polytechnic as engineering majors for an additional two years.

Cooperative programs currently exist with Brooklyn College, Kingsborough College and Union County College.

Students interested in learning more about these cooperative programs are urged to contact the Admissions Office at Polytechnic University.

### **ADMISSION AS A PART-TIME STUDENT**

Students seeking a bachelor's degree may enroll on a part-time basis (11 credits or less) at the Brooklyn or Long Island campus. 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 will be notified when to contact the adviser of their major department. In some cases, this may be accomplished during registration.

### **SPECIAL AND VISITING STUDENTS**

Undergraduate students may also register for a maximum of two courses per semester on a nondegree basis. Application for admission under this special status may be completed during registration. A special nondegree status may satisfy the needs of:

- Applicants for graduate admission seeking courses to satisfy undergraduate or prerequisite deficiencies.
- Students seeking specific courses.
- Students seeking specialized proficiency in a major area of knowledge.
- Students from other colleges wishing to transfer credit back to their college.

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.

### **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") are required to apply for readmission through the Office of Admissions. Students applying for readmission through the Office of Admissions will be expected to state their reasons for leaving the University and are expected to explain why they desire to return. Official transcripts of college-level courses taken during this period of absence from Polytechnic must be submitted with the application for readmission.



# FINANCIAL AID

## GRADUATE

### **GRADUATE FELLOWSHIPS**

Fellowships are available for advanced study leading to master's and PhD degrees in engineering and science. They are awarded through the department in which the applicant is enrolled, or to which he or she has applied. An entering student may apply for a fellowship by completing the appropriate question on the Application for Graduate Admission form. A continuing student should consult her or his academic department.

#### **Research Fellowships**

Students receiving research fellowships are assigned to research leading to the fulfillment of 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 12 or more units per semester, which may include 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.

#### **University Scholars**

University 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. University Scholars must be registered as full-time students taking 12 or more units per semester, which may include their thesis. Students working toward the PhD must also complete the thesis requirement of the department and University.

#### **Special Fellowships**

Individual departments administer special fellowships sponsored by industry and foundations, each with its own conditions, for students in the department. Information on special fellowships may be obtained from the departmental office.

### **MAYOR'S GRADUATE SCHOLARSHIP PROGRAM**

In an effort to strengthen the relationship between the City of New York and Polytechnic University, the Mayor's Graduate Scholarship Program provides scholarships for part-time graduate students who are full-time employees of the City of New York. Half-tuition scholarships are awarded each year to students studying in the fields of management, computer science and engineering. Scholarships are renewed each semester until the courses of study for the MS degree is completed, provided the student maintains an overall B average.

Two applications are necessary to be considered for the scholarship. The student must submit an application for graduate admission to Polytechnic University and be accepted. In addition, students must complete the Mayor's Graduate Scholarship Application, available from the New York City Department of Personnel. Interested students should check with the city for their application deadline. To be considered for a scholarship, all applications must be submitted by May 31. Scholarship recipients are notified of the award in late June.

### **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 Polytechnic. The plan provides a tuition reduction of one-half for graduate courses taken at any campus. Degree candidates and special students

are eligible.

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, must be submitted to the Office of Admissions. 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.

### **GRADUATE TUITION ASSISTANCE PROGRAM (TAP)**

Graduate TAP is an entitlement grant program administered annually by the New York State Higher Education Services Corporation (NYSHESC) for New York State resident students.

Eligible applicants must (1) be New York State residents, U.S. citizens or eligible noncitizens, (2) be enrolled full-time as a matriculated student and (3) meet income requirements established by New York State.

The award amount depends upon the tuition charge and net taxable income. TAP may be received for eight semesters of graduate studies. Applicants must apply annually to NYSHESC using the TAP Student Payment Application. Applications are available in the Office of Financial Aid and must be submitted prior to the May 1 deadline during the award year. TAP recipients will receive an award certificate from NYSHESC that is to be presented to the Office of Student Records and Accounts for payment/deferment.

### **FEDERAL SUBSIDIZED STAFFORD LOAN**

Graduate students may apply for a Federal Subsidized Stafford Loan for \$8,500 per academic year. The interest rate is an annual variable rate based on a 91-day T-bill plus 2.3% with a cap of 8.25%. To be eligible for a Stafford Student Loan, students must (1) be United States citizens or eligible noncitizens, (2) be enrolled for at least 6 credits per semester and matriculated, (3) be making satisfactory academic progress and (4) 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 6 credits per semester. Repayment begins six months after graduating or withdrawal from school. Immediate repayment is required if the borrower is enrolled less than half-time. Loan applications are available at lending institutions or the Polytechnic Office of Financial Aid.

### **FEDERAL UNSUBSIDIZED STAFFORD LOAN**

This loan is open to students who do not qualify for the above Federal Subsidized Stafford Loan. The same terms, conditions, annual borrowing limits and interest rates as Federal Subsidized Stafford Loan apply. In addition, graduate students may borrow an additional \$10,000 annually. The one exception being that the borrower is responsible for interest that accrues while enrolled in school and during the six month grace period. Loan applications are available at lending institutions or the Polytechnic Office of Financial Aid.

## UNDERGRADUATE

Polytechnic University administers a broad range of scholarship and financial aid programs designed to assist students in pursuing their educational goals. To meet the total cost of education, the student may draw upon available sources including student income, family income, Polytechnic University grants, and federal and state funding.

All financial aid is limited to the need of the student as determined by the federal government. Students receiving financial assistance from Polytechnic University must notify the Director of Financial Aid

of all scholarships, loans and other forms of educational assistance from sources other than those directly administered by the Office of Financial Aid.

There are three basic types of financial aid, as follows:

**Scholarships and grants:** Funds awarded to students based on academic ability and financial need which do not require repayment.

**Loans:** Specific sums awarded to students with repayment conditions. Education loans generally have low interest rates with extended repayment terms.

**Employment:** Part-time and summer jobs either on- or off-campus.

About 90% of Polytechnic's undergraduate students receive aid including scholarships, grants, campus jobs and student loans.

**To Apply for Financial Aid:** Incoming freshmen should file the Free Application for Federal Student Aid (FAFSA) during the month of January. (Later applications will be considered on a rolling basis as funds are available.)

Transfer students should file the FAFSA by May 1, or as soon as possible thereafter.

**To Renew Financial Aid:** Continuing students should obtain financial aid packets from the Office of Financial Aid.

Students should file the Polytechnic Financial Aid Application and Verification Supplement with the Office of Financial Aid by the prescribed deadline. A copy of the parents' and/or the student's federal and state tax returns with all required schedules, along with documentation of all untaxed income, must accompany this application. Late or incomplete application material will result in a reduction or forfeiture of institutionally administered financial aid. Contact the Office of Financial Aid for the filing deadline date.

### **FEDERAL CAMPUS-BASED PROGRAMS**

To be eligible for one of the federal campus-based programs, applicants must show need, be enrolled at least half-time (the equivalent of at least 6 credits per semester) and be either U.S. citizens or eligible noncitizens.

To apply for any of these programs, students must have been accepted to

Polytechnic and have filed the FAFSA. Awards are determined by the Polytechnic Office of Financial Aid.

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

### **Federal Supplemental Education Opportunity Grant (SEOG)**

The SEOG is awarded to undergraduates with exceptional financial need. At Polytechnic, qualified applicants receive between \$500 and \$1,500 per year. Usually, the award will continue to be offered for four years, but is based upon financial need.

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

The Perkins Loan is a low-interest (5%) loan. The loans are made available through the Office of Financial Aid. Perkins Loans are awarded as part of the financial aid package, with a range of \$500 to \$2,000 per academic year. Perkins Loans are limited to \$4,500 for the first two years of college study. Total undergraduate Perkins Loans may not exceed \$9,000.

The repayment period and the interest for the Perkins Loan do not begin until nine months after students complete their studies. Interest of 5% per year is charged during the repayment period. Repayment begins 9 months after termination of full- or half-time study and may continue over a 10-year period. Terms for deferment of payment and cancellation of the loan may be found in the Perkins Loan Promissory Note.

### **Federal Work-Study Program**

The Federal Work-Study Program provides part-time jobs for undergraduate students. Earnings from these jobs help students meet college-related expenses. Employment eligibility is determined by the Office of Financial Aid. Work arrangements are made through the Office of Career Services.

At Polytechnic, the average Federal Work-Study award is \$2,000 per academic year and may be higher depending upon financial need. Jobs are arranged on-campus, along with community service opportunities. Most assignments average 15 hours per week, and the work schedule is adjusted to the needs of the student and the employer. The hourly rate varies depending on the position. Students are paid biweekly.

## 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 and are usually the first component of all financial aid packages.

To be eligible, students must be U.S. citizens or permanent residents, be making satisfactory academic progress, be enrolled at least half-time (the equivalent of 6 credits per semester) and meet federal income requirements.

Students may apply for the Federal Pell Grant by completing the FAFSA. Students applying for financial aid at Polytechnic (including the Stafford Loan) are required to apply for a Federal Pell Grant. Students must file an application by May 1 for the current academic year.

### Tuition Assistance Program

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 are able to make their choice based on program characteristics alone and not the difference in cost.

The amount of the TAP award depends on the level of study, tuition charge and net taxable income. (This income is adjusted to reflect other family members enrolled full-time in post-secondary study.)

To be eligible for a TAP award, students must (1) be New York State residents and U.S. citizens or permanent residents, (2) be enrolled full-time at an approved New York State post-secondary institution, (3) meet income requirements established by New York State and (4) complete the TAP application by the required deadline, May 1 for the current academic year.

To apply for the TAP award, students should obtain an application from the Office of Financial Aid or the New York State Higher Education Services Corporation (NYSHESC), 99 Washington Avenue, Albany, NY 12255.

If Polytechnic University's name does not appear on the TAP certificate, a TAP Change Form must be filled out and submitted to NYSHESC. These forms are available in the Office of Financial Aid.

To continue to receive TAP benefits,

students must demonstrate satisfactory academic progress. Standards of satisfactory progress are listed in the "Academic Policies" section of this catalog and are available in the Office of Financial Aid. Effective July 1, 1996, all TAP recipients must achieve a 2.0 cumulative grade-point average after the completion of four full-time semesters of study. Students may apply for a one-time waiver of academic progress requirements; however, waivers are granted only under extraordinary circumstances. Additional information is available from the Office of Financial Aid.

### Aid for Part-Time Study (APTS)

The Aid for Part-Time Study Program is intended to provide state grants to less than full-time students.

To be considered for an award, a student 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 alien, or refugee, (5) not have used up TAP or other New York State student financial aid eligibility for full-time study, and qualify under the New York State mandated income requirements.

To apply for APTS, students should obtain an application from the Office of Financial Aid and return it as soon as possible directly to the Office of Financial Aid. Students must apply annually. Applications should be filed no later than the second week of classes for the current semester.

### Vietnam Veterans Tuition Awards Supplement (VVTA)

The Vietnam Veterans Tuition Award is an entitlement program. Applicants must (1) be residents of New York State since April 20, 1984, or at the time of entry into service and resumption of residency by September 1, 1988; (2) have served in the U.S. Armed Forces in Indochina between January 1, 1963 and May 1, 1975; (3) be honorably or medically discharged from the U.S. Armed Forces; (4) be enrolled in an approved undergraduate program in a degree-granting institution in New York State; and (5) have applied for the Tuition Assistance Program (TAP) and Pell Grant awards. There are no income restrictions connected with this program.

The award provides up to \$500 per semester (full-time attendance) or \$250 per semester (part-time attendance). If a Tuition Assistance Program award is received, the combined awards cannot be

greater than tuition. The TAP award will be reduced accordingly. Awards are available for up to eight semesters (four years), or 10 semesters (five years) of undergraduate study, if programs specifically require five years for full-time study and double the amount of time for part-time study.

To apply, students should obtain applications and other materials available at the Office of Financial Aid, any Veterans Office, or by writing to the New York State Higher Education Services Corporation, VVTA, Albany, NY 12255. Applications for the Vietnam Veterans Tuition Award Supplement must be made by May 1, 1992 by part-time students. Full-time students must apply by submitting both Vietnam Veterans Tuition Supplements and the Student Payment Applications (TAP Application) by May 1.

To continue to receive the VVTA, students must reapply each year.

### Higher Education Opportunity Program (HEOP)

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

## POLYTECHNIC UNIVERSITY SCHOLARSHIPS AND GRANTS

Polytechnic has a strong history of recognizing the scholastic achievements of applicants with outstanding academic credentials. Such awards are based on academic achievement and recommendation.

Polytechnic Scholarships are awarded to freshmen and transfer applicants with strong academic backgrounds for full-time study (12 credit hours per semester). Awards are determined through academic merit. Students apply directly to the Office of Admissions through the application for admission. Awards range up to full tuition. Continuance of the awards demands the maintenance of a 2.5 or 3.0 cumulative grade-point average (depending on the award) and application to the Pell and TAP programs.

The following scholarships are awarded to current freshmen and transfer applicants with strong academic backgrounds, regardless of financial need.

## FINANCIAL AID

### **Board of Trustees Scholarships**

These scholarships are awarded to academically superior freshmen. Amounts of the scholarships are equal to full tuition, less any outside aid for which students are eligible. Continuance of the scholarship is based on maintaining a 3.0 cumulative grade-point average and application to the Pell and TAP programs. (This award does not cover graduate study.)

### **Geiger/Fialkov Scholarships**

Awarded to superior freshmen majoring in engineering or computer science. The amounts of the scholarship are equal to full tuition less any outside aid for which the students are eligible. Continuance of the award is based on maintaining a 3.0 cumulative grade-point average and application to the Pell and TAP programs. (This award is intended for undergraduate study only.)

### **Dean of Engineering Scholarships**

Each year, the dean of engineering awards one scholarship of \$10,000 per year to a student with superior academic credentials in each of the following engineering disciplines: aerospace engineering, chemical engineering, civil engineering, computer science, electrical engineering, industrial engineering, mechanical engineering and metallurgical engineering.

Continuance of the scholarship is based upon maintenance of a 2.5 cumulative grade-point average and application to the Pell and TAP programs. A separate application form available from the Office of Admissions must be filed for these scholarships.

### **Principal's Scholarship**

All high school principals in the New York metropolitan region are invited to nominate their outstanding graduates for a scholarship of \$10,000 per year. Recipients are selected from among nominees by the Scholarship Committee. Continuance of the award is based upon maintenance of a 2.5 cumulative grade-point average and application to the Pell and TAP programs. Application forms are available in the student's high school and from the Office of Admissions.

### **PROMISE Scholarships**

PROMISE Scholarships in varying amounts based upon both need and scholastic achievement may be offered to students who have participated in programs of the Center for Youth in Engineering and

Science (YES) while in high school, or to other graduates of participating high schools. No award may be greater than the amount of tuition less any other aid for which students may be eligible. Depending upon the amount of the award, continuance is based upon maintenance of a 3.0 or 2.5 cumulative grade-point average and application for Pell and TAP programs. No separate application is required.

### **Outstanding Transfer Scholarships**

Awarded to superior transfer students with a 3.0 grade-point average. The award amounts vary depending upon the grade-point average of the student. Continuance of the award is based upon maintenance of a 2.5 cumulative grade-point average, full-time enrollment and application for Pell and TAP programs. No separate application is required.

### **Polytechnic Grants**

Polytechnic grants are available to needy students on a limited basis. Students apply directly to the Office of Financial Aid by completing a Free Application for Federal Student Aid (FAFSA), a Polytechnic Financial Aid Application and Verification Supplement, and by submitting all necessary income documentation.

### **POLYTECHNIC NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS SCHOLARSHIP (NSPE)**

These scholarships are awarded to academically superior freshmen majoring in engineering. Awards are determined by NSPE and range up to \$1,500. Maintenance is based on a 2.5 cumulative grade-point average.

### **CORPORATE AND INDIVIDUALLY SPONSORED SCHOLARSHIPS**

Many of our Polytechnic Scholarships come to us through the generosity of sponsors. Students will be notified if their particular scholarship is corporate or individually donated. Students should thank sponsors for their support.

A list of our current scholarships follows:

Benjamin Adler Memorial Scholarship  
Sidney G. Albert Scholarship  
Alden Challenge Scholarship  
Alumni Scholarship  
Joseph M. Amendda Scholarship

Donald J. Amoruso Scholarship  
Paul C. Bauerle Memorial Scholarship  
Orrin Dodge Berry Scholarship  
Eugene Blank Scholarship  
Board of Trustees Scholarship  
Joseph Bommarito Scholarship  
Joseph Bucich Scholarship  
Dr. George Bugliarello Scholarship  
Salvatore E. Cannizzaro Scholarship  
L. F. Case Foundation Scholarship  
David and Cecilia Chang Scholarship  
J. B. Chittenden Scholarship  
The Claessens Family Scholarship  
Arthur Clapp Scholarship  
Philip Clark Scholarship  
Class of 1942 Scholarship  
Class of 1944 Scholarship  
Samuel and Grace B. Cohen Scholarship  
Davis/Durborow/Brierly Scholarship Fund  
DeWitt Scholarship  
Aaron and Simcha Dubitzky Scholarship  
W. E. Duryea Scholarship  
A. S. Dwight Scholarship  
Eirich/Morawetz Scholarship  
Bernard Farkas Scholarship  
I. W. Fay Scholarship  
Polytechnic Fellows Scholarship  
J. Robert Fisher Scholarship  
Geiger-Fialkov Scholarship  
Roger Gilmont Scholarship  
Dr. Anthony B. Giordano Scholarship  
Gordon Gould Scholarship  
James D. Graham Scholarship  
Ying Chavas Greene Scholarship  
Francis and Mildred Hallenbeck Foundation  
Scholarship  
Alfred Helwig Scholarship  
William Randolph Hearst Scholarship  
F. M. Jabara Scholarship  
Jephson Educational Trust Scholarship  
Dr. Peter Kabasakalian Scholarship  
Susan Kamen Scholarship  
Jacob Kaplan Scholarship  
Ping Ku Scholarship  
Eugene R. Kulka Scholarship  
John F. Kunc Scholarship  
Dr. Irving Kuntz Scholarship  
Litton Industries Scholarship  
Lockheed Martin Scholarship  
Helen T. Lowe Scholarship  
Lyons Scholarship  
P. R. Mallory Memorial Scholarship  
Raymond Mauro Scholarship  
Steven J. Meoli Memorial Scholarship  
NSC-Eddie Mitchell Scholarship  
Dr. Herbert Morawetz Scholarship  
Colonel Frank Mott Scholarship  
Bonnie Nagler Scholarship  
William Nichols Scholarship  
Nippon Electric Scholarship  
Stanley Nisenson Memorial Scholarship

Nordheimer Scholarship  
 Theodore Nowak Scholarship  
 Lilyan and Milton Oran Scholarship  
 Ruth and Richard Orford Scholarship  
 Dr. Donald Othmer Scholarship  
 PamAmSat Scholarship  
 Rajendra Paul Scholarship  
 George S. Pearson Scholarship  
 Poly 100 Scholarship  
 Promise Fund Scholarship  
 Radio Club Scholarship  
 Bengt G. Ranby Scholarship  
 Dr. Julian R. Reasenberg Memorial  
 Scholarship  
 Steven M. Rittvo Scholarship  
 Julian Rogoff Scholarship  
 Nicholas and Angelica Romanelli  
 Scholarship  
 Myron Rosenthal Scholarship  
 Samuel Ruben Scholarship  
 Sidney J. Rubin Scholarship  
 Dr. John P. Schaefer Scholarship  
 Edward C. Schmidt Scholarship  
 Paul J. Schwanenflugel Scholarship  
 Silleck Family Scholarship  
 Frank R. and Emily E. Stammer  
 Scholarship  
 Michael Stock Scholarship  
 William Stolze Scholarship  
 Solon Summerfield Foundation Scholarship  
 Wai Nam Tam Scholarship  
 Arlene and Irving Tashlick Scholarship  
 Arnold Thompson Scholarship  
 Robert Tsao Endowment Fellowship  
 Kenneth G. Van Wynen Scholarship  
 Dr. Ernst Weber (gift from David  
 Packard) Scholarship  
 Ernst and Sonya Weber Scholarship  
 Warren E. Winsehe Memorial  
 Scholarship  
 William Wishnick Scholarship  
 Howard J. and Audrey R. Wulfken  
 Scholarship  
 Edward H. Zucker Scholarship

## **OTHER OPPORTUNITIES**

### **ROTC Scholarships**

Army ROTC offers four-, three-, and two-year scholarships. The four-year scholarships are awarded on a worldwide competitive basis to American citizens entering college as freshmen. The three- and two-year scholarships are awarded and aligned with an ROTC program. Students who attend basic camp for the two-year program may also compete for two-year scholarships. The scholarships pay for tuition, textbooks and lab fees, plus a living allowance of up to \$1000 for each year the scholarship is in effect.

Air Force ROTC scholarships are available to qualified applicants in both two- and four-year programs. Scholarships are based on merit and pay for tuition, books, laboratory and incidental fees, plus a \$100 monthly nontaxable allowance.

### **Veterans Administration (VA)**

#### **Educational Benefits**

Veterans who served over 180 days between January 31, 1955 and January 1, 1977 and (1) continue on active duty, (2) were honorably discharged at the end of their tour of duty and (3) qualify because of service-connected disabilities are eligible for benefits. Veterans are entitled to benefits for full-time study at an approved post-secondary institution, for one and one-half months for each month of active service (up to 45 months). Eligible veterans who served 18 continuous months are entitled to benefits for 45 months of full-time study. In each case, the equivalent in part-time study may be authorized. Eligibility extends for ten years after release from service, but not after December 31, 1989. Children, spouses and survivors of veterans whose deaths or permanent total disabilities were service-connected, or who are listed as missing in action, may be eligible for post-secondary education benefits under the same conditions as veterans.

To apply, students should obtain applications available at all VA offices, active duty stations and American embassies as well as the Office of Student Records. Completed forms should be submitted to the Office of Student Records. A "Summary of Veterans' Benefits" booklet is available from the Office of Student Records.

Current monthly benefit rates are available through VA offices. Veterans may borrow up to \$2,500 for an academic year of full-time study through a special loan program for veterans.

Students requesting VA education benefits should notify the Office of Student Records each semester after completing registration. Students must report interrupted attendance or termination of study. Details of Polytechnic's requirements are given to all applicants. Questions concerning veterans, benefits or paperwork should be directed to the Office of Student Records either in person, by telephone, or by completing a Request for Veteran's Benefits form.

### **Cooperative Education Program (Co-op)**

Co-op is an alternative means of financing

education by combining alternate semesters of outside employment and school attendance.

All inquiries are handled through the Office of Cooperative Education.

### **Grant Aid To Non-New York State Residents**

Some state aid programs frequently require that awarded funds be used within the state. Others sometimes allow funds to be used out of state. Contact the following agencies for more financial aid information if you are a resident of Pennsylvania, Rhode Island, Vermont or Washington, D.C.

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**

### **Federal Subsidized Stafford Loan Program (formerly GSL)**

The Subsidized Stafford Loan Program gives students the opportunity to borrow money from a local lending institution to help them meet the costs of college or vocational school training. Students may borrow this money at a low interest rate and will not have to begin repayment of their loans as long as they meet the program's academic requirements or until six months after they graduate or withdraw from school.

To be eligible for a Subsidized Stafford Loan, students must (1) be a United States citizen or eligible noncitizen, (2) be enrolled for at least 6 credits per semester and matriculated, (3) be making satisfactory academic progress and (4) demonstrate financial need. All applicants must complete a Free Application for Federal Student Aid to determine financial need and eligibility for a Pell Grant.

Effective July 1, 1993, academic year loan limits are \$2,625 for freshmen, \$3,500

## FINANCIAL AID

for sophomores, and \$5,500 for juniors, seniors and fifth-year undergraduates. The interest rate is an annual variable rate based on a 91-day T-bill plus 2.3% with a cap of 8.25%.

Students with more than \$5,000 in loans (Stafford, Perkins, Supplemental Student Loan) can consolidate their loans into one repayment package with an interest rate that is the weighted average of the loans being consolidated, rounded up to the nearest whole percent. Repayment is extended up to 25 years depending on the aggregate amount borrowed. Lenders can offer a graduated or income-sensitive repayment option.

To apply, obtain Stafford applications from participating lending institutions or the Polytechnic Office of Financial Aid. In addition, all students (undergraduate and graduate) must have on file the Free Application for Federal Student Aid (FAFSA), the Polytechnic Financial Aid Application and Verification Supplement, and all necessary income documentation. All transfer students must request that financial aid transcripts from all previously attended institutions be sent to the Office of Financial Aid at Polytechnic University. All new borrowers must complete an entrance interview in the Office of Financial Aid prior to endorsing loan checks. Eligible applicants will be certified and forwarded to the indicated lender and guarantee agency. To ensure that credit for approved Stafford Loans will be given in lieu of payment at registration, Stafford applications should be submitted to the Office of Financial Aid no less than eight weeks prior to registration.

After graduating, withdrawing from school, or dropping to less than half-time study, the student borrower must see his or her lender and make formal arrangements for repayment and must also attend a loan exit interview in the Office of Financial Aid. The borrower must actually begin repayment of the loan six months after graduating or withdrawal from school.

A student will be required to repay the total amount borrowed and all interest on the declining balance in accordance with the following regulations:

1. The minimum monthly installment will be \$50 plus interest. (The monthly installment is determined by the amount borrowed.)
2. The maximum repayment period for the whole of the loan is 10 years.
3. Repayment of part or all of the loan may be made in advance at any time

without penalty.

4. The maximum period of a loan, from the date of the original note, may not exceed 15 years on all loans guaranteed after November 3, 1965, except in cases of authorized deferment (not to exceed three years) while the student is a member of the Armed Forces or a volunteer under Title VIII of the Economic Opportunity Act of 1964.

The length of the payment period depends upon the date the promissory note matures as well as the total amount borrowed. A student borrower may be permitted to make payments of less than \$50 per month under unusual and extenuating circumstances. Request for such forbearance must be made to the lender.

### ***Federal Unsubsidized Stafford Loan***

This loan is open to students who do not qualify for the above subsidized Federal Stafford Loan. The same terms, conditions, annual borrowing limits and interest rates as Federal Subsidized Stafford Loans 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. In addition, independent students may borrow an additional \$4,000 annually at the freshmen and sophomore level, or \$5,000 annually at the junior, senior and fifth-year undergraduate level. Loan applications are available at lending institutions or the Polytechnic Office of Financial Aid.

### ***Parent Loan for Undergraduate Studies***

Parents may borrow up to full tuition per year for each financially dependent student. A Free Application for Federal Student Aid (FAFSA) is not required. However, the parent loan combination with other financial assistance cannot exceed the total cost of education. Repayment begins within 60 days from the date you receive the loan. The maximum repayment period is 10 years.

### ***Polytechnic University-Sponsored Loan***

Polytechnic sponsored loans are available to both incoming and continuing students based on financial need and the availability of funds. Students are considered for Poly Loans when they apply for financial aid using the Financial Aid Form (FAF). Students are generally awarded between \$1,000-\$2,000 per academic year. The current interest rate is 7%. Repayment begins three months

after graduation or when the student withdraws from school.

Eligibility is primarily based on need; special circumstances can influence determination. Students must be U.S. citizens or permanent residents to apply and must be matriculated and enrolled at least half-time (6 credit hours).

### ***Edythe and Albert DeGaeta Scholars Loan Program***

The Edythe and Albert DeGaeta Scholars Loan Program was created as a result of a generous donation from Albert DeGaeta, an alumnus of Polytechnic. This loan program assists undergraduate students based upon their financial need and academic standing. All recipients must maintain a 2.5 cumulative grade-point average, with the maximum award of \$4,000 per academic year. The current interest rate is 4.5% with repayment beginning six months after graduation or when the student ceases to be enrolled.

## ***OTHER RESOURCES***

The Office of Financial Aid has summarized details of several plans currently employed by families to help meet college costs. Students should inquire in the Office of Financial Aid for information concerning these programs, the companies that sponsor these programs and the necessary application procedures.

## ***POLYTECHNIC PAYMENT PLANS***

The University currently offers two types of payment plans: monthly and quarterly. The monthly payment plan begins on July 15 and continues through April 15. The quarterly payment plan begins on July 15 with three additional payments on October 15, December 15 and April 15. There is currently a \$55 annual application fee for each plan.

## ***HOME EQUITY LOAN/HOME EQUITY LINE OF CREDIT***

Many parents are pleasantly surprised to discover the resource value of the equity in their homes or apartments. Currently, many lenders offer loans or lines of credit that enable families to put this significant asset to work in financing a college education. Those wishing to pursue this option are encouraged to contact a local lender.

## **OTHER OPPORTUNITIES**

There are some scholarship programs, usually directed by local and civic organizations, which 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 merit-/need-based.

## **IMPORTANT FINANCIAL AID POLICIES**

- To be eligible to receive financial aid, students must be enrolled for at least 6 credits per semester. All Polytechnic scholarships, Polytechnic grants and TAP awards, however, require students to be full-time to qualify.
- Financial aid applicants (including Stafford Loan applicants) are expected to apply for a Pell Grant and, in the case of New York residents, for the Tuition Assistance Program. Polytechnic scholarships and Polytechnic grants, in combination with Pell Grant and TAP awards, may not exceed tuition.
- Prospective students should not wait until they have been admitted to apply for financial aid. These are concurrent processes. Applicants should make every effort to apply for admissions 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 reapplying, continuing to demonstrate financial need where applicable and fulfilling of other requirements stipulated by the awards. To renew most Polytechnic scholarships, students must maintain a 2.5 cumulative grade-point average. To renew a Board of Trustees Scholarship, students must maintain a 3.0 cumulative grade-point average.
- Standards of achievement for scholarship maintenance are established each semester. Students who fall below the established criteria will be given one semester of grace to restore their grade-point average. If they are not successful, the scholarship will be revoked. It will be reinstated when the student is successful. Scholarships cannot be received retroactively.
- Since financial aid and scholarship funds administered by Polytechnic are limited, students should be aware that it is very unwise to enroll at Polytechnic without financial aid support, on the assumption that at a later date financial aid will be available. Given the fixed amount of resources, Polytechnic deems it unethical to withdraw support from students who have based attendance at Polytechnic on the financial aid awarded them in order to release funds to assist new applicants. Funds from financial aid programs not administered by Polytechnic, such as Pell Grants, TAP, and the Stafford Loan Program, are available to eligible students whether or not they have already received funds from these programs.
- Grants of Title IV Aid (Pell, 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 Forms explaining the terms of the awards;
  - 2) Financial aid transcripts from all previously attended institutions of higher education;
  - 3) copies of students' (or parents') IRS Form 1040 or 1040A/EZ, if requested;
  - 4) signed affidavits acknowledging Selective Service Registration;
  - 5) proof of permanent residency status and
  - 6) any other requested documents.
- Students must assume responsibility for reading, understanding and abiding by the terms of all financial aid documents they sign; they should also keep copies of them.
- Students must know each financial aid program's limits on the amount of aid and number of years they can receive such assistance and must make appropriate plans to finance that part of their education which exceeds the limits.
- Students must report any outside financial aid received or any changes in their family situation, so that the Office of Financial Aid can make proper adjustments in awards offered.
- Students must not be in default on a Perkins Loan or a Stafford Loan, nor can they owe a refund on a Pell Grant or a Supplemental Educational Opportunity Grant, if they wish to continue receiving financial aid.
- In order to continue receiving financial aid, a student must maintain full-time, matriculated (degree) status and must complete a minimum number of quarter credit hours with a minimum grade-point average to be considered making satisfactory academic progress toward his or her degree as illustrated in the "Academic Policies" section of this catalog. Failure to make satisfactory academic progress may result in the loss of financial aid.
- Students who have lost eligibility for financial aid may request reinstatement due to unusual or extraordinary circumstances. Students who wish to appeal must, within 20 days of notification, submit a written appeal to the Financial Aid Committee on Academic Progress. Students must give the reasons for the appeal and provide documentation. If necessary, students will also be expected to appear in person to meet with a member of the committee.

# REGISTRATION

Registration is the process of obtaining academic advisement and approval of courses from a faculty adviser, recording courses with the registrar and paying tuition and fees to the Office of Student Accounts /Bursar, according to published deadlines. For complete details about registration dates and procedures and course schedules, see the *Schedule of Classes* published prior to each registration period and available from the registrar.

To receive academic credit, registration is required each semester for every course, including theses, projects and guided studies. Class attendance without registration is not permitted.

## **ADVISEMENT FOR REGISTRATION**

Polytechnic University endorses close faculty-student relationships. The faculty advising system is the basis for selection of courses and registration. Each academic department identifies faculty who will serve as student advisers. Before registration, students must meet with their adviser and receive written approval for their anticipated program of study. A list of advisers and their office numbers may be obtained from each respective departmental office and is available from the registrar prior to each registration.

Approval to register for a course does not necessarily constitute approval to use that course as a substitution for another course in order to satisfy a specific degree requirement. If the course is not usually used for that purpose, such approval should be explicitly requested from the adviser and must be formally granted on the form used for this purpose, the Request for Adjustment of Degree Requirements, and filed with the Office of the Registrar. 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.

Incoming freshmen are required to take Polytechnic placement exams in mathematics and English. These exams are free and are used solely for advisement and

course placement; they do not affect admission to Polytechnic.

## **REGISTERING FOR CLASSES**

Polytechnic offers three registration periods for each semester and mini-session and two for the summer terms. In addition, new freshmen entering in the fall semester are offered a special advance registration during the summer preceding their admission.

**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. Graduate students, particularly those who work, are encouraged to take advantage of regular registration by mail. Payment of tuition and fees, or arrangement for payment, is due to the Office of Student Accounts no later than the deadline date announced in the *Schedule of Classes*.

**Late Registration:** This usually takes place during the week preceding the start of classes. A late fee is assessed to all continuing students. Information is mailed to each continuing student who did not register during the regular registration periods for fall and spring. New students and special students receive information from the Office of Admissions. Payment of tuition and fees is due on the day of registration.

**Final Registration:** Students are expected to complete registration by the end of the fifth day of the semester. This final period, during the first five days of classes, provides the last opportunity to register for the semester. Students who do not complete registration by the end of the late registration period will not be registered for that semester, except by special permission of the Registrar and the course instructor(s). Although permitted, late registration is not desirable as classes may be filled and early meetings of classes missed. A late fee is assessed to all continuing and readmitted

students. Payment of tuition and fees is due on the day of late registration.

## **PROGRAM ADJUSTMENTS (ADD/DROP)**

Additions or deletions to a student program or course schedule may be made during the first five class days of the fall and spring semesters or summer sessions. Written approval from the faculty adviser, on the Program Adjustment form, is required for each course added or dropped.

Students may not add or change courses within the freshman mathematics or physics programs without the permission of the respective directors of these programs. Authorized changes within these two programs will be allowed through the fourth week of the semester.

## **STUDENT IDENTIFICATION**

All students are required to carry and maintain at all times photo-identification cards issued by the Facilities Department. The photo-IDs must be presented at each registration for validation. IDs must be presented and/or surrendered to any official of the University upon request.

A student ID number is used by the University to identify a student's records (grades, accounts, etc.) from the time of admission through the completion of his or her degree. Student numbers are usually Social Security numbers, but not always. Students who do not have a U.S. Social Security number at the time of application to the University, as in the case of international students, are assigned a number by the Office of Admissions. Assigned numbers may be replaced when a Social Security number is obtained by bringing the original Social Security card to the Office of the Registrar, at which time this number will then become the student's ID number.

## **REFUNDS**

See the section "Tuition and Fees" for information on refund policies.



# 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 *Schedule of Classes* available before the start of each semester. The schedule is an official supplement to this catalog. Tuition and fees are paid by term or all at once for the entire academic year.

## TUITION COSTS

The following costs are in effect at the time of publication, beginning with the fall 1999 term.

### Undergraduate students

Full-time (12–18.5 credits*)	
Each semester	\$10,105
Part-time (0.5–11.5 credits)	
Each credit/credit hour	\$640
Zero credit remedial courses	\$1,920

### Graduate students

Each unit	\$695
-----------	-------

\*All credits/units in excess of 18.5 are charged at the per credit/unit rate.

Tuition rates are set by the Board of Trustees. Due primarily to economic conditions and inflationary costs, the University reserves the right to change tuition charges and fees when it is deemed necessary. The University is mindful of the economic challenges of attending a first-rate private school such as Polytechnic; accordingly, the University will continue to make every effort to keep cost increases to the lowest possible level consistent with maintaining educational quality.

Tuition covers instruction costs, use of libraries and the facilities of the Office of Student Life.

## OTHER CHARGES AND FEES

University Fee (required of all students each term of registration)

Full-time	
Graduate/Undergraduate	\$300
Part-time	
Undergraduate	\$200
Graduate	\$135

Application Fee	
Undergraduate	\$ 40
Graduate	\$ 45

Acceptance Deposit*	\$250
---------------------	-------

Cooperative Education Program Fee	
	\$ 65

Credit by Examination Fee (undergraduate courses)	
per credit	\$70

Doctoral Dissertation	
Microfilm Fee	\$75

Seminar Fees	**
--------------	----

Late Registration Fee	\$50
-----------------------	------

Validation Credit (graduate courses)	
per unit	\$70

\*To be applied toward first term's tuition

\*\*Lists of these charges, by course, are given in the *Schedule of Classes*.

Other fees include the returned check fee, late payment penalty fee and, for transfer students, possible charges for supplies or kits. Details on these charges can be found in the *Schedule of Classes*.

All fees are nonrefundable.

## HOUSING

Housing charges vary according to arrangements at Brooklyn and Farmingdale. For details, consult the Office of Student Development.

## PAYMENT OF TUITION AND FEES

Each semester, tuition and fee payments are due in full from all students at the time of registration.\* Payment in full refers to various methods, used alone or in combination, including cash, check, money order or credit card (Visa, MasterCard, American Express and Discover only), financial aid, grants and loans, or tuition arrangements authorized by the Office of Student Accounts. Evidence of financial aid must be presented to the Office of Student Accounts 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, in order 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. The University reserves the right to withhold transcripts, diplomas and other services, including registration, from students whose financial obligations have not been fully met.

\*This does not apply to early registration. In this case, payment is due by the date specified in the *Schedule of Classes*, usually about one month prior to the start of classes.

## PAYMENT OPTIONS

The University provides monthly, semesterly and yearly payment options. The monthly tuition payment plan is available through Tuition Management Systems, an independent agency. For specific information about these plans, contact the Office of Student Accounts.

Graduate students who submit written proof of eligibility for tuition reimbursement from their employer are eligible for a special deferred payment plan. Under this plan, full payment will be due approximately one month after the end of the semester. Complete details are in the *Schedule of Classes* and available from the Office of Student Accounts.

## TUITION AND FEES

### REFUND OF TUITION/REDUCTION OF LIABILITY

This section pertains to all students, regardless of the method of payment or the manner of covering tuition costs. Once registered, students must officially drop or withdraw from classes in order to be eligible for any applicable tuition refund or to avoid responsibility for payment of charges already assessed. This applies regardless of whether or not classes have been attended. Recipients of financial aid who incur a tuition liability after registration due to a reduction in the aid or to withdrawal from class will be personally responsible for payment of that liability to the University.

#### Refund Schedule

The refund schedule applies only during the first four weeks of the semester. The official withdrawal date is the date the notice of withdrawal is received in the Office of Student Records, not the last date of class attendance.

Withdrawal forms are available in the Office of Student Records.

Whenever a student drops or withdraws from a course or from all courses, tuition charges are adjusted according to the schedule outlined below, provided that:

- (1) the withdrawal notice is filed within the refund period,
- (2) it is submitted in writing to the Office of Student Records and
- (3) the withdrawal lowers the student's program to less than 12 credits

Withdrawal time	% Refund
Prior to and including first day of classes	100%
First week* of semester	90%
Second week of semester	75%
Third week of semester	50%
Fourth week of semester	25%
After the fourth week of semester	0%

\*In this context, week refers to seven calendar days, excluding holidays. For example, if the term begins on a Thursday and there are no holidays, then the last day of that week would be the following Wednesday. Overpayments resulting from program adjustments or withdrawals will be automatically refunded and mailed to the student within 10 days.

#### Pro Rata Refunds for New Students

Pro rata refunds apply to all first-time students who are the recipients of Title IV federal aid, and withdraw from all courses within the first 10 weeks of the term. This aid includes federal Pell Grants, FFELP loans, Federal SEOG and College Work Study. Refunds under this policy apply to tuition, fees, room and board.

Withdrawal time	% Refund
Prior to and including first day of classes	100%
First week* of semester	90%
Second week of semester	80%
Third week of semester	80%
Fourth week of semester	70%
Fifth week of semester	60%
Sixth week of semester	60%
Seventh week of semester	50%
Eighth week of semester	40%
Ninth week of semester	40%
Tenth week of semester	0%

#### Refund Appeals

Appeals for an exception to the refund schedule must be submitted in writing to the Office of Student Accounts, along with all documentation supporting the request.

Awareness of University refund policy and withdrawal procedures is expected, and lack of this knowledge is not sufficient reason for making or granting an appeal.

#### Impact of Refund on Financial Aid

If the University determines that a student is due a refund, and if that student has received Title IV aid, a portion of that refund will be returned to the aid program according to the following formula:

**Step One:**

Total Institutional Costs	
- <u>Total Aid Paid to Inst. Costs</u>	
Scheduled Cash Payment	
- <u>Student's Cash Paid</u>	
Unpaid Charges	

**Step Two:**

Total Institutional Costs	
- <u>Percentage Allowed to Retain</u>	
Initial Amount Retained	
<u>Unpaid Charges</u>	
Amount Retained	

**Step Three:**

Total Paid to Institutional Costs	
<u>Amount Retained</u>	
Refund Amount	
to Be Distributed to Title IV	

In refunding funds to the various financial aid programs, the following federally mandated priority listings will be used:

1. Federal Unsubsidized Stafford Student Loan Program
2. Federal Subsidized Stafford Student Loan Program
3. Federal Parent Loan for Undergraduate Students (PLUS)
4. Federal Pell Grant
5. Supplemental Educational Opportunity Grant (SEOG)
6. Federal Perkins Loan

#### Example:

John Poly is a first-time, full-time, undergraduate student. He received \$250 Perkins Loans; \$250 SEOG; \$1,170 Pell Grant; \$1,680 Stafford Loan and \$2,000 in University aid (total aid \$5,350). He is also on a monthly payment plan and has paid \$3,775 to date. John has withdrawn from all courses for the semester, at a 50% liability.

#### Step One:

Total Institutional Cost	\$10,405
- <u>Less Total Aid Paid to IC</u>	5,350
Scheduled Cash Payment	5,056
- <u>Student's Cash Paid</u>	- 3,775
Unpaid Charge	1,281

#### Step Two:

Total Institutional Cost	\$10,405
- <u>50% Allowed to Retain</u>	- 5,202
Initial Amount Retained	5,203
- <u>Unpaid Charges</u>	- 1,281
Amount Retained	3,992

#### Step Three:

Total Paid to IC	\$9,125
- <u>Amount Retained</u>	- 3,992
Refund Amount	5,133
to Be Distributed	

#### Distribution:

Stafford Loan	\$1,680
+ Perkins Loan	+ 250
+ Pell Grant	+ 1,170
+ SEOG	+ 250
+ <u>University Aid</u>	+ 1,781
Distribution Amount	5,133

The calculation for the impact of a refund on financial aid is the same for all students. The determination of tuition refund is based on length of attendance and eligibility for pro rata refund consideration.

# PLACEMENT STATISTICS

**PLACEMENT RATE —**  
**CLASS OF 1998: 93.7%**

## **AEROSPACE ENGINEERING**

Average starting salary: \$47,500  
**Major Employers:** Atlas Air, Electric Boat, Exxon Corp., Gibbs & Cox, Symbol Technologies, Inc.

## **CHEMICAL ENGINEERING**

Average starting salary: \$46,250  
**Major Employers:** Domino Sugar Corp., Exxon Corp., Petro-Chem Development Co., Picatinny Arsenal, US Patent and Trademark Office, Xerox Corp.

## **CIVIL ENGINEERING**

Average starting salary: \$39,300  
**Major Employers:** Bell Atlantic, Con Edison, Exxon Corp., Frederic R. Harris, Inc., Port Authority of NY & NJ, Raytheon Systems Company, Turner Construction, Tyco Submarine Systems Ltd.

## **COMPUTER ENGINEERING**

Average starting salary: \$47,860  
**Major Employers:** AT&T Labs, Bankers Trust, Bell Atlantic, Cabletron Systems, Chase Manhattan Bank, Computer Associates, Comrise Technology, Inc., Converse Information Systems, Eastman Software, Ericsson Messaging Systems, Inc., Fujitsu Network Communications, Gibbs & Cox, Hamilton Standard, IBM, Lehman Brothers, Lucent Technologies, Merrill Lynch, MIT Lincoln Laboratory, NCR Corporation, Paine Webber, Inc., Pitney Bowes, Qwest Internet Solutions, Sapient Corp., Software Spectrum

## **COMPUTER SCIENCE**

Average starting salary: \$45,360  
**Major Employers:** ComniTech Corp., Eastman Software, Federal Reserve Bank of N.Y., Goldman Sachs, Hamilton Standard, Lucent Technologies, Merrill Lynch, Paradyne Corp., Periphonics Corporation, Photocircuits, Qwest Internet Solutions, Raytheon Systems & Company, Sears, Roebuck & Company, Standard Microsystems Corp., Sun Microsystems, Symbol Technologies, Inc., Telecordia Technologies, Telephonics, Tyco Submarine Systems Ltd., US Patent and Trademark Office

## **ELECTRICAL ENGINEERING**

Average starting salary: \$45,680  
**Major Employers:** AIL Systems, AT&T Labs, Bell Atlantic, Cabletron Systems, Citibank, ComniTech Corp., Comrise Technology, Inc., Con Edison, Eastman Software, Ericsson Messaging Systems, Inc., Exxon Corp., Fujitsu Network Communications, Gibbs & Cox, Goldman Sachs, Hamilton Standard, IBM, KeySpan Energy, Lehman Bros., Inc., Massachusetts Electric Co., Merrill Lynch, MIT Lincoln Laboratory, Northrop Grumman, Photocircuits, Pitney Bowes, Port Authority of NY & NJ, Raytheon Systems Company, Sapient Corp., Software Spectrum, Standard Microsystems, Sun Microsystems Corp., Telecordia Technologies, Telephonics, theglobe.com, Thomson Industries, Tyco Submarine Systems, Ltd., Underwriters Lab., Inc.

## **MECHANICAL ENGINEERING**

Average starting salary: \$40,830  
**Major Employers:** Atlas Air, Bell Atlantic, Con Edison, Estée Lauder, Exxon Corp., Frederic R. Harris, Inc., Gibbs & Cox, Jaros, Baum & Bolles, Nab Construction, Northrop Grumman, Petro-Chem Development Co., Port Authority of NY & NJ, Standard Microsystems Corp., Symbol Technologies, Inc., Syska & Hennessy, Thomson Industries, Torrington Company, Trane Company, Turner Construction

# STATISTICS ON ENROLLMENT AND THE STUDENT BODY

## ENROLLMENT 1997-1998

### FALL 1997

	Undergraduate			Graduate			Total
	FT	PT	TOI	FT	PT	TOI	
Brooklyn	1192	117	1309	201	823	1024	2333
Farmingdale	357	27	384	7	258	265	649
Westchester	N/A	N/A	N/A	2	370	372	372
University totals	1549	144	1693	210	1451	1661	3354

## STUDENT PROFILE

### FALL 1997

	Undergraduate		Graduate	
	Men	Women	Men	Women
Brooklyn	1070	239	844	180
Farmingdale	334	50	219	46
Westchester	N/A	N/A	296	76

## PERSISTENCE AND COMPLETION INFORMATION

Fall 1996 First-time, full-time undergraduate students  
continuing at the University in Fall 1997

University-wide: 80%

## ENROLLMENT BY RACIAL/ETHNIC STATUS (using standard Federal classifications)

	Undergraduate Students	Graduate Students
Caucasian	37%	23%
Asian, Pacific Islander	29%	10%
Black, Non-Hispanic	11%	3%
Hispanic	9%	13%
Native American	1%	0%
Other	0%	0%
Unknown	9%	39%
International	4%	22%

*International students come from more than 50 countries.*

# DEGREES OFFERED AT POLYTECHNIC

Polytechnic offers a wide range of degree programs leading to the award of degrees entitled Bachelor of Science, Master of Science, and Doctor of Philosophy. These programs are offered on the University's three campuses located in Brooklyn, Farmingdale (Long Island) and Hawthorne (Westchester). The table below indicates

which degrees are offered at each campus. Additional information about any of the listed degree programs can be found in the corresponding sections of this catalog.

Graduate courses taken at any campus are applicable toward MS and PhD degrees that may be 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 <sup>1</sup>	Brooklyn	Long Island	Westchester
Aeronautics & Astronautics	0902	MS		
Chemical Engineering	0906	BS, MS, PhD		
Chemistry	1905	BS, MS		MS
Civil Engineering	0908	BS, MS, PhD	BS, MS	
Computer Engineering	0999	BS, MS <sup>2</sup>	BS	
Computer Science	0701	BS, MS, PhD	BS, MS	MS
Electrical Engineering	0909	BS, MS, PhD	BS, MS	MS
Electrophysics	0919	MS	MS	
Environment-Behavior Studies	2201	MS		
Environmental Engineering	0922	MS		
Environmental Science	1999	BS, MS		
Financial Engineering	0599	MS		
History of Science	2205	MS		
Humanities	4903	BS		
Industrial Engineering	0913	MS		
Information Management	0702		BS	
Information Systems Engineering	0990			MS <sup>3</sup>
Journalism & Technical Writing	0602	BS		
Management	0506	MS	MS	MS
Management of Technology	0599			MS <sup>3</sup>
Manufacturing Engineering	0913	MS		MS
Materials Chemistry	1905	PhD		
Materials Science	0915	MS		
Mathematics	1701	BS, MS, PhD		
Mechanical Engineering	0910	BS, MS, PhD	BS	
Organizational Behavior	0514	MS		
Physics	1902	BS, MS, PhD		
Polymer Science & Engineering	0906	MS		
Social Sciences	2210	BS		
Specialized Journalism	0602	MS		
System Engineering	0901	MS	MS	MS
Telecommunications & Information Management	0599			MS <sup>3</sup>
Telecommunication Networks	0799	MS	MS	MS
Transportation Management	0510	MS		
Transportation Planning & Engineering	0908	MS	MS	

1. Higher Education General Inventory System
2. Pending approval by New York State
3. Executive format program; Friday and Saturday, alternate weeks

# ACADEMIC DEPARTMENTS AND DEGREES

## *Department of Mathematics*

BS (Mathematics)  
MS (Mathematics)  
PhD (Mathematics)

## *Department of Chemical Engineering, Chemistry and Materials Science*

BS (Chemical Engineering)  
BS (Chemistry)  
BS (Environmental Science)  
MS (Chemical Engineering)  
MS (Chemistry)  
MS (Polymer Science and Engineering)  
PhD (Chemical Engineering)  
PhD (Materials Chemistry)

## *Department of Civil and Environmental Engineering*

BS (Civil Engineering)  
MS (Civil Engineering)  
MS (Environmental Engineering)  
MS (Environmental Science)  
MS (Transportation Planning and Engineering)  
MS (Transportation Management)  
PhD (Civil Engineering)

## *Department of Computer and Information Science*

BS (Computer Science)  
BS (Information Management)  
MS (Computer Science)  
MS (Information Systems Engineering)  
PhD (Computer Science)

## *Department of Electrical Engineering*

BS (Electrical Engineering)  
BS (Computer Engineering) joint with Dept. of Computer &  
Information Science  
MS (Electrical Engineering)  
MS (Electrophysics)  
MS (System Engineering)  
MS (Telecommunication Networks) joint with  
Dept. of Computer & Information Science  
PhD (Electrical Engineering)

## *Department of Humanities and Social Science*

BS (Humanities)  
BS (Journalism and Technical Writing)  
BS (Social Sciences)  
MS (Environment–Behavior Studies)  
MS (History of Science)  
MS (Specialized Journalism)

## *Department of Management*

MS (Financial Engineering)  
MS (Management)  
MS (Management of Technology)  
MS (Organizational Behavior)  
MS (Telecommunications and Information Management)

## *Department of Mechanical, Aerospace and Manufacturing Engineering*

BS (Mechanical Engineering)  
MS (Aeronautics and Astronautics)  
MS (Industrial Engineering)  
MS (Mechanical Engineering)  
MS (Manufacturing Engineering)  
MS (Materials Science)  
PhD (Mechanical Engineering)

## *Physics Program*

BS (Physics)  
MS (Physics)  
PhD (Physics)

# UNIVERSITY DEGREE REQUIREMENTS

This section details the general university-wide degree requirements which apply to all Polytechnic degrees. They are essentially minimum requirements which apply to all programs and degrees at the University. Academic departments may place additional requirements on individual degrees. Such additional requirements are explained in the programmatic sections of the catalog which follow. In no case, however, may a department specify requirements less stringent than those indicated here.

## BACHELOR OF SCIENCE DEGREES

### BASIC DEGREE REQUIREMENTS

Bachelor of science degree programs require from 120 to 131 credits, depending upon the major as described in the programmatic sections of the catalog. Students may attend on a part-time or full-time basis, and all degrees may be completed in four years of full-time study. Students must have a cumulative grade-point average 2.0 or better in all courses taken at Polytechnic to earn a bachelor's degree. (See the section on academic standing and probation.) Some programs may have additional requirements on grades involving specified courses or groups of courses. To earn a Polytechnic Bachelor of Science degree, the student must take a minimum of 34 credits of junior- and senior-level courses at Polytechnic in order to fulfill residency requirements.

Virtually all undergraduate courses are given during the day. A selection of evening undergraduate courses is available, but it is no longer possible to complete any undergraduate degree by taking courses entirely in the evening.

### PLACEMENT EXAMINATIONS

Polytechnic gives all incoming freshmen placement examinations in writing and mathematics, as well as an entrance questionnaire concerning computer background. Each of these examinations and the resulting placements are discussed in the paragraphs below.

#### Writing Placement Examination

Both employers and accrediting organizations are placing increasing emphasis on the need for well-developed written and verbal communications skills. No engineer or scientist can be an effective professional without the ability to communicate not only with other professionals in his or her own field but with professionals in other technical and nontechnical fields, with private and public decision-makers and the general public.

Polytechnic's programs involve frequent writing and speaking assignments across all areas of the curriculum, and it is essential that all students have the appropriate background skills before getting too far into their professional studies.

All incoming freshmen and most transfer students will be required to take a writing placement examination. Students fall into two general groups: those with an English-speaking background, and those with an English as a Second Language (ESL) background.

Based upon the results of the placement examination, students with an English-speaking background will be placed in either:

HU 101	Writing and the Humanities I	3 credits
or		
HU 009	Introductory Composition	0 credits

Students with an ESL background will be placed in either:

HU 103	Writing and the Humanities I (ESL)	3 credits
or		
HU 008	Reading and Writing in English as a Second Language	0 credits

Students completing HU 101 or HU 103 continue with HU 200, Writing and the Humanities II. Students completing HU 009 continue with HU 101, while those completing HU 008 go on to take HU 103. Students placed in HU 008 or HU 009 are encouraged to take these courses over the summer preceding their freshman year. They are made available at a significantly reduced cost for students who do so. Students unable to take a course over the summer may take HU 008 or HU 009 during their first regular semester. Typical schedules can be rearranged to accommodate this.

#### Mathematics Placement Examination

The Mathematics Placement Examination is an extensive test designed to provide a profile of a student's knowledge and skills in basic and advanced mathematics. The department uses the scores on the various components of this examination to guide a student to the appropriate mathematics courses.

#### Computer Placements

All freshmen take CS 200, Programming Methodology, during their first semester of study. Sections of this course, however, are segregated for students who have had significant hands-on experience with computers previously and those who have had very little experience. The placement determination is made using a questionnaire filled out by each student. Those in the "inexperienced" section will receive additional instruction on basic computer usage.

Transfer students with prior college coursework in C++ may 1) receive transfer credit, 2) place out of CS 200 or 3) register for credit by exam. Students needing more information should meet with the adviser in the Department of Computer and Information Science.

All of Polytechnic's placement examinations are intended to insure that each student receives the exact instruction in basic areas needed for successful completion of the degree program they have chosen. Placement examination results are superceded by the results of Advanced Placement examinations and/or acceptable transfer credits from another institution of higher education.

## UNIVERSITY DEGREE REQUIREMENTS

### CORE CURRICULUM FOR ENGINEERING MAJORS

All engineering majors must follow the core curriculum outlined in this section. Non-engineering majors will take appropriate parts of this core, as described in the programmatic sections of this catalog. Students entering the University as undeclared majors are also required to follow this core curriculum and may select any Polytechnic major without loss of credits up to the end of one year of study.

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

There are four components to the core curriculum, including the (1) liberal arts core, (2) mathematics core, (3) basic science core and (4) engineering and computer science core. Each of these components is described in the paragraphs which follow.

#### Liberal Arts Core

Every engineering student must take a minimum of 24 credits of course work in the humanities and social sciences. These courses have two objectives, namely, the development of communications skills and an exposure to an appropriate balance of study in liberal arts content areas. Both are critically important and contribute to the general literacy of engineering undergraduates in dealing with the world and societal issues which set the context for the practice of their professions.

All students must take the following required courses (9 credits):

HU 101/103	<i>Writing and the Humanities I</i>	3 credits
HU 200	<i>Writing and the Humanities II</i>	3 credits
SS 104	<i>Contemporary World History</i>	3 credits

Students placed in HU 008 or HU 009 must successfully complete these courses before beginning HU 101 or 103. HU 103, if required, must be completed before registering for SS 104, and HU 200 is a desirable co-requisite.

To complete the minimum liberal arts requirements, each engineering student must elect two additional courses in the humanities and three additional courses in the social sciences (15 credits). In some

programs, students are required to take HU 110, Professional Report Writing. In such cases, the remaining 12 credits are taken as one humanities course, two social science courses and one course in either area. In the humanities, electives are available in literature, philosophy, fine arts, or modern language. In the social sciences, electives are available in history, history of science, economics, psychology and sociology/anthropology. In the case of the three required social science electives, at least one course must be other than SS 250, SS 189 or the introductory course in sociology/anthropology (SS 184 or SS 189 effective spring 1994). Courses composing these focus areas are described in the "Humanities and Social Sciences" portion of the catalog. Courses in writing, journalism and speech may not be used to fulfill these elective requirements. The following courses also do not fulfill the ABET HU/SS requirement for engineering students: HU 114, HU 130 and HU 344.

#### Mathematics Core

Every engineering student must take a minimum of 17 credits of study in mathematics. Four courses are required of all students:

MA 106	<i>Calculus I</i>	4 credits
MA 107	<i>Calculus II</i>	4 credits
MA 108	<i>Differential Equations and Numerical Methods</i>	3 credits
MA 109	<i>Multidimensional Calculus</i>	3 credits

Each discipline specifies one additional 3-credit mathematics course in one of the following general areas: probability, probability and statistics, linear algebra, numerical analysis or advanced calculus. Consult the programmatic sections of the catalog for information on specific requirements for each discipline.

Students placed in MA 105 must successfully complete this course before beginning the required sequence described above.

#### Basic Science Core

The basic science core consists of 16 credits of study in the critical areas of chemistry and physics. The following courses are required of all engineering majors:

CM 101	<i>General Chemistry I</i>	2.5 credits
CM 111	<i>General Chemistry Laboratory I</i>	0.5 credits
CM 102	<i>General Chemistry II</i>	2.5 credits
CM 112	<i>General Chemistry Laboratory II</i>	0.5 credits

PH 107	<i>Mechanics</i>	3.0 credits
PH 108	<i>Electricity, Magnetism, and Fluids</i>	3.0 credits
PH 118	<i>Physics Laboratory for PH 108</i>	0.5 credits
PH 109	<i>Waves, Optics and Thermodynamics</i>	3.0 credits
PH 119	<i>Physics Laboratory for PH 109</i>	0.5 credits

Although they are given separate course numbers, courses and their associated laboratories should be taken concurrently.

#### Engineering and Computer Science Core

The centerpiece of the core curriculum for engineering majors is the engineering and computer science core of 22 credits. This portion of the curriculum is intended to insure 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 the engineering disciplines. A major element of this part of the core is the freshman engineering sequence, which provides an early introduction and immersion in engineering both as 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 (not including programming skills). The engineering and computer science core is constructed to guarantee that every engineering major is exposed to many of these fundamental areas. All engineering students are required to take the following courses:

EG 101	<i>Introduction to Engineering</i>	3 credits
EG 102	<i>Introduction to Engineering Design</i>	3 credits
CS 200	<i>Programming Methodology</i>	3 credits
*	<i>Senior Design Project</i>	4 credits

\*Actual course code depends on department

Transfer students replace EG 101 and EG 102 by advanced technical courses if they enroll in the University as sophomores or later.

EG 101/102 constitutes the freshman engineering program, focusing on hands-on experiential learning and on the process of engineering design as the single most unique professional function of the engineer. Each major defines its own senior



design projects, but every engineering student must complete one.

To complete the engineering core, each engineering disciplinary curriculum must specify one course focusing on each of the three fundamental areas of engineering discussed previously. At least one of these courses will be taught in an engineering department (including computer science) other than the student's major.

### **Writing and Speaking Across the Curriculum**

Polytechnic has adopted a "writing and speaking across the curriculum" program to insure the development of adequate communications skills on the part of all graduates. The program ensures that significant writing and speaking assignments will be included in designated courses throughout the student's undergraduate program and that the grades for these courses will be influenced by the quality of presentation in addition to mastery of content. It is expected that every full-time Polytechnic undergraduate will have at least one such course in every semester of registration.

To support this program, a writing learning center has been established at the Brooklyn campus, staffed by instructors and qualified tutors. Appointments can be made to assist in improving writing and/or speaking skills. Similar services are available on the Farmingdale campus through the Department of Humanities and Social Sciences.

Core courses such as HU 101/103, HU 200, SS 104, EG 101, EG 102, all HU/SS electives and all senior design projects are "writing and speaking intensive" courses. Each disciplinary curriculum identifies other courses which will fit into this category as well.

### **FRESHMAN SEMINAR**

All incoming freshmen, including transfer students with less than 6 credits, are required to take SL 101, Freshman Seminar. This seminar includes weekly discussions and presentations on time management, study and test-taking skills, available support services at Polytechnic and many other subjects of importance to beginning students. A short paper on the selection of a major is required of all students in this noncredit course.

At the end of this course, students will be given the opportunity to confirm or change their major. Undeclared majors may choose to select a major, or may remain

undeclared until the end of the freshman year, at which time a major must be declared. In general, the major can be changed at the end of the first semester or at the end of the freshman year without loss of credits.

### **Academic Skills Seminar**

All first-year, first-time probationary students are required to register for and pass the Academic Skills Seminar (SL 102). The seminar consists of eight one-hour sessions which meet once per week and is taught on a pass/fail basis. The purpose of the seminar is to help students learn how to become more academically successful. Please see the Academic Probation section in the "Academic Programs and Policies" portion of this catalog for more complete information.

### **GRADUATION CHECKLIST**

Undergraduates who are nearing completion of their degree requirements receive a graduation check list, which shows the completed courses and their assignment to required areas of study and lists the courses remaining to be completed for the degree. After approval by the major academic department, the checklist is mailed to students by the Registrar. Checklists are prepared for full-time students after completion of 85 credits and for part-time students after 105 credits. A revised checklist will be issued to any student who does not complete his or her degree program within a reasonable period after issuance of the initial checklist.

### **COURSE SUBSTITUTIONS AND OTHER MODIFICATIONS TO CURRICULA**

Curricula sometimes change in order to keep students abreast of the latest knowledge and methods within the subject area, especially in the science, engineering and technology areas taught at Polytechnic. Students will be informed of these changes by their major department. Because of changes in curricula and course content, and to address special situations, it is occasionally necessary to substitute a course for one specified in the curriculum to meet degree requirements. Such substitutions are documented on an Adjustment of Degree Requirements form, commonly known as a "blue sheet" because of its color. The form is available from the Office of Student

Records. Each substitution must be documented on a form, and each must be approved by the student's major faculty adviser and by the Office of Academic Affairs. If a graduation checklist has already 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 Academic Affairs.

Students who have interrupted their studies for a length of time are likely to have degree requirements evaluated according to the curriculum in effect at the time of readmission, not according to the curriculum in effect at the time the student first matriculated. This is to ensure that the course work used to fulfill degree requirements is current and meets the current standards in the field. At the time of readmission, the student should discuss with the adviser the specific courses remaining to be taken for graduation as well as the applicability toward the degree of courses already taken.

### **SENIOR HONOR STUDENTS**

Each spring, the departments of Electrical Engineering and Computer Engineering select students with high grade-point averages 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 make substitutions in their selection of senior courses. Most often this takes the form of substituting more advanced graduate courses in place of usual requirements in the same area of study. To be eligible for this designation, transfer students must complete half of the credits needed to satisfy degree requirements at Polytechnic (for example, 64 of 128).

### **DEGREES WITH HONORS**

Degrees with honors will be awarded to undergraduate students of high scholastic rank upon unanimous recommendation of the faculty. Honors are based upon the following schedule of cumulative grade-point averages:

BS Cum Laude	3.40 - 3.59
BS Magna Cum Laude	3.60 - 3.69
BS Summa Cum Laude	≥ 3.70

To be eligible for graduation with honors, including selection as valedictorian, transfer students must have completed a minimum of 60 credits toward their degree requirements at Polytechnic.

## UNIVERSITY DEGREE REQUIREMENTS

### DUAL MAJORS

A *dual major* is a single BS degree with two major disciplines indicated on the degree. A student may receive a degree indicating dual majors if he or she:

- is assigned a home department that will be responsible for the student's primary (first) major.
- applies for and is admitted to the second department in the same manner as a student who wishes to change majors and
- has, prior to graduation, approval from each department of the courses for its major.

Interested students should consult departmental advisers, for not all disciplines are available as dual majors.

### DUAL UNDERGRADUATE DEGREES

It is also 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 is, therefore, computed using the following formula:

$$\text{Total Credits} = \text{Credits (Degree 1)} + \text{Credits (Degree 2)/4}$$

- 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, mechanical engineering and aerospace 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 departments, (3) obtain approval from both departmental faculty advisers when registering or withdrawing from a course, (4) maintain good academic standing in the University and in each academic department and (5) complete all courses specified in the graduation check list provided by each department with satisfactory grades.

- Both degrees may be simultaneously earned, or the primary degree may be earned first. Graduation honors for each degree are separately determined.

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 baccalaureate degree followed by a master's degree in a different, but related, discipline.

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

### BS/MS ACCELERATED HONORS PROGRAMS

Students who have outstanding academic records may apply for admission to BS/MS Accelerated Honors Programs that lead to simultaneous award of a bachelor's and a master's degree. These programs allow students to make accelerated progress toward completion of the two degrees through combinations of Advanced Placement credits, summer course work and taking more credits per semester.

The courses required for the two degrees in these programs include all courses required for the individual BS and MS degrees, but the total number of credits may be less than the sum of the credits required for the individual degrees. Specific combinations of BS and MS majors that are available in this accelerated format are described in the individual academic program sections of this catalog. Additional information can be obtained from departmental faculty advisers.

### MASTER OF SCIENCE

Admission to Master of Science degree programs requires a bachelor's degree in an appropriate preparatory discipline from an institution acceptable to Polytechnic. Candidates for Master of Science degrees must complete no less than 36 units of advanced study and/or research beyond the bachelor's degree in the program selected. Specific course requirements for each Master of Science program are detailed in the programmatic descriptions of this catalog.

In order to obtain any graduate degree or certificate, students must maintain a grade-point average of 3.0 (equivalent to a B letter grade) or better in all graduate courses taken at Polytechnic, including those not used to fulfill specific program requirements. An average of B or better is also required in all guided studies, including readings, projects, theses and dissertations.

Students may offer no more than 12 units of project, guided studies and/or thesis towards fulfillment of the Master of Science degree requirements. Registration

in a project and/or thesis must be continuously maintained until the work is completed and a grade recorded.

A minimum of 27 units of work must be taken at Polytechnic. A maximum of 9 units may be accepted as transfer and/or validation credits, the latter not exceeding 6 units. All requirements for the Master of Science degree must be completed within a period of no more than five years after beginning graduate studies at Polytechnic. Any extension of this period requires the approval of the Office of Academic Affairs.

Individual programs may specify required courses, minimum grade-point averages in specific courses or course groups and/or require a comprehensive examination, presentation of a seminar, or completion of a project or thesis.

### DOCTOR OF PHILOSOPHY

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

Graduate students who wish to enter into a systematic program leading to the doctorate should confer with an adviser in the department of major interest regarding selection of courses, major and minor fields of study, formulation of a guidance committee, qualifying and language examinations and degree candidacy. Students must satisfy the detailed requirements of the degree program selected.

All candidates for the doctorate must complete a minimum of 90 units of graduate work beyond the bachelor's degree, including a minimum of 24 units of dissertation research. A minimum of 30 units, including all dissertation units, must be taken at Polytechnic.

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 each year, and students should consult the academic department for specific infor-

mation. Once the student has started the dissertation, registration for the dissertation must be continuous until the dissertation has been completed and accepted, unless a leave of absence is formally granted.

Students must maintain a grade-point average of 3.0 (equivalent to a B letter grade) or better for all graduate courses taken at Polytechnic and a B or better average for the dissertation. Departments may have specific course or grade requirements which must be fulfilled.

Full-time doctoral students are required to complete all work for the doctorate within six years of initiation of graduate work at Polytechnic. Part-time students must complete within 12 years. Any extension of these periods requires the approval of the Office of Academic Affairs.

### GRADUATE CERTIFICATE PROGRAMS

Polytechnic offers a number of graduate certificate programs in specialized subject areas for students who may not wish to enroll in a full degree program. Students must officially enroll in a certificate program when they begin graduate study at Polytechnic. Detailed descriptions of the certificate programs are available from the responsible departments.

Depending on the program, 12 to 15 units must be taken at Polytechnic in order to earn the certificate, and the courses may also be applied to graduate degrees. Applicants must be formally admitted to a certificate program before beginning course work. Admission requirements are the same as those for the related MS programs.

A cumulative grade-point average of 3.0 in all graduate courses taken at Polytechnic is required for receipt of a certificate. No courses applied to one certificate program can be applied to another. Requirements for certificates must be completed within three years.

A student in such a program who subsequently decides to pursue a graduate degree must file a separate application for admission to the regular graduate program.

### The following graduate certificate programs are currently available:

- Achieving World Class Quality
- Computational Methods for Engineering Design and Analysis
- Construction Management
- Financial Engineering
- Hazardous Waste Management
- Human Resources
- Information Management
- Manufacturing Engineering and Production Science
- Manufacturing Excellence by Design: Holistic Approach
- Operations Management
- Organizational Behavior
- Polymeric Materials
- Software Engineering
- Technical Communications
- Technology Management
- Telecommunications Management
- Traffic Engineering
- Transportation Management and Economics
- Transportation Planning
- Wireless Communications

### APPLICATION FOR DEGREE

Formal application for the award of any Polytechnic degree or certificate must be filed by graduate and undergraduate students. Filing dates for each semester are published in the *Schedule of Classes*. Students who do not file by the published deadline dates become candidates for the next graduating class.

Applications for BS and MS degrees are available in the Office of Student Records. Applications for the PhD degree are available in the Office of Academic Affairs. 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 prior to the date of graduation. Upon graduation, no transfer of courses among degree programs is allowed.

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

## THESES AND DISSERTATIONS

### **UNDERGRADUATE THESES**

The purposes of the undergraduate thesis is to apply knowledge gained in the major field of interest and to familiarize the student with methods of planning, conducting and reporting original research. The thesis may be a discourse upon a subject included in the student's courses of study, an account of an original investigation or research, a report on a project, or an original design accompanied by an explanatory statement.

All undergraduate students who plan to undertake a thesis should report to the head of their major department for choice of a thesis topic at least one year prior to graduation. The head of the department will approve requests and appoint a thesis adviser. Students should contact their thesis adviser immediately and register for a thesis at the next registration. Thereafter, the student must register for the thesis every fall and spring until it is completed and accepted, and the final grade is entered into the student's permanent record.

The undergraduate thesis is optional. All theses and results obtained become the property of Polytechnic University. Regulations covering thesis registration and thesis format are available in all departmental offices.

### **GRADUATE RESEARCH (PROJECTS, THESES, DISSERTATIONS)**

Investigations undertaken for graduate research have as their primary purpose the development of independent and creative thinking. Through them, students are trained in analysis, research and synthesis, and contribute to the advancement of science and engineering.

Research for an advanced degree shall embody knowledge of the field of 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.

Master of science students may elect to complete an MS project or MS thesis and may be required to do so in certain programs. Consult the programmatic descrip-

tions of this catalog for details. The thesis is generally a more extended piece of work, usually entailing 9 to 12 units, while the project usually entails 3 to 6 units. At this level, research shall exhibit a thorough understanding of advanced scientific thought or ability to apply advanced principles constructively to engineering planning and design.

Each doctor of philosophy 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 in the exploration and development of new areas of knowledge in science or engineering. A successful dissertation must demonstrably advance the state-of-the-art in the subject area of research. University requirements for dissertations set a minimum of 24 units 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 THESES AND DISSERTATIONS**

After a project, thesis, or dissertation adviser and/or guidance committee has been appointed, the candidate should register each semester for the number of units that realistically reflects the amount of time and effort the candidate expects to devote to this research. Registration must be continuous each fall and spring until an adequate research effort has been completed and the required oral examination has been passed. Registration may not be interrupted until a grade is entered on the permanent record except with the permission of the Office of Academic Affairs. If, at the end of any semester, the work covered by any unit of registrations is deemed unsatisfactory by the adviser, reregistration for the same unit may be required, obligating the student for full tuition and laboratory fees involved. Registration for the last unit is required until a final grade is submitted to the Office of Student Records.

For the PhD, if the minimum number of dissertation units has already been taken and the dissertation is finished except for the final defense, then the student will be allowed to register for the dissertation for a ½ unit in order to keep the tuition charges to a minimum. Registrations for ½ unit may only be done once.

### **MANUSCRIPT PRESENTATION**

The research is to be presented to the appointed guidance committee by the candidate in final manuscript form for official acceptance on or before the Monday seven weeks before commencement. The format of the bound document resulting from research is prescribed in a brochure entitled "Regulations on Format, Duplication, and Publication of Project Reports, Theses, and Dissertations," which is available from the Office of Academic Affairs and in the various departmental offices. Some of the regulations are summarized below.

Master's degree candidates are to submit four final bound copies of their research, and doctoral candidates must submit five final copies, of which one copy is to be left unbound for microfilming. Duplication processes of high quality are acceptable. In addition, each doctoral candidate is required to submit two copies of an abstract of not more than 350 words suitable for publication in *Dissertation Abstracts*.

The four finished copies are to be submitted to the department for appropriate signatures and presented to the Office of Academic Affairs before noon on the first Friday in December (for fall degrees) or the first Friday in May (for spring degrees). At the same time, doctoral candidates must submit the unbound copy in a labeled envelope along with the two copies of the abstract. The original copy is kept permanently in the Polytechnic library.

### **PUBLICATION**

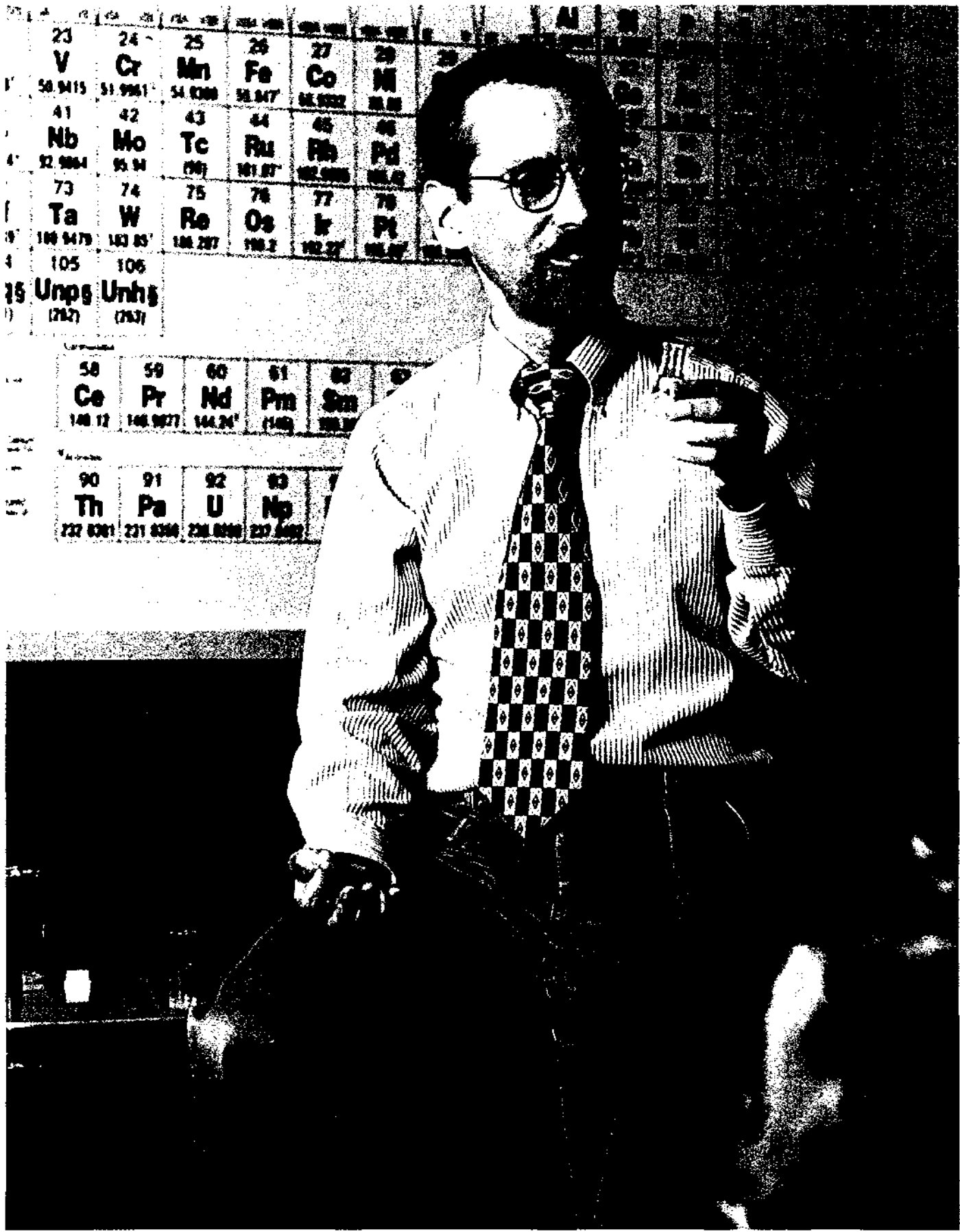
Doctoral dissertations will be microfilmed by University Microfilms, Ann Arbor, Michigan, and abstracts of them will be published in the journal *Dissertation Abstracts*. The cost of this service will be charged to the student. Copies of these microfilms may then be purchased from University Microfilms by any interested person.

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 University dissertation.

# **PART II**

## **ACADEMIC DEPARTMENTS AND PROGRAMS, DEGREE REQUIREMENTS AND CURRICULA**





23 V 50.9415	24 Cr 51.9961	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.64	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
41 Nb 92.9064	42 Mo 95.94	43 Tc 98	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.757	52 Te 127.6	53 I 126.905	54 Xe 131.29
73 Ta 180.9479	74 W 183.85	75 Re 186.207	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.967	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po 209	85 At 210	86 Rn 222
105 Unpg (262)	106 Unhh (263)												

58 Ce 140.12	59 Pr 140.9077	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 164.930	68 Er 167.259	69 Tm 168.930	70 Yb 173.054	71 Lu 174.967
--------------------	----------------------	--------------------	-------------------	--------------------	---------------------	--------------------	---------------------	--------------------	---------------------	---------------------	---------------------	---------------------	---------------------

90 Th 232.0377	91 Pa 231.0369	92 U 238.0289	93 Np 237.0482	94 Pu 244.0642	95 Am 243.0614	96 Cm 247.0713	97 Bk 247.0703	98 Cf 251.0795	99 Es 252.0833	100 Fm 257.1037	101 Md 258.1037	102 No 259.1037	103 Lr 260.1037
----------------------	----------------------	---------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	-----------------------	-----------------------	-----------------------	-----------------------

# 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 123 Experimental Design**

2½:1½:0:4

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 224 Co-requisite: MA 153*

**Also listed under IE 123**

The first line gives the official *course number* for which you must register, the official *course title*, and the breakdown of credits (undergraduate) or units (graduate) for the course. In the sample description, the course meets for 2½ lecture periods, 1½ laboratory periods and no recitation periods per week. If successfully completed, 4 credits are earned.

The paragraph description briefly indicates the contents and coverage of the course. A detailed course syllabus may be available on request from the office of the offering department.

“Prerequisites” are courses (or their equivalent) that *must* have been 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 are sponsoring the described course, and that you may register under either number, usually the one representing your major program. The classes are jointly given and held.

## DEPARTMENT OF CHEMICAL ENGINEERING, CHEMISTRY AND MATERIALS SCIENCE

*Head:* Kalle Levon

The increased complexity of materials and biomaterials in science, engineering and technology applications has increased the need for interdisciplinary approaches to synthesis, production and applications. Tasks ranging from synthesis of molecules to factory production of materials require increased numbers of chemists, chemical engineers and material scientists. Employment opportunities include the pharmaceutical, cosmetics, food and plastics industries, as well as materials in biomedical sciences. Job growth rates in these related fields are among the highest in the technical professions.

To face the demands and challenges in modern industry, the Chemical Engineering, Chemistry, and Materials Science Departments at Polytechnic University have joined their forces to form a single, multidisciplinary department. We now offer educational and research programs that fulfill the present trends with novel molecules, advanced properties and processes, and high quality optimization. The programs include BS degrees in chemical engineering, degrees in chemistry with options in biomedical sciences, biomaterials, materials chemistry, and polymer chemistry. MS degrees are in chemical engineering, polymer science and engineering, chemistry, and materials science. The PhD program offers degrees in chemical engineering and in materials chemistry. The department also offers advanced certificates in smart materials and in materials characterization. Our programs rely strongly on our reputation in polymeric materials. Polytechnic University was the first in the world to offer education in polymer science. The department works closely with the Herman F. Mark Polymer Research Institute, which coordinates industrial cooperations, advanced education with workshops and specific symposia.

The professors in the Department of Chemical Engineering, Chemistry and Materials Science are all researchers at the leading edge of their fields. International symposia are organized at Polytechnic University on specific topics and worldwide recognition is based on the enthusiastic activity of our faculty. Research fields include both government and industrial cooperation with annual meetings to optimize recruiting, mutual interactions and information exchange. The fundamental areas of research consists of molecular thermodynamics, molecular modelling and crystallization studies, which together form the essentials for overall understanding of structure formation. The faculty specializes in advanced characterization methods, using laboratories for surface analysis, scattering, HOP-chromatography, molecular modelling, X-ray scattering, spectroscopy, microscopy (STEM, STM and OM) and electrical and optical properties of materials. The wide variety of areas in research include chiral polymers, with their importance in the pharmaceutical and information technology industries, and complex polymer fluids, which respond to external conditions like temperature, pressure and stress. Composite materials and polymer blends involve research in which the desired properties are tailor-made for various structural applications. The study of electrical and optical properties of materials has brought the fundamental science closer to applications with electro-active materials. Biomedical materials also play an important part in research efforts to create elastic biodegradable materials, encapsulated medicine, and new drug-release technology. Research projects include interdisciplinary aspects with mechanical and electrical engineering and computer science departments.

To meet the needs of industry, the department offers evening courses, part-time study opportunities, on-site research in the industrial workplace and the possibility of classes via Internet as attractive options.

### UNDERGRADUATE PROGRAMS

The undergraduate program in chemical engineering provides a sound foundation in science and the engineering sciences and builds on this a strong and integrated set of courses in chemical engineering. Thorough instruction is given in chemistry, physics, mathematics and in the engineering sciences basic to the understanding of physical and chemical operations and processes. Courses in engineering science include engineering thermodynamics, reaction kinetics, process dynamics, fluid mechanics, heat transfer and mass transfer.

An undergraduate program leads to a bachelor of science in chemical engineering and is accredited by the Accreditation Board for Engineering and Technology (ABET). The chemical engineering curriculum provides a background that enables the graduate to select a professional career from an extremely broad spectrum of opportunities. Graduates are prepared to take employment in a number of capacities in industry or to enter graduate school for advanced study in chemical engineering or other fields.

For students majoring in chemistry, the Department of Chemical Engineering, Chemistry and Materials Science provides curricula which go beyond the professional training requirements of the American Chemical Society. Courses offered are designed to prepare students for graduate studies or work in industry. The BS in chemistry is certified by the American Chemical Society, and graduates are immediately eligible for membership.

The BS in chemistry with an option in materials chemistry is to provide specialization in the field of materials with the introduction of ceramics, alloys semiconductors and polymers. The BS with an option in polymer chemistry is designed to prepare the student both for industrial employment and for graduate



work in the field of polymers.

The Biomedical Sciences Option of the Bachelor of Science in chemistry provides significant exposure to both chemical and biological sciences. The curriculum may be selected by students preparing for professional careers in medicine, dentistry, osteopathy, veterinary, podiatry, optometry or biotechnology and bioengineering.

The Biomaterials option is directed toward science and engineering studies of materials for biomedical use. The program includes study of structure and properties of biological macromolecules and the use of materials such as ceramics and polymers in the medical field.

## GRADUATE PROGRAMS

Graduate programs in chemical engineering are designed to introduce students to advanced designs, research and development. The department offers graduate programs leading to a master of science, engineer and doctor of philosophy in chemical engineering and to a master of science in polymer science and engineering.

The MS program in chemistry and the PhD program in materials chemistry are intended to develop broad competence in the field of chemical sciences with specializations in synthesis of novel molecules, polymers and biomaterials, characterization of these materials, or final evaluation of the performance level of the developed products. A series of advanced special courses are designed to fulfill modern expectations in addition to fundamental courses. On-site research and electives in other disciplines like Management are encouraged for part-time students.

The Materials Science program prepares students for a Master of Science in materials science. MS and PhD degrees are offered at the Brooklyn campus and certain MS degrees are offered at the Westchester Center.

## FACULTY

### PROFESSORS

**Nitash P. Balsara**, Professor of Chemical Engineering  
PhD, Rensselaer Polytechnic Institute  
*Polymer phase behavior, scattering (light and neutrons) and diffusion*

**Bruce A. Garetz**, Professor of Physical Chemistry  
PhD, Massachusetts Institute of Technology  
*Laser spectroscopy, nonlinear optics and multiphoton processes, molecular dynamics*

**Mark M. Green**, Professor of Organic Chemistry  
PhD, Princeton University  
*Macromolecular stereochemistry: synthesis and structure*

**Richard Gross**, Herman F. Mark Professor of Polymer Science  
PhD, Polytechnic University  
*Interface between biology and polymer science, enzymes in organic media for regio- and enantioselective polymerizations, whole-cell systems for the generation of polymeric structures, biodegradable polymers*

**Kalle Levon**, Professor, Department Head and Director of the Polymer Research Institute  
Dr. Agr., University of Tokyo  
*Phase separation in polymer blends and solutions, gelation, conductive polymers, bioagent detection*

**Jovan Mijovic**, Professor of Chemical Engineering  
PhD, University of Wisconsin at Madison  
*Relaxation dynamics in complex systems, modeling of processing of polymers, in-situ monitoring of processes, structural relaxation in the glassy state*

**Shirley M. Motzkin**, Professor of Biology  
PhD, New York University  
*Development mechanisms, teratology and skeletal development, radiation effects*

**Allan S. Myerson**, Joseph J. and Violet J. Jacobs Professor Chemical Engineering  
PhD, University of Virginia  
*Crystallization, mass transfer, biochemical engineering*

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

**Abraham Ulman**, Alstadt-Lord-Mark Professor of Chemistry  
PhD, The Weizmann Institute (Israel)  
*Self-assembled monolayers and surfacing engineering, wetting and adhesion, surface initiated polymerization and polymer brushes, nanoparticles and nanotechnology, advanced materials*

### ASSOCIATE PROFESSORS

**Mary K. Cowman**, Associate Professor of Biochemistry  
PhD, Case Western Reserve University  
*Molecular biomechanics of connective tissue polysaccharides. Solution conformation and interactions of hyaluronan, novel methods for structure characterization, connective tissue organization and function*

**Leonard I. Stiel**, Associate Professor of Chemical Engineering  
PhD, Northwestern University  
*Thermodynamic properties of mixtures, properties of polar fluids*

**Iwao Teraoka**, Associate Professor of Polymer Chemistry  
PhD, University of Tokyo  
*Polymer solution dynamics, fractionation of polymers*

**Nancy M. Tooney**, Associate Professor of Biochemistry and Associate Dean of Engineering and Applied Sciences  
PhD, Brandeis University  
*Structure and function of proteins and other biopolymers, blood clotting system, fibronectin structure and function, environmental chemistry*

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

**Walter P. Zurawsky**, Associate Professor of Chemical Engineering  
PhD, University of Illinois  
*Plasma polymerization, mass transfer in membranes*

#### ASSISTANT PROFESSORS

**Yitzhak Shnidman**, Assistant Professor  
PhD, The Weizmann Institute (Israel)  
*Modeling structure and dynamics in multiphase fluid, solid, colloid and polymer systems, focusing on interfacial phenomena, such as wetting, adsorption, adhesion and nucleation*

#### RESEARCH FACULTY

**T.K. Kwei**, Research Professor of Polymer Chemistry  
PhD, Polytechnic Institute of Brooklyn  
*Polymer-polymer miscibility, segmented polyurethanes and unsaturated polyesters, phase relationships in polymer blends, interactions in composites*

**Yoshiyuki Okamoto**, Research Professor of Organic and Polymer Chemistry  
PhD, Purdue University  
*Organic and polymer synthesis, characterizations and applications*

**Sergio Petrucci**, Research Professor of Physical Chemistry  
PhD, University of Rome  
*Relaxation kinetics, ligand substitution in nonaqueous media, microwave and diffusional rotational relaxation*

**Arnost Reiser**, Research Professor of Chemistry  
DrIng, University of Prague  
*Polymer photochemistry, photoresists, image science*

#### EMERITUS FACULTY

**Robert C. Ackerberg**, Professor Emeritus of Chemical Engineering  
PhD, Harvard University  
*Fluid Mechanics, Applied Mathematics*

**Frederick Eirich**, Distinguished Professor of Polymer Chemistry  
PhD, University Vienna  
*Mechanical behavior of polymers, rheology, colloid chemistry, chemical evolution, biopolymers*

**Ernest Loebl**, Professor Emeritus of Physical Chemistry  
PhD, Columbia University  
*Theoretical chemistry, quantum statistical mechanics*

**Herbert Morawetz**, Institute Professor, Professor Emeritus of Polymer Chemistry  
PhD, Polytechnic Institute of Brooklyn  
*Polymer reactions, hindered rotation in polymer systems, properties of polymer gels, polymer compatibility*

# CHEMICAL ENGINEERING PROGRAM

Chemical engineers rely heavily on science, engineering methods, experience and ingenuity to develop the processes and equipment required for economical production of new and useful products. Chemical engineers have contributed to the development of virtually every material common to modern life. They are involved with the production of petroleum products, plastics, pharmaceuticals, foodstuffs, synthetic rubber and rocket propellants, to name a few. Their influence has been felt in developing fuel cells, automatic controls, water desalination plants, missiles and artificial kidneys.

Chemical engineers may choose from a very wide range of activities including research, process and product development, design and supervision of the construction and operation of industrial plants, technical sales and services, consulting, management and teaching. Opportunities in chemical engineering are virtually unlimited.

The foundations of chemical engineering are the sciences, with emphasis on chemistry, mathematics, physics and the engineering sciences (including thermodynamics, fluid mechanics, kinetics, and heat and mass transfer). Chemical engineering courses include the analysis, design and control of equipment, operations and processes. Through this course of study, chemical engineering 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 engineering provides a sound foundation in science and the engineering sciences. An integrated set of chemical engineering courses is built upon this foundation. Thorough instruction is given in chemistry, physics, mathematics and engineering science, which are basic to the understanding of physical and chemical opera-

tions and processes. Courses in engineering science include engineering thermodynamics, reaction kinetics, process dynamics, fluid mechanics, heat transfer and mass transfer.

The goal of the chemical engineering program is to provide our students with a solid foundation in science and engineering that will allow them to work in industry or pursue advanced degrees in chemical engineering or related fields. To meet this goal, thorough instruction is given in chemistry, physics and mathematics. An integrated set of chemical engineering courses is built upon this foundation and includes courses in thermodynamics, reactor design, transport processes, process dynamics and process design. Through this course of study, chemical engineering students develop the knowledge and analytical skills necessary to bridge the gap between scientific advances and large-scale production of products.

Design is an essential part of the chemical engineering education and is incorporated into many of the chemical engineering courses. Generally, as students progress through the curriculum and learn more fundamental engineering science, more design components are introduced into the courses and the complexity of the design problems increase. A two-semester sequence of courses in process design is required in the senior year. In these courses students must design chemical processes and must include engineering, safety and economic considerations in their designs.

The chemical engineering curriculum provides a background that enables the graduate to select a professional career from an extremely broad spectrum of opportunities. Graduates are prepared to take employment in a number of capacities in industry or to enter graduate school for advanced study in chemical engineering or other fields.

An undergraduate program leads to a Bachelor of Science in chemical engineering and is accredited by the Accreditation Board for Engineering and Technology (ABET).

Polytechnic requires a 2.0 minimum average for graduation. Students must

also meet the academic standards of the department. For students to advance to the senior year, a 2.0 grade-point average must be maintained in chemical engineering courses CH 120, CH 152, CH 231, CH 232 and CH 252; the same course must not be failed twice. Students who do not meet these requirements will not be allowed to register for senior courses. All listed prerequisites must be satisfied before students are permitted to enroll in chemical engineering courses.

## GRADUATE PROGRAMS

Graduate programs in chemical engineering are designed to introduce students to advanced designs, research and development. The department offers graduate programs leading to a Master of Science in chemical engineering, Doctor of Philosophy in chemical engineering, and Doctor of Philosophy in chemical engineering with an option in polymer science and engineering. The department also offers a program leading to a Master of Science in polymer science and engineering, which is described in a separate section of this catalog. A degree in chemical engineering is generally required for admission to graduate study. An applicant who has earned a bachelor's degree from a foreign institution is required to submit Graduate Record Examination and TOEFL scores. Applicants with degrees in other fields or from other colleges may be admitted with undergraduate and/or graduate deficiencies as evaluated by the graduate adviser. Students must have had differential equations. The program leading to a master's in chemical engineering may be used as either a terminal course for development and advanced design, or as a research degree giving preliminary graduate training for a doctorate in chemical engineering. The Doctor of Philosophy in chemical engineering program provides advanced graduate study and research for qualified students interested in research and development.

## Typical Course of Study for the Bachelor of Science in Chemical Engineering

### FRESHMAN YEAR

#### Fall Semester

Course No.	Subject	Hours/Week			
		Class	Lab	Rec.	Cr.
MA 106	Calculus I	4	0	1	4
CS 200	Prog. Meth.	3	0	0	3
CM 101	Gen. Chem. I	3	0	0	2.5
CM 111	Gen. Chem. Lab. I	0	1.5	0	0.5
HU 101	Writing & the Humanities I <sup>1</sup>	3	0	0	3
EG 101	Intro. to Eng.	1	3	1	3
SL 101	Freshman Seminar	1	1	0	0
<b>TOTAL</b>					<b>16.0</b>

#### Spring Semester

Course No.	Subject	Hours/Week			
		Class	Lab	Rec.	Cr.
MA 107	Calculus II	4	0	1	4
PH 107	Mechanics	4	0	0	3
CM 102	Gen. Chem. II	3	0	0	2.5
CM 112	Gen. Chem. Lab. II	0	1.5	0	0.5
EG 102	Intro. To Eng.	1	3	1	3
SS 104	Contemp. World History <sup>2</sup>	3	0	0	3
<b>TOTAL</b>					<b>16.0</b>

### SOPHOMORE YEAR

#### Fall Semester

MA 108	Diff. Equations and Num. Methods	3	0	1	3
PH 108	Elect., Magnetism, and Fluids	3	0	1	3
PH 118	Physics Lab. I	0	1.5	0	0.5
CH 120	Chem. Process Analysis	3	0	0	3
CM 122	Organic Chem. I	3	0	0	3
CM 124	Organic Chem. Lab. I	1.3	5	0	2
HU 200	Writing & the Humanities II	3	0	0	3
<b>TOTAL</b>					<b>17.5</b>

#### Spring Semester

MA 109	Multidimensional Calculus	3	0	1	3
CH 152	Chem. Eng. Thermo. I	3	0	0	3
CM 161	Physical Chemistry I	3	0	0	3
CM 123	Organic Chemistry II	3	0	0	3
PH 109	Waves, Optics, and Thermo.	3	0	2	3
PH 119	Physics Lab. II	0	1.5	0	0.5
<b>TOTAL</b>					<b>15.5</b>

### JUNIOR YEAR

#### Fall Semester

CH 231	Transport Phenomena	4	0	0	4
CH 252	Chem. Eng. Thermo. II	3	0	0	3
CM 162	Physical Chemistry II	3	0	0	3
HU 110	Prof. Report Writing	3	0	0	3
	Technical Elective				3
<b>TOTAL</b>					<b>16.0</b>

#### Spring Semester

CH 232	Mass Transfer Operations	4	0	0	4
EE 370	Principles of Elect. Eng.	3	0	0	3
EE 377	Instrumentation Lab.	0	3	0	1
MT 305	Eng. Properties of Materials	3	0	0	3
	SS Elective				3
	Technical Elective				3
<b>TOTAL</b>					<b>17.0</b>

### SENIOR YEAR

#### Fall Semester

CH 311	Chem. Eng. Lab. I	1.5	4.5	0	3
CH 322	Chem. Reactor Engineering	3	0	0	3
CH 351	Process Dynam. and Control	2	3	0	3
CH 361	Process Design I	3	0	0	3
	HU Elective				3
	SS Elective				3
<b>TOTAL</b>					<b>18.0</b>

#### Spring Semester

CH 312	Chem. Eng. Lab. II	1.5	4.5	0	3
CH 372	Engineering Polymeric Mat.	3	0	0	3
CH 362	Process Design II	3	0	0	3
	Technical Elective				3
	HU or SS Elective				3
<b>TOTAL</b>					<b>15.0</b>

**Total credits required for graduation:**

**131**

<sup>1</sup> Consult the "University Degree Requirements" section of the catalog for variations in the mathematics and humanities sequence that may result from placement examination results.

<sup>2</sup> HU 200 and SS 104 may be taken in either order.

#### Electives

**Technical Electives:** A total of 9 credits of technical electives is required. These must include 3 credits of advanced mathematics, 3 credits of advanced chemistry or biosciences, and 3 credits of advanced engineering.

**Humanities and Social Science Electives:** A total of 12 credits of Humanities and Social Science electives is required. These must include 6 credits of social science and 3 credits of humanities; the remaining 3 credits may be in either humanities or social science. Details of the humanities and social science requirements are found in the "University Degree Requirements" section of the catalog.

### REQUIREMENTS FOR THE MASTER OF SCIENCE IN CHEMICAL ENGINEERING

Candidates for the Master of Science in chemical engineering are to plan their programs in accordance with the following list of requirements for full-time study:

1. Required Subjects	Credits
CH 631 <i>Transport Phenomena I</i>	3
CH 632 <i>Transport Phenomena II</i>	3
CH 773 <i>Thermodynamics I</i>	3
CH 781 <i>Chemical Reactor Analysis and Design</i>	3
CH 991/992 <i>Departmental Seminar</i>	0
<b>2. Electives: 4 courses</b>	<b>12</b>

At least two electives must be chosen from CH 600-CH 940, while the other two may be chosen from another science or engineering department with the approval of the graduate adviser in chemical engineering.

<b>3. CH 997 Master's Thesis</b>	<b>12</b>
<b>Total</b>	<b>36</b>

Part-time students can choose between the above program and the **Guided Study Option**, which includes the following requirements:

<b>1. Required subjects: as above</b>	<b>12</b>
<b>2. Electives: 6 courses</b>	<b>18</b>

At least two electives must be chosen from CH 600 - CH 928, while the other four may be chosen from other science or engineering departments with the approval of the graduate adviser in chemical engineering.

<b>3. CH 902 Guided Study in Chemical Engineering</b>	<b>6</b>
<b>Total</b>	<b>36</b>

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

Programs of study are planned individually with each candidate by the participating members of the department. Systematic study toward a doctor's degree is carried out under a guidance committee appointed by the Office of Research and Graduate Studies. The program is planned to give the student a thorough chemical engineering back-

ground accompanied by study in a minor field chosen by the candidate. The student must pass a comprehensive qualifying examination in chemical engineering and present a doctoral dissertation.

Each candidate for the doctorate must complete a minimum of 90 units (credits) of academic work past the bachelor's degree, including a minimum of 48 units of dissertation research. Although the student may elect to take more than 48 units of PhD thesis, only 48 of those units can be counted in the required 90 units. Furthermore, of those 48 units, at least 36 must be taken beyond MS thesis and at Polytechnic University. A minimum of 24 graduate units beyond the bachelor's degree (not including PhD or MS thesis units) are required in chemical engineering subjects, of which at least 9 must be taken at Polytechnic in the required subjects. A minor is required within a science or engineering department and must consist of at least 9 units taken at Polytechnic. The minor must meet the approval of the graduate adviser in chemical engineering. 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 three grades of C in required subjects.

Candidates for the degree Doctor of Philosophy in Chemical Engineering are to plan their programs in accordance with the following requirements:

1. Required Subjects	Units
CH 631 <i>Transport Phenomena I</i>	3
CH 632 <i>Transport Phenomena II</i>	3
CH 773 <i>Thermodynamics I</i>	3
CH 774 <i>Thermodynamics II</i>	3
CH 781 <i>Chemical Reactor Analysis and Design I</i>	3
CH 991/(2 yrs.) <i>Departmental Seminar</i>	0
<b>2. Electives: six courses, of which at least two must be in chemical engineering subjects.</b>	<b>18</b>

To be chosen in conference with the graduate adviser in Chemical Engineering.

<b>3. Minor: 3 courses</b>	<b>9</b>
A minor must be taken in another science or engineering department with the approval of the graduate adviser in chemical engineering.	

<b>4. CH 989 PhD Thesis</b>	<b>48</b>
Up to 12 units of Master's Thesis can be included here.	90

### REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY IN CHEMICAL ENGINEERING WITH AN OPTION IN POLYMER SCIENCE AND ENGINEERING

The department also offers a graduate program leading to the degree Doctor of Philosophy in chemical engineering with an option in Polymer Science and Engineering. An undergraduate degree in chemical engineering is usually required for admission to this program. Applicants with degrees in other fields may be admitted with undergraduate or graduate deficiencies upon the approval of a graduate adviser. Candidates for the Doctor of Philosophy in chemical engineering with option in polymer science and engineering are to plan their programs in accordance with the following list of requirements for full-time study:

1. Required Subjects	Credits
CH 631 <i>Transport Phenomena I</i>	3
CH 632 <i>Transport Phenomena II</i>	3
CH 773 <i>Thermodynamics I</i>	3
CH 781 <i>Chemical Reactor Analysis &amp; Design</i>	3
CH 921 <i>Polymer Processing</i>	3
CH 926 <i>Engineering Properties of Polymers</i>	3
CH 991-2 (2 yrs.) <i>Seminar in ChE</i>	0

<b>2. Minor: 3 courses</b>	<b>9</b>
----------------------------	----------

A three-course minor must be chosen in polymer-related subjects from the following courses in the department: CM 771, CM 772, CM 781, CM 782, CM 783 and CM 785.

<b>3. Electives: 5 courses</b>	<b>15</b>
--------------------------------	-----------

At least two electives must be chosen from the residual courses on the minor list and the following courses in chemical engineering: CH 862, CH 922, CH 928, CH 933, CH 940. The remaining three electives may be chosen from any graduate course in chemical engineering or chemistry, or from another science or engineering department with the approval of the graduate advisor in chemical engineering.

<b>4. CH 989 PhD Thesis</b>	<b>48</b>
-----------------------------	-----------

Up to twelve units of Master's Thesis can be included here.

<b>Total</b>	<b>90</b>
--------------	-----------

We emphasize that of the 14 courses, at least one half are on polymers.

<b>UNDERGRADUATE COURSES</b>
----------------------------------

**CH 120 Chemical Process Analysis** 3:0:0:3

Introduction to chemical processes and process synthesis and design. Flow sheets, material balances, recycle and properties of materials. Applications of computer methods in solving chemical engineering problems. *Prerequisite: adviser's approval.*

**CH 152 Chemical Engineering Thermodynamics I** 3:0:0:3

Thermodynamic principles of chemical processes. First law of thermodynamics. Energy balances for closed and open systems. Combined energy and mass balances. Humidity and psychrometric charts. Heat capacities and heats of reaction. Equations of state for real fluids. Introduction to the second law of thermodynamics. *Prerequisite: CH 120.*

**CH 231 Transport Phenomena** 4:0:0:4

This course is an introduction to viscous fluid flow, heat transfer and mass transfer. Basic conservation equations and rate equations are developed, discussed and used to analyze systems of interest for chemical processing. *Prerequisites: CH 152 and MA 109.*

**CH 232 Mass Transfer Operations** 4:0:0:4

This course introduces many aspects of mass transfer. Topics covered in this course range from diffusion, convection and mass transfer coefficients to the analysis and design of separation processes such as distillation, absorption and extraction. Analytical and computer techniques are stressed. *Prerequisites: CH 252 and CH 231.*

**CH 252 Chemical Engineering Thermodynamics II** 3:0:0:3

Thermodynamic analysis of cyclical processes. Applications of first and second laws for real fluids with equations of state. Ideal and nonideal mixtures. Partial molar and excess properties of mixtures. Heats of mixing and enthalpy-concentration diagrams. Phase equilibrium calculations at low and elevated pressures by computer procedures. Chemical reaction equilibria. *Prerequisites: CM 161 and CH 152 or adviser's approval.*

**CH 311/312 Chemical Engineering Laboratory I, II** each 1½:4½:0:3

Introduction to and performance of experiments in unit operations, transport processes and unit processes. Students analyze and design their experiments to meet stated objectives. Their results are presented in written and oral form. Computers are integrated into the analysis. *CH 311 Prerequisites: CH 232 and CH 312 Prerequisites: CH 301, CH 322, CH 351.*

**CH 322 Chemical Reactor Engineering** 3:0:0:3

Application of thermodynamics and chemical kinetics to analysis and design of chemical reactor systems. Homogeneous and heterogeneous reactors of various types, uncatalyzed and catalyzed. Design of single and cascaded industrial reactors. *Prerequisites: CH 232, CH 252 or instructor's permission.*

**CH 351 Process Dynamics and Control** 3:0:0:3

Dynamic simulation of chemical processes. Frequency response techniques. Design of feedback and feedforward controllers. Introduction to nonlinear control. *Prerequisites: CH 232, MA 109 or adviser's approval.*

**CH 361 Process Design I** 3:0:0:3

Syntheses and designs of chemical processes, with considerations of site and process selections, process economics, materials of construction, data requirements and acquisition flowsheeting and subsystems. Computer utilized. Case studies. *Prerequisites: CH 261 and Co-/Prerequisite: CH 351.*

**CH 362 Process Design II** 3:0:0:3

Design of large chemical process systems, with special emphasis on more complex, integrated process schemes and systems optimization. *Prerequisites: CH 322 and CH 361.*

**CH 372 Engineering Polymeric Materials** 3:0:0:3

Processing, structure, properties and applications of polymers and their composites as engineering materials. Fundamentals of processing and morphology of polymers. Basic concepts of viscoelasticity, fracture behavior, and thermal and electrical properties of polymers and their composites. *Prerequisites: CM 162 or CH 322, CM 123 CM 124 and MT 305.*

**CH 380-381 Chemical Engineering Project**

*variable credit to max. of 3 each*

Independent work in areas of interest in chemical engineering selected by students and faculty supervisors. Not open to honors or senior thesis students. CH 380 only or both CH 380 and CH 381 may be taken. *Prerequisite: department's approval.*

**H 391-392 Bachelor's Thesis in Chemical Engineering** *variable credit*

Original investigations of problems in chemical engineering. A thorough search of the literature required. Special apparatus constructed as required for experimental work.

**CH 396 Chemical Engineering Internships** 3 credits

Supervised, creative engineering experiences 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. *Prerequisite: senior standing and adviser's approval.*

**CH 399 Senior Honors Work in Chemical Engineering**

*credit to be arranged*

Independent work undertaken by qualified honors students under faculty guidance.

<b>GRADUATE COURSES</b>
-----------------------------

**CH 615 Applied Mathematics in Chemical Engineering** 2½:0:0:3

Mathematical formulation of chemical engineering problems in terms of ordinary, partial differential and difference equations. 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, numerical techniques. *Prerequisites: MA 260 or MA 531 or instructor's permission.*

**CH 631/632 Transport Phenomena I, II** each 2½:0:0:3

Fundamental concepts of momentum, energy and mass transport; transport in stationary and flow systems, steady-state and transient conditions. Elementary Cartesian vector and tensor analyses; conservation equations for general cases and in macroscopic form; rate expressions. Fluid dynamics, energy transfer and diffusion; turbulent transport; transport coefficients; analogies; dimensional analysis; boundary layers, high rates of mass transport. Applications to chemical engineering systems stressed. *CH 631 prerequisites: CH 231 and CH 232, or equivalent. CH 632 prerequisite: CH 631.*

**CH 752 Air Pollution Engineering Control** 2½:0:0:3

Pollutant emissions control; analysis of pollutant properties, concentrations and boundary conditions; absorptive and reactive recovery processes for moving and stationary sources; formation and removal of gaseous oxides (NO<sub>x</sub>, SO<sub>x</sub>, CO, etc.) and of aerosols and other particulates. *Prerequisite: adviser's approval. Also listed under CE 758.*

**CH 773 Chemical Engineering Thermodynamics I** 2½:0:0:3

Advanced treatment of chemical and phase equilibria, phase rules, Gibbs-Duhem equation, non-ideal solutions; stability of thermodynamic systems, osmotic pressures, surface tensions, thermodynamic equilibria in potential fields; introduction to irreversible thermodynamics. *Prerequisite: CH 771 or equivalent.*

**CH 774 Chemical Engineering Thermodynamics II** 2½:0:0:3

Laws of thermodynamics, conditions for thermodynamic equilibria; use of equations of state and the principle of corresponding states to determine changes in thermodynamic properties for pure substances and mixtures. Chemical potentials, standard states, ideal solutions, introduction to chemical and phase equilibria. *Prerequisites: CH 252 or equivalent.*

**CH 781 Chemical Reactor Analysis and Design** 2½:0:0:3

Kinetics of complex homogenous and heterogeneous reactions; determination of kinetic parameters, effects of transport processes; catalyst deactivation. Analysis and design of reactors; ideal reactors, effects of nonideal flow; fixed-bed, fluidized-bed and multiphase reactors. *Prerequisite: CH 322.*

**CH 821 Process Dynamics and Control** 2½:0:0:3

Instrumentation and control of chemical processes from the viewpoint of systems engineering. Unsteady state behavior of chemical engineering systems. Analyses of closed-loop feedback systems for control of variables of chemical processes equipment. *Prerequisite: CH 351 or equivalent.*

**CH 921 Polymer Processing** 2½:0:0:3

Applications of engineering principles to polymer processing. Non-Newtonian polymeric systems. Extrusion theory and applications. Discussions and problem-solving in injection molding, fiber spinning, film blowing and co-extrusion, as well as other polymer engineering processes. *Prerequisites: CH 231 and CH 232 or instructor's permission.*

**CH 926 Engineering Properties of Polymers** 2½:0:0:3

Mechanical properties and structures of solid polymers. Viscoelastic theory and response of amorphous, crystalline and composite materials in stress-strain, creep, stress relaxation and dynamic tests. Effects of orientation and previous history on mechanical behavior. *Prerequisites: CH 917, CM 771.*

**CH 928 Polymer Composites** 2½:0:0:3

Production, properties and durability of polymer composites, with emphasis on continuous fiber-reinforced polymer matrices. Modeling of processing. Chemical compositions, cure kinetics and rheology, crystallization, viscoelasticity, processing methods, residual stresses and fracture mechanics. Composites in service. *Prerequisites: CH 921 and CH 926.*

**CH 940-941 Selected Topics in Polymer Science and Engineering I, II** each 2½:0:0:3

Topics of special interest in polymer science and engineering are announced in advance of each semester offering. *Prerequisite: adviser's approval.*

**PROJECTS, THESES  
AND SEMINARS**

**CH 902 Guided Studies in Chemical Engineering** 6 units, each 2 units

Selections, analyses, solutions, and presentations of engineering reports of problems in processes or equipment design, thermodynamic studies or correlations, or other fields of chemical engineering practices under supervision of staff member. Conferences scheduled. Master's degree candidates required to submit three unbound copies of typewritten reports to advisers one week before the last day of classes. *Prerequisite: degree status.*

**CH 930 Guided Studies in Polymer Science and Engineering** 6 units, each 2 units

Selections, analyses, solutions, and presentations of comprehensive reports of problems involving polymeric materials, such as polymer synthesis, processing, evaluations and equipment design. Supervision by staff members. Conferences scheduled. Master's degree candidates required to submit three unbound copies of typewritten project reports to advisers one week before the last day of classes. *Prerequisite: degree status.*

**CH 987 Thesis for Degree of Master of Science in Polymer Science and Engineering** 9 units, each 3 units

Theses for the master's degree in polymer science and engineering should give results of original investigations of problems in the chemistry and chemical engineering of polymeric materials. Theses may involve experimental research, theoretical analyses, process design, or combinations thereof. Master's degree candidates required to submit four typewritten unbound thesis copies to advisers before or on the seventh Wednesday before commencement. *Prerequisite: degree status.*

**CH 989 Dissertation for Degree of Doctor of Philosophy in Chemical Engineering with option in Polymer Science and Engineering**

30 units, each 3 units

See description for CH 999. A wide variety of problems may be selected from topics in polymer science and engineering. *Prerequisite: see CH 999.*

**CH 991-992 Departmental Seminars** No Credit

Recent developments in chemical engineering, chemistry and materials science are presented through lectures given by engineers from industry, research and educational institutions, by staff members and qualified graduate students. Two semesters are required of all graduate students seeking degrees.

**CH 997 Thesis for Degree of Master of Science in Chemical Engineering**

9 units, each 3 units

Theses for the master's degree in chemical engineering should give results of original investigation of problems in chemical engineering or 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 typewritten unbound thesis copies to advisers before or on the seventh Wednesday prior to commencement. *Prerequisite: degree status.*

**CH 999 Dissertation for Degree of Doctor of Philosophy in Chemical Engineering** 30 units, each 3 units

Dissertations must give results of independent investigations of problems in chemical engineering and may involve experimental and/or theoretical work. Theses must show ability to do creative work and that original contributions worthy of publication in recognized journals have been made to chemical engineering. Candidates are required to take oral examinations on thesis subjects and related topics. Doctor's degree candidates required to submit five unbound thesis copies to advisers before or on the seventh Wednesday prior to commencement. *Prerequisites: degree status and a qualifying examination on quantitative aspects of chemical engineering.*



# CHEMISTRY PROGRAM

Chemistry is concerned with our knowledge of the structures, properties and reactions of matter and our evolving theories to explain our observations, predict chemical behavior and suggest experiments.

Classical divisions of chemistry were organic chemistry, dealing primarily with compounds of carbon; inorganic chemistry, concerned with all other compounds; analytical chemistry, concerned with quantitative determinations of composition; and physical chemistry, which seeks understanding of matter, including chemical bonds and molecular interactions. These classical fields have overlapped increasingly, and several interdisciplinary fields are now of great importance: biochemistry, electrochemistry, photochemistry, polymer chemistry, solid state chemistry and chemical physics.

Polytechnic's Department of Chemical Engineering, Chemistry and Materials Science offers a full complement of undergraduate and graduate courses in various aspects of modern chemistry. Graduates are prepared for positions with educational institutions, research institutes, industrial organizations and government laboratories.

Staff members conduct and supervise research at undergraduate, graduate and postdoctorate levels. This research is combined with teaching so that courses at all levels are taught by chemists who are highly competent in their respective fields.

Participation of undergraduates in optional research activities provides them with both stimuli and good preparation for graduate school or professional positions. The department offers programs leading to a Bachelor of Science in chemistry (with options in materials chemistry, biomedical sciences, biomaterials and polymer chemistry), materials chemistry and polymer chemistry, a Master of Science in chemistry and a Doctor of Philosophy in materials chemistry.

## POLYMER SCIENCE AND ENGINEERING

Polymer science and engineering is an interdisciplinary program leading to a Master of Science. (For details see special listing.)

## UNDERGRADUATE PROGRAMS

The department provides curricula that go beyond the requirements of the American Chemical Society for professional training. Courses offered are designed to prepare students for graduate studies or work in industry. Bachelor of Science degrees in chemistry are certified by the American Chemical Society, and graduates are immediately eligible for membership.

### REQUIREMENTS FOR THE BACHELOR OF SCIENCE

Credits	
Chemistry	34
Advanced Courses	21
Chemistry Electives	6
Thesis Research (CM 390-394)*	10
Computer Science	3
Mathematics	14
Physics	10

The minimum of 128 credits required for the Bachelor of Science in chemistry includes a minimum of 30 credits in humanities and social sciences.

At least two semesters of a foreign language (French, German or Russian) are strongly recommended.

\*Students registering for thesis research are required to submit a written report prior to graduation. Students may elect a no-thesis option (such degree programs will not be certified by the American Chemical Society) and select 10 credits of advanced chemistry courses in consultation with an adviser.

### Option in Materials Chemistry

The BS in chemistry with an option in materials chemistry is to provide specialization in the field of materials with the introduction of ceramics, alloys, semiconductors and polymers. Special emphasis is focused on the characterization aspect. The chemical electives must be selected in the field of materials science.

### Option in Biomedical Sciences

The biomedical sciences option of the Bachelor of Science in chemistry provides a significant exposure to both chemical and biological sciences. The curricula may be selected by students preparing for professional careers in medicine, dentistry, osteopathy, veterinary, podiatry, optometry, bioengineering or biomaterials. A two-year core curriculum taken by all students provides a strong base that enables them to select concentrations of courses in their chosen area such as bioengineering, biotechnology or biochemistry during the last two years.

Technological developments in these biomedical fields will be promoted by integration of science and applied technologies.

## Curriculum for the Bachelor of Science in Chemistry

**FRESHMAN YEAR**

<b>Fall Semester</b>		Hours/Week			
Course No.	Subject	Class	Lab	Rec.	Cr.
CM 101	General Chemistry I	3	0	1	2½
CM 111	General Chemistry Lab I	0	1½	0	½
CS 200	Programming Methodology	4	0	0	3
MA 106*	Calculus I	5	0	0	4
HU 101 or HU 103*	Writing and the Humanities I	3	0	0	3
SS 104	Main Themes in Contemporary World History	3	0	0	3
SL 101	Freshman Seminar	0	1	0	0
<b>TOTAL</b>					<b>16.0</b>

<b>Spring Semester</b>		Hours/Week			
Course No.	Subject	Class	Lab	Rec.	Cr.
CM 102	General Chemistry II	3	0	1	2½
CM 112	General Chemistry Lab II	0	1½	0	½
MA 107	Calculus II	5	0	0	4
PH 107	Mechanics	4	0	0	3
HU 200	Writing and the Humanities II	3	0	0	3
HU	Elective	3	0	0	3
<b>TOTAL</b>					<b>16.0</b>

**SOPHOMORE YEAR**

<b>Fall Semester</b>		Hours/Week			
Course No.	Subject	Class	Lab	Rec.	Cr.
CM 122	Organic Chemistry I	3	0	0	3
CM 124	Organic Chemistry Lab. I	1/3	5	0	2
MA 108	Diff. Eqns. & Num. Meth.	3	0	0	3
PH 108	Elec., Magnetism and Fluids	4	0	0	3
PH 118	Physics Laboratory I	0	1½	0	½
SS	Elective	3	0	0	3
HU 110	Prof. Report Writing	3	0	0	3
<b>TOTAL</b>					<b>17.5</b>

<b>Spring Semester</b>		Hours/Week			
Course No.	Subject	Class	Lab	Rec.	Cr.
CM 123	Organic Chemistry II	3	0	0	3
CM 125	Organic Chemistry Lab II	1/3	5	0	2
CM 161	Physical Chemistry I	3	0	0	3
MA 109	Multidimen. Calculus	3	0	0	3
PH 109	Waves, Optics & Thermo.	4	0	0	3
PH 119	Physics Laboratory II	0	1½	0	½
HU or SS	Elective	3	0	0	3
<b>TOTAL</b>					<b>17.5</b>

**JUNIOR YEAR**

<b>Fall Semester</b>		Hours/Week			
Course No.	Subject	Class	Lab	Rec.	Cr.
CM 162	Physical Chemistry II	3	0	0	3
CM 177	Physical Chemistry Lab	1/3	5	0	2
CM 504	Chemical Lab Safety	1	0	0	1
CM 201	Biochemistry I	3	0	0	3
CH 120	Chemical Process Analysis	3	0	0	3
SS	Elective	3	0	0	3
<b>TOTAL</b>					<b>15.0</b>

<b>Spring Semester</b>		Hours/Week			
Course No.	Subject	Class	Lab	Rec.	Cr.
CM 108	Inorganic Chemistry	3	0	0	3
CM 119	Analytical Chemistry	3	0	0	3
CM 120	Analytical Chemistry Lab	0	6	0	2
CM 501	Chemical Literature	1	0	0	1
CM 202	Biochemistry II	3	0	0	3
MT 309	Introduction to Materials Sci.	3	0	0	3
<b>TOTAL</b>					<b>15.0</b>

**SENIOR YEAR**

<b>Fall Semester</b>		Hours/Week			
Course No.	Subject	Class	Lab	Rec.	Cr.
CM 390-91	Undergraduate Research	0	12	0	4
CM	Elective	3	0	0	3
HU or SS	Elective	3	0	0	3
CM 440	Introduction to Polymer Sci.	3	0	1	3
CM 441	Polymer Laboratory Course	1/3	5	1	3
<b>TOTAL</b>					<b>16.0</b>

<b>Spring Semester</b>		Hours/Week			
Course No.	Subject	Class	Lab	Rec.	Cr.
CM 392-94	Undergraduate Research	0	18	0	6
CM	Elective	3	0	0	3
HU or SS	Elective	3	0	0	3
MT 345	Materials Characterization	3	0	0	3
<b>TOTAL</b>					<b>15.0</b>

**Total credits required for graduation: 128**

**\*Placement by examination**

Students are strongly urged to select areas of concentration (such as literature, communications, the arts or philosophy in the humanities, or political science, economics, history, anthropology or psychology in the social sciences) and to elect two or three courses in these concentrations in consultation with departmental advisers. Modern languages are recommended as suitable concentrations, but students without prior knowledge of languages must plan to devote at least 12 credit hours to each one. A minimum of two

semesters of French, German or Russian is recommended. For remaining humanities/social sciences requirements, students should select courses in areas other than that of their concentrations. Additional courses in the humanities and social sciences may be taken as free electives. All laboratory courses in chemistry require a breakage deposit. The department does not usually grant transfer credits to students who, while registered at Polytechnic, take chemistry courses at other schools.

## Curriculum for the Bachelor of Science in Chemistry — Option in Biomedical Sciences

### FRESHMAN YEAR

#### Fall Semester

Course No.	Subject	Hours/Week				Cr.
		Class	Lab	Rec.		
CM 101	General Chemistry I	2.5	0	1	2.5	
CM 111	General Chemistry Lab.	0	1.5	0	0.5	
LS 105	Biology	3	0	0	3	
LS 115	Biology Laboratory	0	3	1	2	
HU 101	Writing and Humanities	3	0	0	3	
MA 106	Calculus I	3	0	2	4	
TOTAL						15.0

#### Spring Semester

Course No.	Subject	Hours/Week				Cr.
		Class	Lab	Rec.		
CM 102	General Chemistry II	2.5	0	1	2.5	
CM 112	General Chem Laboratory	0	1.5	0	0.5	
LS 106	Biology	3	0	0	3	
LS 116	Biology Laboratory	0	3	1	2	
MA 107	Calculus II	3	0	2	4	
PH 107	Mechanics	3	0	1	3	
SS 104	Contemporary World History	3	0	0	3	
TOTAL						18.0

### SOPHOMORE YEAR

#### Fall Semester

CM 122	Organic Chemistry	3	0	0	3	
CM 124	Organic Chem. Laboratory	0.3	5	0	2	
PH 108	Elec., Magnetism and Fluids	3	0	1	3	
PH 118	Physics Laboratory	0	1.5	0	0.5	
SS 189	Psychology	3	0	0	3	
HU 118	Public Speaking Seminar	1	0	0	1	
CS 200	Programming Methodology	3	0	1	3	
TOTAL						15.5

#### Spring Semester

CM 123	Organic Chemistry II	3	0	0	3	
CM 125	Organic Chem. Laboratory	0.3	5	0	2	
PH 109	Waves, Optics and Thermo.	3	0	1	3	
PH 119	Physics Laboratory	0	1.5	0	0.5	
HU 200	Writing and Humanities II	3	0	0	3	
LS 130	Organismal Physiology	3	3	0	4	
TOTAL						15.5

### JUNIOR YEAR

#### Fall Semester

CM 201	Biochemistry	3	0	0	3	
LS 120	Microbiology	3	3	0	4	
MA 222	Probability and Statistics	3	0	0	3	
HU 110	Report Writing	3	0	0	3	
ME 321	Instrumentation	3	0	0	3	
TOTAL						16.0

#### Spring Semester

LS 112	Genetics	3	3	0	4	
CM 202	Biochemistry II	3	0	0	3	
CM 204	Biochemistry Laboratory	0.3	5	0	2	
HU 347	Ethics and Technology	3	0	0	3	
CM 161	Physical Chemistry	3	0	0	3	
	Free Elective	3	0	0	3	
TOTAL						18.0

### SENIOR YEAR

#### Fall Semester

LS 300-01	Undergraduate Research	0	12	0	4	
LS 132	Cell Physiology	3	0	0	3	
ME 381	Sys. Approach to Biomed	3	0	0	3	
HU/SS	Elective				3	
	Technical Elective				3	
TOTAL						16.0

#### Spring Semester

LS 302-04	Undergraduate Research	0	18	0	6	
SS 204	Physiological Psychology	3	0	0	3	
HU/SS	Elective	3	0	0	3	
	Free Elective				3	
TOTAL						15.0

**Total credits required for graduation:**

**129**

The Biomedical Sciences Option of the Bachelor of Science in chemistry provides a significant exposure to both chemical and biological sciences. The curricula may be selected by students preparing for professional careers in medicine, dentistry, osteopathy, veterinary, podiatry, optometry or biotechnology, bioengineering or biomaterials. A two-year core curriculum

taken by all students provides a strong base which enables them to select concentrations of courses in their chosen area such as bioengineering, biotechnology or biochemistry during the last two years. Technological developments in these biomedical fields will be the beneficiaries of this integration of science and applied technologies.

## Curriculum for the Bachelor of Science in Chemistry—Option in Biomaterials

### FRESHMAN YEAR

#### Fall Semester

Course No.	Subject	Hours/Week			
		Class	Lab	Rec.	Cr.
CM 101	General Chemistry I	2.5	0	1	2.5
CM 111	General Chemistry Lab.	0	1.5	0	0.5
LS 105	Biology	3	0	0	3
LS 115	Biology Laboratory	0	3	1	2
HU 101	Writing and Humanities	3	0	0	3
MA 106	Calculus I	3	0	2	4
TOTAL					15.0

#### Spring Semester

Course No.	Subject	Hours/Week			
		Class	Lab	Rec.	Cr.
CM 102	General Chemistry II	2.5	0	1	2.5
CM 112	General Chem Laboratory	0	1.5	0	0.5
LS 106	Biology	3	0	0	3
LS 116	Biology Laboratory	0	3	1	2
MA 107	Calculus II	3	0	2	4
PH 107	Mechanics	3	0	1	3
SS 104	Contemporary World History	3	0	0	3
TOTAL					18.0

### SOPHOMORE YEAR

#### Fall Semester

CM 122	Organic Chemistry	3	0	0	3
CM 124	Organic Chemistry Laboratory	0.3	5	0	2
PH 108	Elec., Magnetism and Fluids	3	0	1	3
PH 118	Physics Laboratory	0	1.5	0	0.5
SS 189	Psychology	3	0	0	3
HU 118	Public Speaking Seminar	1	0	0	1
CS 200	Programming Methodology	3	0	1	3
TOTAL					15.5

#### Spring Semester

CM 123	Organic Chemistry II	3	0	0	3
CM 125	Organic Chem. Laboratory	0.3	5	0	2
PH 109	Waves, Optics and Thermo.	3	0	1	3
PH 119	Physics Laboratory	0	1.5	0	0.5
HU 200	Writing and Humanities II	3	0	0	3
LS 130	Organismal Physiology	3	3	0	4
TOTAL					15.5

### JUNIOR YEAR

#### Fall Semester

CM 201	Biochemistry	3	0	0	3
ME 120	Elem. Statics & Strength Materials	3	0	0	3
MA 222	Probability and Statistics	3	0	0	3
HU 110	Report Writing	3	0	0	3
MT 309	Intro. to Materials Science	3	0	0	3
TOTAL					15.0

#### Spring Semester

CM 161	Physical Chemistry	3	0	0	3
CM 202	Biochemistry	3	0	0	3
LS 132	Cell Physiology	3	0	0	3
MA 108	Differential Equations & Numerical Methods	3	0	1	3
HU	Elective	3	0	0	3
TOTAL					15.0

### SENIOR YEAR

#### Fall Semester

CM 440	Intro. to Polymer Science	3	0	0	3
CM 390-39	Undergraduate Research	0	12	0	4
CM 441	Polymer Laboratory	0	6	0	3
HU/SS	Elective	3	0	0	3
	Technical Elective	3	0	0	3
TOTAL					16.0

#### Spring Semester

CM 392-39	Undergraduate Research	0	18	0	6
MT 345	Materials Characterization	3	0	0	3
CM 490	Biomaterials	3	0	1	3
	Technical Elective	3	0	0	3
HU/SS	Elective	3	0	0	3
TOTAL					18.0

**Total credits required for graduation:**

**129**

The Biomaterials Option is directed towards science and engineering studies of materials for biomedical usage. In addition to exposure to basic biomedical topics such as biochemistry, physiology and microbiology, the program includes studies of structure and properties of biological macro-

molecules and the usage of materials such as ceramics and polymers in the medical field. A successful graduate of this program will have an excellent opportunity to continue graduate or professional studies in the medical field.

### Option in Biomaterials

The biomaterials option is directed toward science and engineering studies of materials for biomedical usage. In addition to exposure to basic biomedical topics such as biochemistry, physiology and microbiology, the program includes studies of structure and properties of biological macromolecules and the usage of materials such as ceramics and polymers in the medical field. A successful graduate of this program will have an excellent opportunity to continue graduate or professional studies in the medical field.

### Option in Polymer Chemistry

The BS in chemistry with an option in Polymer Chemistry is designed to prepare the student for both industrial employment and graduate work in the field of polymers. The program combines courses in all aspects of polymeric materials. Chemical electives must be selected in the field of polymer science.

## GRADUATE PROGRAMS

Admission to graduate studies in chemistry requires a solid foundation in mathematics, physics and chemistry. College preparation should include at least four semesters of mathematics, two semesters of physics, and all basic chemistry courses (analytical, inorganic organic and physical). In addition, it is desirable for students to have had differential equations, atomic and nuclear physics, and two years of German, Russian or French. All applicants are required to take the Graduate Record Examination (General and Chemistry). Applicants whose native language is one other than English must score at least 550 on the TOEFL. Chemistry graduate students cannot take CM 500 level courses for graduate credit.

### REQUIREMENTS FOR THE MASTER OF SCIENCE IN CHEMISTRY

A total of 36 units past the bachelor's degree is required with an overall grade point average of B (3.0) or better in all courses (exclusive of thesis research or guided studies) submitted for a master's degree. Programs must include the following core courses:

No.	Subject	Units
CM 601	<i>Inorganic Chemistry</i>	4/
CM 703	<i>Chemical Physics I</i>	4/
or		
CM 704	<i>Chemical Physics II</i>	4/
CM 802	<i>Applied Spectroscopy</i>	4/
or		
CM 903	<i>Advanced Organic Chemistry I</i>	4/
CM 907	<i>Organic Spectroscopy</i>	4/
or		
CM 904	<i>Advanced Organic Chemistry II</i>	4/

Upon the approval of the department head, students may elect CM 771, Introductory Polymer Chemistry, in place of CM 601. Students may elect research and a thesis (12 units). The oral defense of the thesis is held after the typed thesis has been submitted. A grade of "A" or "B" in thesis research is required. Students not electing to write a thesis are required to take 3-6 units of guided studies (CM 871-872) with the submission of a written report.

Students in the master's program must participate in seminars for two semesters (CM 973-974); those not preparing thesis must present at least one lecture to the seminar group. Students must be in continuous attendance at departmental colloquia. All master's students must take CM 504, Chemical Laboratory Safety. Students are strongly encouraged to take CM 501, Chemical Literature.

### REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY IN MATERIALS CHEMISTRY

Programs of study are planned individually. The student selects a research adviser after interviewing a minimum of five faculty members. The student must take the written preliminary examination during the second year. Two attempts are allowed. (After a second failure, the student is dropped from the doctoral program). The student then selects a dissertation committee including the research

adviser, major advisers, a minor adviser and at least one faculty member who monitors the progress of the student through the rest of the program. Within six months after the written preliminary examination, an oral preliminary examination must be completed, where students will present plans and possibly results from specific areas of thesis research for evaluation by the committee. When all thesis research is completed, the student schedules an oral defense of the thesis. Final judgement on awarding a PhD is made by the dissertation committee.

A total of 90 units past the baccalaureate degree level is required. A grade point average of B or better is mandatory in all courses (not including dissertation research) submitted for the PhD degree and a grade of "A" or "B" is required for the dissertation.

Currently the department offers the PhD with a major in materials chemistry. Minors are also required and may be in biochemistry, inorganic chemistry, organic chemistry, physical chemistry, polymer chemistry and, additionally, in other departments or areas such as polymer science and engineering. The program includes the following courses, for which students must maintain at least a "B" average.

#### 1. Required Courses

In the doctoral curriculum, required courses are listed below:

Course	Title	Units
CM 601	<i>Inorganic Chemistry</i>	4/
CM 703	<i>Chemical Physics I</i>	4/
or		
CM 704	<i>Chemical Physics II</i>	4/
CM 802	<i>Applied Spectroscopy</i>	4/
or		
CM 903	<i>Organic Chemistry I</i>	4/
CM 907	<i>Organic Spectroscopy</i>	4/
or		
CM 904	<i>Organic Chemistry II</i>	4/

These courses are offered in two consecutive terms so that full-time students entering in the fall term can complete the sequence in two terms. In addition to the 18 credits of required courses listed, PhD students must take a one-credit course in laboratory safety, CM 504, and fulfill the seminar and other requirements described in the catalog.

**2. Minor Requirements**

The department offers a minor concentration in biochemistry, inorganic, organic, physical and polymer chemistry. Students may elect a minor in areas of concentration offered by other departments. In all cases a faculty adviser from the minor area will be a member of the guidance committee. The student shall select courses to fulfill minors in consultation with the minor adviser.

3. Participation in seminar for four semesters, twice as a lecturer.

4. Research presented in a dissertation.

5. All doctoral students must take CM 504, Chemical Laboratory Safety, prior to registering for thesis research.

6. Students are strongly encouraged to take CM 501, Chemical Literature.

7. Students must be in continuous attendance at departmental colloquia for the duration of research.

8. The final oral examination will take place after members of the guidance committee have read the dissertation in typed, unbound form.

All students in the doctoral program are granted a master of science upon satisfactory completion with a B average of course requirements and 12 units of research toward doctoral dissertations, as certified by the chair of the guidance committee. On application to the Vice Provost's Office and after completion of preliminary examinations, the student is certified as having earned a master of science.

**UNDERGRADUATE  
COURSES**

**UNDERGRADUATE COURSES**
**CM 101 General Chemistry I** 3:0:1:2 ½

Chemical equations, chemical conservation laws, stoichiometry, thermochemistry, properties of gases, atomic structure, periodic table, chemical bonding and molecular structure. *Co-requisite: MA 105 or MA 106.*

**CM 102 General Chemistry II** 3:0:0:2 ½

States of matter; chemical thermodynamics and chemical equilibria; kinetics; acid-base chemistry; descriptive inorganic chemistry; introduction to organic chemistry. This course covers some traditional topics plus a considerable emphasis on the properties of materials and their relationship to molecular structure. *Prerequisite: CM 101 or equivalent.*

**CM 108 Inorganic Chemistry** 3:0:0:3

Atomic structures of elements as a basis for periodic classification. Descriptive chemistry of elements and their compounds. Theories of chemical bonds and introduction to coordination chemistry. *Prerequisites: CM 102, CM 112 and CM 161.*

**CM 111 General Chemistry Laboratory I** 0:1 ½:0:½

Laboratory experiments in general chemistry; taken in conjunction with CM 101. Lab fee required. *Pre/Co-requisite: CM 101.*

**CM 112 General Chemistry Laboratory II** 0:1 ½:0:½

Laboratory experiments in general chemistry; taken in conjunction with CM 102. Lab fee required. *Prerequisite: CM 111. Pre/Co-requisite: CM 102.*

**CM 119 Instrumental Methods in Analytical Chemistry** 3:0:0:3

Theories and applications of instrumental techniques in modern analytical chemistry, including chromatography, spectroscopy (absorption, fluorescence, infrared, Raman, nuclear magnetic resonance, electron spin resonance, atomic absorption and emission); x-ray absorption, fluorescence and diffraction; mass spectrometry; thermal methods, etc. *Prerequisites: CM 161-162.*

**CM 120 Analytical Chemistry Laboratory** 0:6:0:2

Techniques described in CM 119 applied to various chemical problems stressing physicochemical interpretation of data obtained. Lab fee required. *Prerequisites: CM 161-162. Co-/Prerequisite: CM 119.*

**CM 122 Organic Chemistry I** 3:0:0:3

Chemistry of organic molecules: structure, nomenclature, properties and reactions of carbon compounds with emphasis on aliphatic compounds. Introduction to reaction, mechanisms and stereochemistry. *Prerequisites: CM 102 and CM 112.*

**CM 123 Organic Chemistry II** 3:0:0:3

Continuation of CM 122 with emphasis on finding the principles of organic chemistry in industrial practice and biochemical mechanisms. *Prerequisite: CM 122.*

**CM 124 Organic Chemistry Laboratory I** ½:5:0:2

Laboratory methods for preparation, isolation and purification of typical organic compounds. Experiments chosen to illustrate basic techniques. Lab fee required. *Co-/Prerequisite: CM 122.*

**CM 125 Organic Chemistry Laboratory II** ½:5:0:2

Laboratory methods for preparation, purification, characterization and identification of organic compounds by chemical and physical means. Introduction to instrumental methods of analysis and identification. Lab fee required. *Prerequisite: CM 124. Co-/Prerequisite: CM 123.*

**CM 161 Physical Chemistry I** 3:0:0:3

Chemical thermodynamics (macroscopic and molecular approach) with applications to solutions, phase and chemical equilibria. Kinetic theory. *Prerequisites: CM 102, CM 112, MA 108 and PH 108.*

**CM 162 Physical Chemistry II** 3:0:0:3

Electrochemistry; ionic solutions. Solids, liquids, surfaces, high polymers. Chemical kinetics. Relation of bulk properties of matter to atomic and molecular properties. *Prerequisite: CM 161.*

**CM 177 Physical Chemistry Laboratory** ½:5:0:2

Experimental quantitative chemical methods of analytical and physical chemistry, which will include introduction to gravimetric and volumetric quantitative methods, thermodynamics and chemical kinetics. Computer analysis of experimental data and report writing. Lab fee required. *Co-/Prerequisite: CM 162.*

**CM 201 Biochemistry I** 3:0:0:3

Survey of modern biochemistry with emphasis on current areas of research. Structure-function relationships in proteins. Enzymes and their mechanisms of action. Bioenergetics principles and energy production. Biochemical theories and techniques. *Prerequisites: CM 123, CM 125 and CM 161, or instructor's permission.*

**CM 202 Biochemistry II** 3:0:0:3

Continuation of Biochemistry I. Principles of intermediary metabolism, energetics, membrane structure and transport; structure and function of DNA and RNA, principles of molecular biology, the immune system, hormonal regulation and cancer. *Prerequisites: CM 201 and CM 162, or instructor's permission.*

**CM 204 Biochemistry Laboratory** ½:5:0:2

Laboratory experiments illustrating techniques for isolating and characterizing biological macromolecules, analyzing enzyme kinetics and elucidating metabolic pathways. Lab fee required. *Co-/Prerequisite: CM 201.*

**CM 390-394 Undergraduate Research in Chemistry** each 2 credits

Original investigations by student under guidance of staff members. Careful literature search required before inception of laboratory work; continued reference to chemical literature expected and active participation in conferences and seminars scheduled as work progresses. A written report is required. Full-time students are expected to register for 10 credits of thesis during senior year. Research (lab) fee required. *Co-/Prerequisites: CM 501 and CM 504.*

**CM 440 Introduction to Polymer Science** 3:0:1:3

An introductory course for undergraduate and graduate students. Provides initial education in the field of polymer science for students who are not majoring in polymer science or for students who plan to enter the field of polymer science in their advanced education. The course will include principles of various polymerization methods, characterization and physical chemistry of polymers. *Prerequisites: CM 122 and CM 123.*

**CM 441 Polymer Laboratory Course** ½:5:1:3

Teaches experimental skills in the field of polymer science for students who are not polymer science majors or who may, in the later stages of their education, become polymer science majors. The experimental skills taught include polymerization methods and characterization of polymers. *Co-/Prerequisite: CM 440.*

**CM 490 Biomaterials** 3:0:1:3

Natural macromolecules, including polypeptides, polysaccharides, lignin, biodegradable polymers, and special characterizations of these biopolymers. *Prerequisite: CM 440.*

**GRADUATE COURSES  
(SPECIAL LISTINGS)****UNDERGRADUATE AND  
GRADUATE****CM 501 Information Sources for the Chemical Sciences** 1:0:0:1

A Hands-on introduction to methods and tools for searching. Includes both electronic (CD-ROM and online) as well as print databases. Students may emphasize topics related to their research. *Required of all BS students in chemistry. Graduate students are encouraged to take this course, but credits do not count toward degree requirements in chemistry graduate programs.*

**CM 502 Environmental Chemistry** 3:0:0:3

Chemical properties of pollutants in air, water, soil and hazardous wastes. Effects of chemical pollutants on health. *Prerequisites: CM 122, CM 124 and CM 161 or instructor's permission. This course does not fulfill requirements for the regular MS or PhD in chemistry.*

**CM 504 Chemical Laboratory Safety** 1:0:0:1

Discussion of problems of health and safety arising in chemical laboratories. How to work safely with dangerous chemicals. This course must be completed by both graduate and undergraduate chemistry students before they undertake laboratory research.

<b>GRADUATE COURSES</b>
-------------------------

**INORGANIC CHEMISTRY****CM 601 Inorganic Chemistry**  
3%:0:0:4%

Theories of bonding in inorganic compounds. Introduction to group theory as applied to molecular orbital and ligand field theories. Spectra of inorganic compounds. Nonaqueous solvents. Introduction to transition metal chemistry. Required of all candidates for PhD degree in chemistry.

**CM 615 Advanced Topics in Inorganic Chemistry** 2%:0:0:3**PHYSICAL CHEMISTRY****CM 703 Chemical Physics I**  
3%:0:0:4%

Quantum structures of molecules. Fundamental ideas of quantum mechanics. Applications to atomic and molecular structures and bonding. Approximation methods. Interactions of light and matter. *Prerequisites: undergraduate physical chemistry and physics.*

**CM 704 Chemical Physics II**  
3%:0:0:4%

Chemical kinetics and thermodynamics. Fundamental ideas of statistical mechanics. Development of relationships of various bulk properties of matter to molecular structures and interactions. Applications to solutions, polymers. *Prerequisites: Undergraduate physical chemistry and physics.*

**CM 750 Special Topics in Physical Chemistry** 2%:0:0:3

Advanced or specialized topics in physical chemistry.

**POLYMER CHEMISTRY****CM 771 Introductory Polymer Chemistry** 2%:0:0:3

Synthesis of polymers by step-reaction and addition polymerization; copolymerization; formation of three dimensional networks; block and graft polymers; polymer degradation; characterization of polymers in solution rubber elasticity; polymer crystallization; spectroscopic techniques for polymer study; properties of commercial polymers. *Prerequisites: CM 123, CM 125 and CM 162, or instructor's permission.*

**CM 772 Synthesis of High Polymers**  
2%:0:0:3

Organic aspects. Chemistry of monomer and polymer formations. Modern mechanistic analyses of reactions. Stereochemistry of polymer structures and forces of stereoregulation. Condensation: free radical (bulk, suspension, emulsion, solution); ionic, ring-opening and nonclassical polymerization reactions. *Prerequisite: CM 771.*

**CM 781 Solution Properties of High Polymers** 2%:0:0:3

Application of osmometry, light scattering, equilibrium ultracentrifugation, electrophoresis, viscosity, diffusion, ultra centrifugal sedimentation, flow birefringence, polarimetry, spectroscopy and other techniques to the characterization of dissolved macromolecules. Properties of polyelectrolytes, association in solutions containing macromolecules and reaction kinetics in macromolecular solutions also are discussed. The course is designed to cover both synthetic and biological macromolecules. *Prerequisite: CM 771.*

**CM 782 Macromolecules in Solid States** 2%:0:0:3

Crystalline-amorphous systems, thermodynamics of crystallization, defect structures, morphology of polymer crystals, characterization of polymeric solids by x-ray and electron diffraction, potential energy calculations, electron microscopy, absorption spectroscopy and nuclear magnetic resonance. Electrical and optical properties of polymer solids. *Prerequisite: CM 771.*

**CM 783 Laboratory Methods in Polymer Chemistry** 0:4:0:3

Experiments on free radical and ionic polymerizations, copolymerization: UV/VIS and NMR spectroscopy, intrinsic viscosity, light scattering, gel permeation chromatography, x-ray diffraction, thermogravimetric analysis, differential scanning calorimetry, dilatometry, concentrated solution viscosity and other aspects of polymer synthesis and characterization. Lab fee required. *Prerequisite: CM 771.*

**CM 785 Special Topics in Polymer Chemistry** 2%:0:0:3

Presentation at intervals of various advanced or specialized topics in polymer chemistry.

**CM 790 Biopolymers** 2%:0:0:3

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. Biopolymers may be used to satisfy minor field requirements in polymers or biochemistry. *Co-Prerequisite: CM 941 or instructor's permission.*

**ANALYTICAL CHEMISTRY****CM 802 Applied Spectroscopy**  
3%:0:0:4%

Solving chemical problems using spectroscopic methods. Vibrational, electronic, nuclear magnetic resonance spectroscopy and mass spectrometry. Discussion of physical principles, instrumentation, interpretation of spectra, applications to molecular and physical problems.

**ORGANIC CHEMISTRY****CM 903 Organic Chemistry I**  
3%:0:0:4%

Molecular structure and bonding. Stereochemical and conformational principles. Theories of bonding and the physical parameters of stable and reactive molecular states. Applications in biochemistry and polymer chemistry. *Prerequisites: undergraduate physical chemistry and organic chemistry.*



**CM 904 Organic Chemistry II**

3%:0:0:4%

Reactivity of molecules. The methods of mechanistic study of reaction pathways. Important reactions of organic and organometallic chemistry. Introduction to synthesis and applications in living systems and in polymer reactions. *Suggested prerequisite: CM 903 or instructor's permission.*

**CM 907 Organic Spectroscopy**

3%:0:0:4%

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 903 or CM 904 or instructor's permission.*

**CM 940 Special Topics in Organic Chemistry**

2%:0:0:3

Topics selected from current research or literature and approaches to problem solving. *Co-/Prerequisite: CM 903 or CM 904.*

**BIOCHEMISTRY****CM 941-942 Biochemistry I, II**

Each 2%:0:0:3

In depth studies of biochemistry. Structure and function of biological macromolecules: proteins, nucleic acids, polysaccharides. Enzyme kinetics, mechanism and control. Membrane structure and function. Energy production, transformation and utilization. Regulation of biochemical systems. Replication, transcription and translation of DNA. Mutagenesis and carcinogenesis. Immune system. *Prerequisite: instructor's permission.*

**CM 945 Advanced Topics in Biochemistry**

2%:0:0:3

Selections from the following topics: protein and nucleic acid chemistry; intermediary metabolism; and metabolic regulation. *Prerequisite: CM 941 or instructor's permission.*

**GENERAL COURSES****CM 871-872 Guided Studies**in Chemistry *As arranged***CM 971-972 Chemical Colloquium**

1:0:0:0

Meetings of the members of the department staff, invited guests and qualified students to study recent developments in chemistry. Required each year of all students in graduate degree status majoring in chemistry and for two years of doctoral matriculants in other departments with minor in any field of chemistry. Seminar fee required.

**CM 973-976 Seminar in Chemistry**

Each 0:0:1%:1%

Chemical topics of current interest presented by participating students, staff and outside lecturers. Two semesters, required of all master's candidates and four semesters of all doctoral candidates.

**CM 998 Research in Chemistry***As arranged*

Original research, which serves as basis for master's degrees. To be taken by PhD candidates before completion of PhD preliminary examinations in materials chemistry. Minimum research registration requirements for the master's thesis: 12 units. Registration for research required each semester consecutively until students have completed adequate research projects and acceptable theses and have passed required oral examinations. Research credits registered for each semester realistically reflect time devoted to research. A maximum of 6 units may be counted towards a PhD in materials chemistry. Research charge. *Prerequisites: for MS candidates, degree status, consent of graduate adviser and thesis director, and CM 504.*

**CM 999 Research in Chemistry***As arranged*

Original experimental or theoretical research (undertaken under guidance of a chemistry faculty member), which may serve as basis for degree of philosophy. Minimum research registration requirements for degree for holders of MS based on research and thesis

acceptable to department, 33 units; for other students, 45 units. Registration required each semester consecutively until students have completed adequate research projects and acceptable theses and have passed required oral examinations. Research fees required. *Prerequisites: completion of PhD preliminary examination in chemistry, consent of thesis director and CM 504.*

**LIFE SCIENCES COURSES**

In recent years, Polytechnic has developed life sciences courses which complement those in its teaching and research programs in engineering and physical sciences. Undergraduate students with specific interests in the areas of biology, biochemistry, environmental sciences, bioengineering, premedicine and laboratory techniques may elect life sciences courses to fulfill specific BS program requirements or to serve as technical or free electives.

Biology is concerned with the study of life in all manifestations, from the simple to the complex, to the invisible to the macroscopic to the virus to the human. To move beyond definitions of life to an understanding of life's fundamental nature, the characteristics of living systems must be examined. This includes growth, heredity and reproduction; metabolism; and the study of molecular, cellular and organismal levels.

**UNDERGRADUATE COURSES****LS 105-106 General Biology I, II**

Each 3:0:0:3

Fundamentals of biology. Physical, chemical, biochemical bases of life on various organizational levels. Cellular morphology, complementarity of form and function. Reproduction, development, genetics. Homeostasis, regulation, integration, coordination. LS 105 *prerequisite: high school chemistry. LS 106 prerequisite: LS 105 or instructor's permission.*

**LS 112 Genetics** 3:3:0:4

Fundamental aspects of the genetics of bacteria, viruses and high organisms. Emphasis is placed on both the genetic and biochemical analyses of gene replication, heredity, mutation, recombination and gene expression. Comparisons of prokaryotic and eukaryotic genetics and regulation as well as topics in human genetics are included. Laboratory techniques used in the biological and biochemical study of genetic phenomena in prokaryotes, eukaryotes and their viruses. Emphasis placed on modern approaches to genetic research. Lab fee required. *Prerequisites: LS 106 and 116. Co-requisite: CM 122.*

**LS 115-116 General Biology Laboratory I, II** 0:3:1:2

Recitations in relationship to laboratory experiments include discussions of such topics as cell structure and function; chemical and physical characteristics of living things; unity and diversity of living things; genetics; development, homeostasis, integration and coordination; adaption; adaption, evolution, ecology and the biological bases of behavior. Lab fee required. *LS 115 co-prerequisite: LS 105. LS 116 co-prerequisite: LS 106.*

**LS 120 Microbiology** 3:3:0:4

Study of microbial organisms, especially bacteria and viruses. Microbial relationship to disease, infectious and immunologic processes. Mutation, transformation, transduction, induction and bioenergetic processes. Laboratory work includes experimental analysis of microbial structure and physiology by biochemical and cytochemical means. Influence of environment on nutrition, enzymes and metabolism of representative microbial species. Lab fee required. *Prerequisites: LS 106, 116 and CM 102, or instructor's permission.*

**LS 130 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: LS 106, LS 116, CM 102 and CM 112. Co-requisites: PH 109.*

**LS 132 Cell Physiology** 3:0:0:3

Analyses of chemical and physical mechanisms of cellular function. Molecular constituents of biological systems, enzymes and reaction rates, energetics and regulation of metabolic processes, membrane transport, contractility and irritability. Laboratory studies include examination of cellular components in terms of their functional activities (enzymes, oxidative-phosphorylation, photosynthesis), kinetics of soluble and membrane-bound enzymes and membrane transport. Lab fee required. *Prerequisites: LS 106 and 116. Co-requisites: CM 123 and 161.*

**LS 103-200 Topics in Biology** *As arranged***LS 305-307 Projects in Life Sciences** *each 2 credits*

Investigations of problems in biology under supervision of faculty members. Library research, experimental studies, and written reports required. Lab fee required. *Prerequisite: senior status or adviser's consent.*

**LS 308 Life Science Internship** *2 credits*

Supervised projects carried out in hospital, community or industrial settings. Evaluated on basis of written and oral reports present to faculty and outside project cosponsors. Faculty conferences and visits required. Open to senior students on approval of departmental adviser. Preplanned experiences provide students with significant exposure to relationships between theoretical information and practical applications. *Prerequisite: senior status or adviser's consent.*

**LS 310 Seminar in Biology** *1 credit***GRADUATE COURSES****LS 561-702 Advanced Topics in Biology** *As arranged*

From time to time, graduate level courses may be offered in bioethics, electron microscopy, environmental biology, neurophysiology, topics in neurophysiology, topics in neurosciences, and cytology.

---

## ENVIRONMENTAL SCIENCE PROGRAM

---

The Department of Chemical Engineering, Chemistry and Materials Science offers an interdisciplinary program leading to the undergraduate degree Bachelor of Science in environmental science.

**BACHELOR OF SCIENCE  
IN ENVIRONMENTAL  
SCIENCE**

As products and waste streams are generated at an exponentially increasing pace, society is faced with the problem of assessing and controlling their environmental impact. Environmental scientists, engineers and planners are currently involved in solving global problems such as the ozone hole, acid rain, the greenhouse effect and ocean dumping as well as local problems such as toxic waste landfill dumping, non-ionizing radiation control and indoor pollution (such as lead-based paint, asbestos and radon) hazards.

The University has devised a stimulating mixture of courses with significant scientific depth to evaluate and develop techniques for solving the problems of impact and control of toxic agents in the biosphere. The interdisciplinary courses span the environmental science and engineering interface and include elements of planning, regulations and socioeconomic

benefits and liabilities. The program draws primarily on the existing strengths of the chemistry (including life sciences), and engineering faculty members with environmental specialities.

Graduates of the program will be ideally suited for careers in industry, environmental and health agencies, the public domain, and in more advanced environmental research. Environmental equipment firms require environmental scientists to monitor the ambient, stack gases, waste streams, and to perform laboratory analysis. Other companies perform studies which model pollutant transport and predict impacts. Diverse companies have career opportunities in industrial health assessment, contaminated soil and ground-water remediation, and in managing compliance and permitting for new and existing facilities. The environmental scientist can be a valuable team member in the interdisciplinary approach to problem solving. The U.S. Environmental Protection Agency hires scientists who regulate industrial emissions and assure compliance; state and local agency scientists are involved with planning and enforcement.

After a series of fundamental courses in physics, mathematics, chemistry, biology, computer science and engineering, the environmental science student branches into alternative energy and environmental planning courses as well as hands-on experience in chemical and biological laboratories. These are followed by more specialized air and water pollution courses. Also, in the junior and senior year, elective courses (see following program) are chosen in concert with the student's adviser. These courses are intended to expand the student's knowledge of specialized environmental and related areas. Typical examples include risk analysis, hazardous waste disposal and toxicology as well as relevant advanced science and engineering courses. The program is administered by an interdisciplinary advisory faculty committee. Professor Edward Ziegler, director of the program, and editor of the *Encyclopedia of Environmental Science and Engineering* (now entering its fourth edition), can be contacted for further information at 718/260-3276.

The environmental science faculty consists of both research and practice-oriented professors who provide an up-to-date curriculum enriched with experience related to environmental systems. All faculty members have PhD degrees.

## Typical Course of Study for the Bachelor of Science in Environmental Science

### FRESHMAN YEAR

#### Fall Semester

Course No.	Subject	Hours/Week				Cr.
		Class	Lab	Rec.	Cr.	
MA 106	Calculus I	4	0	1	4.0	
CS 200	Intro. to Program Method.	3	0	0	3.0	
CM 101	Gen. Chem. I	3	0	0	2.5	
CM 111	Gen. Chem. Lab. I	0	1.5	0	0.5	
HU 101	Writing & Hum. I	3	0	0	3.0	
SS 104	Contemp. World Hist.	3	0	0	3.0	
SL 101	Freshman Seminar	1	1	0	0.0	
PE 10x	Sports & Teams (Optional)	0	1.5	0	0.0	
Subtotal						16.0

#### Spring Semester

Course No.	Subject	Hours/Week				Cr.
		Class	Lab	Rec.	Cr.	
MA 107	Calculus II	4	0	1	4.0	
PH 107	Mechanics	4	0	0	3.0	
CM 102	Gen. Chem. II	3	0	0	2.5	
CM 112	Gen. Chem. Lab. II	0	1.5	0	0.5	
HU SS	Elective**				3.0	
HU 200	Writing and Hum. II	3	0	0	3.0	
CP 101	Co-op. Education (Optional)	0	1.5	0	0.0	
Subtotal						16.0

### SOPHOMORE YEAR

#### Fall Semester

MA 108	Diff. Eqns. & Num. Methods	3	0	1	3.0	
PH 108	Electr., Magnetism & Fluids	4	0	1	3.0	
PH 118	Phys. Lab. I	0	1.5	0	0.5	
CM 112	Organic Chem. I	3	0	0	3.0	
CM 124	Organic Chem. Lab. I	1.5	5	0	2.0	
LS 105	Gen. Biology I	3	0	0	3.0	
LS 115	Gen. Biology Lab.	0	3	1	2.0	
PE 10x	Sports & Teams (Optional)	0	1.5	0	0.0	
Subtotal						16.5

#### Spring Semester

MA 109	Multidem. Calculus	3	0	1	3.0	
PH 109	Waves, Optics & Thermo.	3	0	2	3.0	
PH 119	Phys. Lab. II	0	1.5		0.5	
CM 161	Physical Chem. I	3	0	0	3.0	
CM 123	Organic Chem. I	3	0	0	3.0	
LS 118	Eco. for Environmental Engineers and Scientists	3	0	0	3.0	
PE 10x	Sports & Teams (Optional)	0	1.5	0	0.0	
Subtotal						15.5

### JUNIOR YEAR

#### Fall Semester

CM 162	Physical Chem. II	3	0	0	3.0	
MA 222	Probab. & Statistics	3	0	0	3.0	
CM 201	Biochemistry	3	0	0	3.0	
CH 120	Chem. Process Anal.	3	0	0	3.0	
SS 182 or						
SS 210	Environmental Psychology	3	0	0	3.0	
CM 504	Chem. Lab. Safety	1	0	0	1.0	
PE 10x	Sports & Teams (Optional)	0	1.5	0	0.0	
Subtotal						16.0

#### Spring Semester

TE*	Technical Elective				4.0	
CH 152	Chem. Eng. Thermody.	3	0	0	3.0	
MT 309	Intro. to Materials	3	0	0	3.0	
HU/SS	Elective				3.0	
CE 223	Fluid Mechanics	2.5	1.5	0	3.0	
PE 10x	Sports & Teams (Optional)	0	1.5	0	0.0	
Subtotal						16.0

### SENIOR YEAR

#### Fall Semester

CE 340	Water & Res. Hydrology	3	0	0	3.0	
CE 341	Enviro. Engineering I	2	3	0	3.0	
CM 502	Enviro. Chemistry	3	0	0	3.0	
CM 119	Analytical Chem.	3	0	0	3.0	
HU/SS	Elective				3.0	
PE 10x	Sports & Teams (Optional)	0	1.5	0	0.0	
Subtotal						15.0

#### Spring Semester

CM 380	Enviro. Sci. Proj.				4.0	
CH 372	Air Poll. Engrg. Control	3	0	0	3.0	
TE*	Tech. Elective				3.0	
FE	Free Elective				3.0	
HU/SS	Elective	3	0		3.0	
CM 501	Chemical Literature	1	0	0	1.0	
PE 10x	Sports & Teams (Optional)	0	1.5	0	0.0	
Subtotal						17.0

**Total credits required for graduation: 128**

#### Notes:

\*TE Technical Electives include sciences, mathematics, computer science and engineering courses and should include at least one of the following LS1 20 (Microbiology and Lab), CM 120 (Analyt. Chem. Lab) or LA144

(Ener. Tech./Soc. Issues).

\*\*SS 189 recommended if SS 210 Environmental Psychology is to be taken later.

# POLYMER SCIENCE AND ENGINEERING PROGRAM

For over half a century, Polytechnic University has had a traditional commitment to strong polymer programs of worldwide renown. At the present time, the Department of Chemical Engineering, Chemistry and Materials Science offers a graduate program leading to a Master of Science in polymer science and engineering. Candidates interested in a PhD in the area of polymer science and engineering can conduct their studies according to the requirements described in chemical engineering and chemistry programs.

## ADMISSION TO GRADUATE STUDY

An undergraduate degree in either chemical engineering or chemistry with a mathematics background including at least one course in differential equations, is usually required for admission to the graduate program. Applicants who have earned bachelor's degrees from foreign institutions are required to submit Graduate Record Examinations (GRE) and TOEFL scores. Applicants with degrees in other fields or from other colleges may be admitted with undergraduate or graduate deficiencies with the consent of a graduate adviser. The program leading to Master of Science is designed to meet the needs of engineers and chemists well versed in the fundamental principles of polymer science and engineering.

## REQUIREMENTS FOR THE MASTER OF SCIENCE IN POLYMER SCIENCE AND ENGINEERING

Candidates for a Master of Science in polymer science and engineering are to include in their programs the following required courses:

No.	Course	Units
CH 921	<i>Polymer Processing</i>	3
CH 926	<i>Engineering Properties of Polymers</i>	3
CH 991-2	<i>Departmental Seminar</i>	0
CM 771	<i>Introductory Polymer Chemistry</i>	3
CM 783	<i>Laboratory Methods in Polymer Chemistry</i>	3
	<i>Electives*</i>	12

### Guided Study/Thesis Option

Either

CH 930	<i>Guided Studies in Polymer Science and Engineering</i>	6
	<i>Electives</i>	6
	or	
CH 997	<i>Thesis for Master of Science in Polymer Science &amp; Engineering</i>	12
	Total	36

To meet graduate requirements, students must have an overall B average in all courses and must not obtain more than two grades of C in required subjects.

\* As electives any graduate course offered by the department may be chosen. The approval of the graduate adviser will be needed in order to take courses in other disciplines.

## GRADUATE COURSES

### CH 921 Polymer Processing 2%:0:0:3

Applications of engineering principles to polymer processing. Non-Newtonian polymeric systems. Extrusion theory and applications. Discussions and problem-solving in injection molding, fiber spinning, film blowing and coextrusion as well as other polymer engineering processes. *Prerequisite: CH 220 and CH 221 or instructor's permission.*

### CH 926 Engineering Properties of Polymers 2%:0:0:3

Mechanical properties and structures of solid polymers. Viscoelastic theory and response of amorphous, crystalline and composite materials in stress-strain, creep, stress relaxation and dynamic tests. Effects of orientation and previous history on mechanical behavior. *Prerequisites: CH 917 CM 771.*

### CH 928 Polymer Composites 2%:0:0:3

Production, properties and durability of polymer composites, with emphasis on continuous fiber-reinforced polymer matrices. Modeling of processing. Chemical compositions, cure kinetics and rheology, crystallization, viscoelasticity, processing methods, residual stresses and fracture mechanics. Composites in service. *Prerequisites: CH 921 and CH 926.*

### CH 940-941 Selected Topics in Polymer Science and Engineering, I, II each 2%:0:0:3

Topics of special interest in polymer science and engineering are announced in advance of each semester offering. *Prerequisite: adviser's approval.*

### CM 771 Introductory Polymer Chemistry 2%:0:0:3

Synthesis of polymers by step reaction and addition polymerization, formation of three-dimensional networks, block and graft polymers, polymer degradation, characterization of polymers in solution, rubber elasticity, polymer crystallization. Spectroscopic techniques for polymer study, properties of commercial polymers. *Prerequisites: CM 123 and CM 125*

### CM 772 Syntheses of High Polymers 2%:0:0:3

Organic aspects. Chemistry of monomer and polymer formation. Modern mechanistic analyses of reactions. Stereochemistry of polymer structures and forces of stereo regulation. Condensation, free radical (bulk, suspension, emulsion, solution), ionic, ring-opening and non-classical polymerization reactions.

**CM 781 Solution Properties of High Polymers** 2½:0:0:3

Application of osmometry, light scattering, equilibrium ultracentrifugation, electrophoresis, viscosity, diffusion, ultracentrifuge sedimentation, flow birefringence, polarimetry, spectroscopy and other techniques used in the characterization of dissolved macromolecules. Properties of polyelectrolytes, association in solutions containing macromolecules and reaction kinetics in macromolecular solutions. Synthetic and biological macromolecules are covered. *Prerequisites: CM 161, and CM 771 or CM 783.*

**CM 782 Macromolecules in the Solid State** 2½:0:0:3

Crystalline-amorphous systems, thermodynamics of crystallization, defect structures, morphology of polymer crystals. Characterization of polymeric solids by x-ray and electron diffraction, potential energy calculations, electron microscopy, absorption spectroscopy and nuclear magnetic resonance. Electrical and optical properties of polymer solids. *Prerequisite: CM 771.*

**CM 783 Laboratory Methods of Polymer Chemistry** 0:5:0:3

Experiments on free radical, condensation, ionic and polymerization, absorption, NMR spectroscopy, intrinsic viscosity, light scattering, gel permeation chromatography, x-ray diffraction, thermogravimetric analysis, differential scanning calorimetry, dilatometry, concentrated solution viscosity and other aspects of polymer synthesis and characterization. Lab fee required. *Prerequisite: CM 771.*

**CM 785 Special Topics in Polymer Chemistry** 2½:0:0:3

Presentation at intervals of various advanced or specialized topics in polymer chemistry.

**PROJECTS, THESES AND SEMINARS**

**CH 930 Guided Studies in Polymer Science and Engineering** 6 units, each 2 units

Presentations of a comprehensive report of some problem involving polymer science and engineering, such as polymer synthesis, processing, evaluation, or equipment design is required. Master's degree candidates are required to submit three unbound copies of a typewritten project report to advisers one week before the last day of classes. *Prerequisite: degree status.*

**CH 987 Thesis for Degree of Master of Science in Polymer Science and Engineering** 12 units, each 3 units

Thesis for master's degree in polymer science and engineering should give results of original investigations of problem in polymer science and engineering. Theses may involve experimental research, theoretical analyses, or process designs, and possibly a combination thereof. Master's degree candidates are required to submit four typewritten unbound thesis copies to advisers before or on the seventh Wednesday prior to commencement. *Prerequisite: degree status.*

**CH 991-992 Departmental Colloquium** 0:2½:0:0

Recent developments in the field of chemical engineering, chemistry and materials science will be presented through lectures given by experts from industry, research, and educational institutions as well as by staff members or qualified graduate students.

*Required for two semesters of all graduate students seeking degrees.*

# DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

*Head:* John C. Falocchio

The Department of Civil and Environmental Engineering offers undergraduate and graduate programs in civil engineering and related areas leading to the degrees of:

- Bachelor of Science (Civil Engineering)
- Master of Science (Civil Engineering)
- Master of Science (Environmental Engineering)
- Master of Science (Transportation Planning and Engineering)
- Master of Science (Transportation Management)
- Doctor of Philosophy (Civil Engineering)

Information on these degree programs is described in the sections that follow. Program descriptions for Environmental Engineering and Transportation immediately follow sections on Civil Engineering programs.

Civil engineers are responsible for the design, construction, maintenance and operation of the infrastructures of modern society. These cover a wide variety of urban and regional systems, including buildings, roads, bridges, airports, rail systems, dams, irrigation systems, harbors, solid and liquid waste treatment and disposal, water supply, and others. The civil engineer practices in a broad and exciting field, one which has a major impact on society in general, and on our infrastructure environment in particular.

The Department of Civil and Environmental Engineering provides an undergraduate program that provides the beginning engineer with a broad background across these many areas. Graduate programs are designed to allow students to specialize in particular areas or subdisciplines, as well as to pursue general graduate work across several different areas.

## FACULTY

The Department of Civil and Environmental Engineering has a distinguished faculty, all of whom are actively involved in both teaching and research. While some laboratories may be supervised by graduate students, virtually all courses are taught by members of the full-time or adjunct faculty. Many of the faculty conduct research focused on problems of the New York region, and are actively involved in solving the region's infrastructure problems.

### PROFESSORS

**George Bugliarello**, Professor of Civil Engineering and Chancellor  
ScD, Massachusetts Institute of Technology  
*Bioengineering, fluid mechanics*

**John C. Falocchio**, PE, Professor of Transportation Engineering; Department Head and Executive Director of Transportation Research Institute  
PhD, Polytechnic Institute of Brooklyn  
Certificate in Highway Traffic Engineering, Yale University  
*Transportation planning, public transportation, travel demand analysis, traffic engineering, transportation systems evaluation, transportation systems management*

**Ilan Juran**, Professor of Civil Engineering  
PhD, Dsc, University of Paris VI, Ecole Nationale des Ponts et Chaussees  
*Geotechnical engineering, soil improvement technologies, geosynthetic engineering, in-situ soil testing*

**William R. McShane**, PE, Professor of Mechanical and Systems Engineering; Dean of Engineering and Applied Sciences

PhD, Polytechnic Institute of Brooklyn  
*Traffic operations and control, highway capacity and level of service analysis, expert systems in transportation, transportation economics and finance*

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

**Dipak Roy**, PE, Professor of Environmental Engineering  
PhD, University of Illinois  
*Hazardous waste management, in-situ remediation, bioremediation, soil flushing, biological processes for waste treatment, disinfection*

### ASSOCIATE PROFESSORS

**Feng-Bao Lin**, PE, Associate Professor of Civil Engineering  
PhD, Northwestern University  
*Non-linear finite element methods, design of reinforced concrete and steel structures, constitutive modeling of engineering materials, damage modeling and fracture mechanics*

**Alan H. Molof**, Associate Professor of Environmental Engineering  
PhD, University of Michigan  
*Water and wastewater treatment processes, river and stream pollution, industrial waste treatment, hazardous/toxic waste management*

## DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

### ASSISTANT PROFESSORS

**Symeon Christodoulou**, Assistant Professor of Civil Engineering  
PhD, University of California at Berkeley

*Construction engineering and management, construction cost control and scheduling, decision support systems, information management, system integration and database development*

**Magued Iskander**, PE, Assistant Professor of Civil Engineering  
PhD, University of Texas at Austin  
*Foundation engineering, marine geotechnology, pile foundations, alternative foundations, geotechnical instrumentation, transparent soils*

**Eakalak Khan**, Assistant Professor of Civil Engineering  
PhD, University of California at Los Angeles  
*Environmental science and engineering, wastewater treatment*

**Elena S. Prassas**, Assistant Professor of Transportation Engineering  
PhD, Polytechnic Institute of New York  
*Traffic engineering, public transit, transportation economics, AI applications, software systems and simulation for transportation applications*

**Hualiang Teng**, Assistant Professor of Transportation Engineering  
PhD, Purdue University  
*Intelligent transportation systems, demand modeling, traffic engineering, network analysis, freight transportation systems, pavement management systems*

### INDUSTRY FACULTY

**Eugene Fasullo**, PE, Distinguished Industry Professor of Civil Engineering; Director, Exec21 Program  
MS, University of Illinois  
Former Director of Engineering and Chief Engineer, Port Authority of NY and NJ Member, Concrete Industry Board of Directors, NY Building Congress  
*Construction engineering and management*

**Angelos L. Protopapas**, PE, Industry Assistant Professor of Civil Engineering  
PhD, Massachusetts Institute of Technology  
*Surface and groundwater hydrology and pollution, water resources systems, urban hydrology, fluid mechanics, irrigation*

### INSTRUCTORS

**Jose M. Ulerio**, EIT, Instructor of Transportation Engineering; Special Assistant to the Dean of Engineering and Applied Sciences  
MS, Polytechnic Institute of New York  
*Highway and traffic engineering, travel demand modeling, CAD and CAE applications*

### EMERITUS FACULTY

**Paul R. DeCicco**, PE, Professor Emeritus  
MCE, Polytechnic Institute of Brooklyn  
*Urban systems, fire safety*

**Alvin S. Goodman**, PE, Professor Emeritus  
PhD, New York University  
*Comprehensive water resources planning, water supply studies, hydrologic estimates, groundwater models, conjunctive use of surface and groundwater*

**Albert H. Griswold**, PE, Professor Emeritus  
MSCE, Columbia University  
*Mechanics*

**Stephen T. Mikochik**, Professor Emeritus  
MS, Rutgers University  
*Geotechnical engineering*

**Robert C. Velt**, Professor Emeritus  
MCE, Polytechnic Institute of Brooklyn  
*Structural Engineering*

**Ping Chun Wang**, PE, Professor Emeritus  
PhD, University of Illinois  
*Structural engineering*



**ADJUNCT FACULTY**

**Milton Alpern, PE**, Adjunct Professor of Civil Engineering  
MS, Columbia University

**Sidhartha Bagchi, PE**, Adjunct Associate Professor of Civil Engineering  
PhD, Polytechnic Institute of New York

**Raul R. Cardenas Jr**, Adjunct Professor of Environmental Engineering  
PhD, New York University

**Sergey Drabkin**, Adjunct Professor of Civil Engineering  
PhD, Polytechnic University

**Philip A. Habib, PE**, Adjunct Professor of Transportation Engineering  
PhD, Polytechnic Institute of Brooklyn

**Michael Horodnicanu, PE**, Adjunct Professor of Transportation Engineering  
PhD, Polytechnic Institute of New York

**Mark Kulewicz**, Adjunct Lecturer in Transportation  
MS, Polytechnic University

**J. Jong Lou, PE**, Adjunct Associate Professor of Civil Engineering  
PhD, Northwestern University

**Vassilus Papayannoulis**, Adjunct Lecturer in Transportation Engineering  
PhD, Polytechnic University

**Herbert Rothman, PE**, Adjunct Associate Professor of Civil Engineering  
BSCE, Rensselaer Polytechnic Institute

**Michael J. Sakala, PE**, Adjunct Assistant Professor of Civil Engineering  
MSCE, Polytechnic Institute of New York

**Gennaro E. Sansone**, Adjunct Lecturer in Transportation Engineering  
MBA, Iona College

**Raymond Schaeffer**, Adjunct Lecturer in Transportation Engineering  
MS, Swiss Federal Institute of Technology

**Sri K. Sinha, PE**, Adjunct Associate Professor of Civil Engineering  
MS, College of the City of New York

**John T. Tanacredi**, Adjunct Professor of Environmental Engineering  
PhD, Polytechnic University

# CIVIL ENGINEERING PROGRAM

## UNDERGRADUATE PROGRAM

### ACCREDITATION

The Bachelor of Science in civil engineering is accredited by the Accreditation Board for Engineering and Technology (ABET).

### PHILOSOPHY AND BACKGROUND

The philosophy followed in the Civil Engineering Program is that all undergraduate students should have exposure to all major subdisciplines of the profession to allow them to choose a career path intelligently, to develop a program of depth in at least two subdisciplines as an undergraduate, and to continue in an MS program in any civil engineering subdiscipline. This philosophy reflects the breadth of the civil engineering profession and the belief that undergraduate students cannot choose between potential career paths intelligently without sufficient knowledge of the subspecialties involved.

Required courses give the student a firm basic background in structures, geotechnical engineering, environmental engineering, water resources and highway and transportation engineering. Six credits of civil engineering design electives, 9 credits of technical electives, and 6 credits of free electives provide ample opportunity for the student to gain significant depth in two or more subdisciplines. The program results in students who are prepared either to enter the workforce as engineers, or to pursue graduate studies in a subdiscipline of their choice. The program, therefore, graduates students with substantial breadth and depth in civil engineering, and gives them maximum flexibility to pursue a future in either practice or research, in the public, private or university domains.

Of all of the engineering disciplines, civil engineering is perhaps the most design-oriented. Design in the CE cur-

riculum is handled via a separate capstone design course in the senior year, focused design courses in various subdisciplines, and in courses where design is integrated with other engineering topics.

All students are required to take a design course in Steel Structures (CE 331), Design of Highways (CE 350) and the capstone design course, Design of Civil Engineering Systems (CE 432). In addition, students must select two of four design courses offered by the department covering foundations, structural and environmental design. These electives are taken in the junior and senior years.

Design elements are included in a number of other courses. Basic design methodology and process are taught in the freshman engineering program as part of EG 102. In the sophomore year, Introduction to Civil Engineering (CE 200) includes an introduction to the use of AutoCAD in design drawings. Water Resources and Hydraulic Engineering (CE 340) includes design applications.

Thus, the program includes design topics in every year of the curriculum, developing a sense and familiarity with the design process throughout the program. Design is included in all subspecialties of civil engineering—structures, geotechnical, environmental, water resources and transportation—giving students the opportunity to gain a broad overview of design practices within the civil engineering profession.

Written and verbal skills are developed in a comprehensive way. The freshman engineering courses, EG 101 and EG 102, include a heavy emphasis on verbal and written presentation of work. All humanities and social science elective courses have writing components. In many civil engineering courses, written and oral communication are emphasized through project and design reports and presentations. The Writing Learning Center, supervised by the Department of Humanities and Social Sciences, is staffed by professional tutors, who are available to work with students at any level of their studies, either by appointment or on a drop-in basis.

Ethics are treated throughout the curriculum as pertinent issues arise. A focused treatment of engineering ethics is given as part of Introduction to Civil Engineering (CE 200) using a case-study approach. The course includes a treatment of the codes of ethics of ASCE and ASPE.

### CURRICULUM FOR A BACHELORS OF SCIENCE IN CIVIL ENGINEERING

The undergraduate curriculum in civil engineering is summarized in Table 1. A typical four-year course is shown in Table 2.

### UNDERGRADUATE TRANSFER CREDITS

Potential transfer students should refer to the University guidelines as shown elsewhere in this catalog. The faculty of the Civil and Environmental Engineering Department has established additional requirements and interpreted the University guidelines as follows:

The 128-credit curriculum is fulfilled through a combination of transfer credits, credits by examination and course credits completed at Polytechnic. Transfer credits for courses in mathematics, physics, chemistry, the humanities and social sciences are evaluated by the Office of Admissions with the guidance of the faculty from the appropriate departments.

The length of time for a transfer student to complete the degree requirements depends on the following factors:

- the total number of transfer credits awarded
- the particular courses required to complete the degree requirements
- enrollment status, i.e., full-time or part-time

To earn a Polytechnic BS in civil engineering, all students must complete a minimum of 30 credits of courses at Polytechnic at the junior and/or senior level (i.e., courses numbered CE 3xx or CE 4xx).

**PART-TIME STUDENTS**

Students may register as part-time students. Such students must be advised, however, that the department no longer offers many courses in the evening, and that part-time students must expect to take most of their courses during the day. The department attempts to make most upper-division courses available periodically in the late afternoon, after 4PM. Part-time students should maintain constant contact with their advisers to work out the details of course sequence in the most efficient manner.

**UNDERGRADUATE MANUAL**

The curriculum in civil engineering often changes more frequently than catalogs are published. The department publishes an *Undergraduate Manual* annually, which is available in the departmental office, and students are encouraged to remain up-to-date by consulting this manual whenever needed.

**TABLE I: CURRICULUM FOR A BACHELOR OF SCIENCE IN CIVIL ENGINEERING**

**A. Courses Required of All Civil Engineering Undergraduates**

No.	Course Title	Credits	Sem
MA 106	<i>Calculus I</i>	4	F1
MA 107	<i>Calculus II</i>	4	F2
MA 108	<i>Differential Equations and Numerical Methods</i>	3	So1
MA 109	<i>Multidimensional Calculus</i>	3	So2
MA 222	<i>Probability and Statistics</i>	3	J1
<b>Total Mathematics Required</b>		<b>17</b>	
CM 101	<i>General Chemistry I</i>	2.5	F1
CM 111	<i>General Chemistry Lab I</i>	0.5	F1
CM 102	<i>General Chemistry II</i>	2.5	F2
CM 112	<i>General Chemistry Lab II</i>	0.5	F2
PH 107	<i>Mechanics</i>	3	F2
PH 108	<i>Electricity, Magnetism, and Fluids</i>	3	So1
PH 118	<i>Lab for PH 108</i>	0.5	So1
PH 109	<i>Waves, Optics, and Thermodynamics</i>	3	So2
PH 119	<i>Lab for PH 109</i>	0.5	So2
<b>Total Physical Sciences Required</b>		<b>16</b>	
CS 200	<i>Programming Methodology</i>	3	F1
EG 101	<i>Introduction to Engineering</i>	3	F1
EG 102	<i>Introduction to Engineering Design</i>	3	F2
ME 111	<i>Engineering Mechanics I</i>	3	So1
<b>Total General Engineering/Computer Science Required</b>		<b>12</b>	

HU 101/3	<i>Writing &amp; the Humanities I</i>	3	F1
HU 200	<i>Writing &amp; the Humanities II</i>	3	F2/So1
SS 104	<i>Contemp. World History</i>	3	F2/So1
<b>Total Humanities and Social Sciences Required</b>		<b>9</b>	

CE 200	<i>Introduction to Civil Engineering</i>	2	So1
CE 202	<i>Mechanics of Materials</i>	3	So2
CE 223	<i>Fluid Mechanics</i>	3	So2
CE 307	<i>Construction Materials</i>	3	J1/J2
CE 322	<i>Analysis of Structures I</i>	3	J1
CE 323	<i>Analysis of Structures II</i>	3	J2
CE 331	<i>Steel Structures</i>	3	J2
CE 333	<i>Soil Mechanics</i>	3	J2
CE 340	<i>Water Resources and Hydraulic Engineering</i>	3	J1
CE 350	<i>Design of Highways</i>	3	J1/J2
CE 432	<i>Design of Structural Systems</i>	3	Sr2
CE 435	<i>Project Management for Construction</i>	3	Sr2
CE 441	<i>Environmental Engineering I</i>	3	Sr1
<b>Total Civil Engineering Required</b>		<b>36</b>	

**TOTAL OF ALL REQUIRED COURSES 92 CREDITS**

**B. Humanities and Social Science Electives**

Students must select 6 credits of Humanities and 9 credits of social science electives at an advanced level, as defined in the Polytechnic catalog. These electives may not include courses in writing or speaking skills, which may be taken as free electives.

**TOTAL OF HUMANITIES AND SOCIAL SCIENCE ELECTIVE CREDITS: 15 CREDITS**

**C. Civil Engineering Design Electives**

Students must select a minimum of 6 credits from the following list of approved civil engineering design courses:

CE 312	<i>Structural Design for Dynamic Loads</i>	3	credits
CE 352	<i>Reinforced Concrete Structures</i>	3	credits
CE 417	<i>Foundations</i>	3	credits
CE 442	<i>Environmental Engineering II</i>	3	credits

**TOTAL OF CIVIL ENGINEERING DESIGN ELECTIVE CREDITS: 6 CREDITS**

**D. Civil Engineering Technical Electives**

Students must select a minimum of 9 credits of technical electives from the following approved civil engineering technical electives, listed by program

area. Technical electives may also be selected from other engineering programs, computer science, mathematics, and/or the physical sciences with the approval of the academic adviser.

**Technical Electives in Structural, Geotechnical, and Construction Engineering**

CE 310	<i>Site Planning and Design</i>	3	credits
CE 312*	<i>Structural Design for Dynamic Loads</i>	3	credits
CE 336	<i>Timber and Masonry Structures</i>	3	credits
CE 417*	<i>Foundations</i>	3	credits
CE 419	<i>Environmental Geotechnology</i>	3	credits
CE 452*	<i>Reinforced Concrete Structures</i>	3	credits

**Technical Electives in Environmental and Water Resources Engineering**

CE 260	<i>Ecology for Environmental Eng. &amp; Science</i>	3	credits
CE 310	<i>Site Planning and Design</i>	3	credits
CE 339	<i>Environmental Microbiology</i>	3	credits
CE 419	<i>Environmental Geotechnology</i>	3	credits
CE 442*	<i>Environmental Engineering II</i>	3	credits
CE 443	<i>Solid and Hazardous Wastes</i>	3	credits
CE 444	<i>Environmental Engineering Project</i>	3	credits
CE 447	<i>Air Pollution</i>	3	credits

**Technical Electives in Highway and Transportation Engineering**

CE 352	<i>Traffic Engineering</i>	3	credits
CE 354	<i>Introduction to Trans. Planning Methods</i>	3	credits
CE 310	<i>Site Planning and Design</i>	3	credits
TR 609	<i>Transportation Economics and Finance</i>	3	credits
TR 682	<i>Freeways and Rural Highways: Design, Operation and Management</i>	3	credits
TR 684	<i>Arterials and Networks: Design, Operation and Management</i>	3	credits

\* If selected as a design elective, course does not count as a technical elective.

Note: Adviser may authorize additional graduate CE courses, or courses in other engineering disciplines, computer science, mathematics, and/or the physical sciences as technical electives.

**TOTAL OF TECHNICAL ELECTIVE CREDITS: 9 CREDITS**  
**TOTAL OF FREE ELECTIVE CREDITS: 6 CREDITS**

**TOTAL CREDITS REQUIRED FOR DEGREE: 128 CREDITS**

## Typical Course of Study for the Bachelor of Science in Civil Engineering

### FRESHMAN YEAR

#### Fall Semester

Course No.	Subject	Hours/Week				Cr.
		Class	Lab	Rec.	Cr.	
MA 106	Calculus I	5	0	0	4	
CM 101	Gen. Chem. I	3	0	0	2.5	
CM 111	Gen. Chem. Lab I	0	1.5	0	.5	
CS 200	Programming Meth.	4	0	0	3	
HU 101/3	Writing and the Humanities I	3	0	0	3	
EG 101	Intro. to Engineering	2	3	0	3	
SL 101	Freshman Seminar	1	1	0	0	
16						

#### Spring Semester

Course No.	Subject	Hours/Week				Cr.
		Class	Lab	Rec.	Cr.	
MA 107	Calculus II	5	0	0	4	
CM 102	Gen. Chem. II	3	0	0	2.5	
CM 112	Gen. Chem. Lab II	0	1.5	0	.5	
PH 107	Mechanics	3	0	0	3	
HU 200	Writing and the Hum. II (1)	3	0	0	3	
EG 102	Intro to Eng. Design	1	3	1	3	
16						

### SOPHOMORE YEAR

#### Fall Semester

MA 108	Diff. Equations & Num. Meth.	3	0	0	3
PH 108	Elect. Magn. & Fluids	3	0	1	3
PH 118	Phys. Lab for PH 108	0	1.5	0	.5
SS 104	Cont World Hist (2)	3	0	0	3
CE 153	Intro to Civil Eng.	1	3	0	2
ME 111	Eng. Mechanics I	3	0	0	3
14.5					

#### Spring Semester

MA 109	Multidim Calculus	3	0	0	3
PH 109	Waves, Opt. & Therm.	3	0	1	3
PH 119	Phys Lab for PH 109	0	1.5	0	.5
CE 223	Fluid Mechanics	2.5	1.5	0	3
CE 202	Mech. of Materials	3	0	0	3
SS	Advanced Elective (3)	3	0	0	3
15.5					

### JUNIOR YEAR

#### Fall Semester

MA 222	Probability & Statistics	3	0	0	3
CE 340	Water Resources & Hydraulic Eng.	3	0	0	3
CE 322	Analysis of Struct. I	3	0	0	3
CE 350	Design of Highways (4)	2.5	1.5	0	3
HU	Advanced Elective (3)	3	0	0	3
	Free Electives (5)	3	0	0	3
18					

#### Spring Semester

CE 232	Soil Mechanics	2	3	0	3
CE 307	Const. Materials (6)	2	3	0	3
CE 331	Steel Structures	2	3	0	3
CE 323	Anal. of Struct. II	3	0	0	3
	Technical Elective (5)	3	0	0	3
SS	Advanced Elective (3)	3	0	0	3
18					

### SENIOR YEAR

#### Fall Semester

HU	Advanced Elect. (3)	3	0	0	3
CE 441	Environmental Eng. I	2	3	0	3
	Technical Elective (5)	3	0	0	3
CE	Design Elective (5)	3	0	0	3
	Technical Elective (5)	3	0	0	3
15					

#### Spring Semester

SS	Advanced Elective (3)	3	0	0	3
CE 435	Proj. Mgmt for Const.	3	0	0	3
CE 432	Design of Structural Systems (4)	2	3	0	3
CE	Design Elective (5)	3	0	0	3
	Free Elective (5)	3	0	0	3
18					

**Total credits required for graduation:**

**128**

- (1) Can be switched with SS 104
- (2) Can be switched with HU 200
- (3) Location of HU and SS advanced electives in schedule may be switched
- (4) Junior spring in Farmingdale
- (5) Location of free electives, technical electives and design electives may be switched in schedule with the approval of the adviser
- (6) Junior fall in Farmingdale

Note: Technical electives include any undergraduate course given in civil engineering, courses in other engineering disciplines, computer science, mathematics or physical science may be taken with the approval of the adviser. Graduate courses in civil engineering may be taken with the approval of the adviser.

Free electives include any Polytechnic course supporting the student's overall objectives, subject to the adviser's approval.

<b>GRADUATE PROGRAM</b>
-----------------------------

### **REQUIREMENTS FOR THE MASTER'S DEGREE IN CIVIL ENGINEERING**

Students pursuing the MS in civil engineering generally have undergraduate preparation in civil engineering. Students pursuing this degree who have undergraduate or graduate degrees in other fields may qualify for this program by completing additional undergraduate engineering courses. When a student pursues both a BS and MS simultaneously at Polytechnic, the bachelor's degree requirements must be completed first.

Qualified undergraduate students may take up to 9 credits of graduate course work while matriculating as undergraduates for later transfer to their graduate degrees. These credits must, however, be beyond the 128 credits required for the BS.

Courses in some areas of specialization are not offered on a regular basis. Students should consult with their advisers to determine the expected scheduling of such courses.

Students pursuing the MS in civil engineering may do so in two ways:

- 1) They may select an area of specialization from among construction project management; geotechnical and geo-environmental engineering; highway construction, materials and engineering; structural materials and engineering; and environmental and water resources engineering.
- 2) They may elect to complete a more general program consisting of courses from a number of specialty areas.

### **REQUIREMENTS FOR STUDENTS SELECTING AN AREA OF SPECIALIZATION**

Students selecting an area of specialization must complete a total of 36 units of work, including a 3-unit master's project (or a 6-unit master's thesis), and satisfy the following two requirements:

- 1) A minimum of 15 units (five courses) must be in the specialty area selected, and a minimum of 9 units (three courses) must be in courses outside the specialty area. Remaining courses are selected with the concurrence of your adviser. Some of the courses in a given specialty area may be *required* for students selecting that specialty.
- 2) With respect to course work, 21 units (seven courses) must be selected within five identified skill areas as follows: two courses in analysis (A), two courses in design (D), one course in materials and monitoring (M), one course in technologies and processes (T) and one course in project management (P).

Courses taken to satisfy requirement 2 may overlap those taken to satisfy requirement 1. Table 3 contains a list of graduate courses in civil engineering. For each course, the skill area is identified as well as the specialty area. Those courses required for a given specialty area are also identified.

### **REQUIREMENTS FOR STUDENTS NOT SELECTING A SPECIALTY AREA**

Students not selecting a specialty area will be permitted to follow a program of study meeting their professional needs. This program must be laid out with the assistance and approval of a graduate faculty adviser. Any changes in this program must also be approved by the adviser. Students must still complete 36 units, including a 3-unit master's project (or a 6-unit master's thesis). They are not subject to requirement 1, but must meet the skills requirements under requirement 2, as specified above.

### **ADDITIONAL COURSES GIVEN IN SPECIALTY AREAS**

The Department of Civil and Environmental Engineering schedules additional courses for various reasons, including:

- 1) To satisfy course requirements for other MS degrees offered by the department:
  - MS in Environmental Engineering
  - MS in Transportation Planning and Engineering
  - MS in Transportation Management
 These degrees and associated courses are described in other sections.
- 2) To provide additional state-of-the-art courses of special interest in analysis and professional practice.

These courses may be applied toward the MS in Civil Engineering when approved by the student's faculty adviser. Courses in other departments may also be used towards the MS in Civil Engineering when approved by the faculty adviser. When approved, specialty and skill areas for courses not listed in Table 3 may also be designated by the student's faculty adviser.

### **REQUIREMENTS FOR THE DOCTORAL DEGREE**

Students with exceptional scholastic ability may pursue a doctorate in civil engineering. Majors are offered in structural materials and engineering, environmental engineering, water resources and hydraulic engineering, construction project management, highway materials and engineering, and geotechnical and geo-environmental engineering. The PhD in civil engineering is also offered with a major in transportation planning and engineering; information on this program is described in the "Transportation" section.

An applicant for a PhD in civil engineering must hold a master's in civil engineering. Applicants with degrees in other fields may be admitted with deficiencies as evaluated by a departmental graduate adviser and upon approval of the department head.

All doctoral students must complete a minimum of 90 units of work beyond the bachelor's degree. Minimum requirements of formal course work (not including guided readings, seminars, projects, or theses) are 48 units beyond the bachelor's degree or 24 units beyond the master's degree. Generally, at least 12 units

of formal course work must be completed at Polytechnic. PhD students must select a major field and two minor fields in consultation with the advisers. Each minor consists of 9 to 12 units of approved courses.

To qualify as PhD candidates, students must pass a written and oral qualifying examination on the major and one minor. The oral examination may be waived in exceptional cases by the department head upon the recommendation of the examining committee. Generally, students take the qualifying examination within their first year of full time course work beyond the MS degree. Students are allowed a maximum of three attempts to pass the qualifying exam.

Students must submit and orally defend dissertation proposals within one semester after the initial registration for dissertation units or before going beyond 9 dissertation units. Registration for a total of 30 units of dissertation research is required. Registration should be continuous until the dissertation has been completed and accepted.

### **GRADUATE STUDENT MANUAL**

The department publishes a *Graduate Student Manual* each year. As changes in curriculum sometimes occur more frequently than the catalog is printed, the student is urged to consult a copy of this departmental manual each year to be informed of the most recent changes.

## Department of Civil & Environmental Engineering Courses Scheduled for the MS(CE)

(Corresponding to new degree requirements effective fall 1998)

COURSE	TITLE	SKILLS	FREQ	CPM	SPECIALTY AREA			
					GEOT	HWY	STRUCT	ENV&WR
<b>COURSES GIVEN REGULARLY</b>								
CE 601	Theory of Structure Analysis & Design	A	alt				S	
CE 606	Bridge Engineering	D	alt				S	
CE 613	Stability of Structures	A	alt				S	
CE 614	Steel Structures	D	alt				R	
CE 616	Finite Element Methods	A	y		S		R	
CE 625	Structural Dynamics	A	y				R	
CE 641	Reinforced Concrete Structures	D	y				R	
CE 643	Prestressed Concrete	D	alt				S	
CE 651	Condition Assessment	M	alt		S	S	S	
CE 653	Structural/Construction Failures	A, T	alt				S	
CE 655	Earthquake Engineering	D	alt		S		S	
CE 722	Hydrology	A	y					R
CE 723	Groundwater Hydrology & Pollution	A	y					R
CE 737	Environmental Chemistry & Microbiology I	M	y					R
CE 739	Environmental Chemistry & Microbiology II	M	alt					S
CE 742	Water & Wastewater Treatment I	D, T	y					R
CE 743	Water & Wastewater Treatment II	D, T	alt					S
CE 747	Analysis of Stream & Estuary Pollution	A	y					R
CE 752	Air Pollution	A, M	alt					S
CE 753	Hazardous/Toxic Wastes Management	A, M, P	alt					S
CE 754	Site Remediation	D, T	alt					S
CE 770	Solid Waste Management	P	alt					S
CE 781	Infrastructure Planning, Engin. & Economics	P	alt	S		S		
CE 782	Forensic Structural Engineering	A	alt	S			S	
CE 783	Infrastructure Rehabilitation: Practical Approach	A	alt	S				
CE 796	Pavement Design & Analysis	D, A	y			R		
CE 813	Advanced Highway & Construction	M	y	S		R		
CE 814	Infrastructure Management Systems	T	alt	S		R aft		
CE 821	Advanced Geometric Highway Design	D	alt			R aft		
CE 825	Project Management for Construction	P	y	R				
CE 826	Construction Cost Estimates	P	alt	S				
CE 827	Contracts & Specifications	P	y	R				
CE 828	Risk Analysis	A	alt	S	S			
CE 829	Construction Operations Analysis	A	alt	S				
CE 830	Information Systems in Project Management	T	alt	S				
CE 831	Engineering for Construction I	T	alt	S				
CE 832	Engineering for Construction II	D	alt	S				
CE 840	Geotechnics & Geomaterials	M	alt		S			
CE 841	Exper Geotechnics & Site Monitoring	M	alt		S			
CE 842	Foundations & Ground Improvement	T	y		R	S		
CE 843	Urban Geotechnology	T, D	alt	S	S			
CE 849	Environmental Geotechnics	T, D	alt		S			
CE 866	Advanced Foundation Design	D	y		R			

### Notes on Table 3

The following key is provided for Table 3:

#### For Specialty Area Categories:

R = required of a student selecting this specialty

S = elective course given by the faculty of the specialty area

#### For the Skill Categories:

A = analysis

D = design

M = materials and monitoring

T = technologies and processes

P = project management

The table shows information concerning frequency of course offerings in Brooklyn, but these are approximate and not guaranteed. The student must consult with his/her adviser and keep informed about the most recent scheduling information. Offerings in Farmingdale depend upon the level of student enrollment and their interests and will be determined on a semester-by-semester basis. The table also lists courses that are not expected to be given regularly; when such additional courses are scheduled, the appropriate classifications will be made available.

<b>UNDERGRADUATE COURSES</b>
----------------------------------

**CE 200 Introduction to Civil Engineering** 1:3:0:2

This course provides a basic introduction to the profession of civil engineering. It provides an overview of the various subdisciplines of the profession—structural engineering, geotechnical engineering, environmental engineering, water resources engineering, highway and transportation engineering, and construction engineering and management. The laboratory component focuses on a brief introduction to surveying measurements and in-depth familiarity and use of Auto-CAD™ in a variety of civil engineering applications. General professional issues, such as writing reports, giving oral presentations and professional ethics, are also introduced. *Prerequisites: EG 101/102 or equivalent.*

**CE 202 Mechanics of Materials** 3:0:0:3

Basic principles of stresses and strains of members subjected to direct force, torsion and bending. Deflections of beams. Statically determinate and indeterminate problems. Column stability. *Prerequisite: ME 111.*

**CE 223 Fluid Mechanics** 2½:1½:0:3

Fluid properties. Hydrostatics. Continuity, energy and momentum equations. Laminar and turbulent flow. Similitude and dimensional analysis. Incompressible flow in closed pipes. Laboratory work parallels and supplements lectures. *Prerequisite: ME 111.*

**CE 307 Construction Materials** 2:3:0:3

Material properties and behavior. Environmental impact and concerns. Structure, physical and mechanical properties of construction materials such as timber, aggregates, asphalt, concrete, metals and alloys, plastics, masonry and mortar. Relationship between microstructure and behavior. Asphalt and concrete

mixture design, performance and deterioration. Plastics and geosynthetics. Reclaimed materials and recycling of waste products in civil engineering applications. Materials related to environmental hazards. Experimental investigation of mechanical and physical properties of selected construction materials.

**CE 310 Site Planning and Design** 2:3:0:3

The course introduces and develops an understanding of site planning, including the process and components of site design, such as site analysis and program development, feasibility analysis, zoning and municipal approvals, construction documents, grading and drainage, utility design, sanitary disposal and water supply, and construction administration. Various types of site design are treated, including residential housing, municipal/public works, commercial, institutional and recreational. *Prerequisites: Junior status or instructor's permission.*

**CE 322 Analysis of Structures I** 3:0:0:3

Analysis of statically determinate beams, frames and trusses. Deflection calculations using energy methods. Analysis of indeterminate structures using superposition. Determinate and indeterminate influence lines. Slope deflection. *Prerequisite: CE 202.*

**CE 323 Analysis of Structures II** 3:0:0:3

Analysis of statically indeterminate linear frames by moment distribution. Matrix analysis of structures using force and stiffness methods. Computer applications. *Prerequisite: CE 322.*

**CE 331 Steel Structures** 2:3:0:3

Design of steel beams and girders, tension members and columns. Bolted, riveted and welded connections. *Prerequisite: CE 322.*

**CE 333 Soil Mechanics** 2:3:0:3

Geological soil-forming processes and physical and mechanical properties of soils. Plasticity, capillarity, permeability, stress distribution in soil masses, consolidation theory, settlement of structures. Laboratory studies of physical and mechanical properties of soils. *Prerequisites: CE 223 and CE 202.*

**CE 336 Timber and Masonry Structures** 3:0:0:3

Properties and classification of structural lumber. Design of timber connectors. Design and erection 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. Design and construction of load-bearing reinforced and unreinforced masonry structural elements. *Prerequisite: CE 322, CE 331 and CE 352.*

**CE 340 Water Resources and Hydraulic Engineering** 3:0:0:3

Fluid Measurements. Hydrologic techniques. Surface water and ground water supplies. Open channel flow. Water transmission and distribution. Wastewater and storm water drainage. Development of water resources projects. *Prerequisite: CE 223.*

**CE 350 Design of Highways** 2½:1½:0:3

This course covers a broad range of highway engineering fundamentals, including route surveying, geometric highway design and pavements. Mapping principles and GIS/GPS technology are introduced. Geometric design principles and highway systems functions and classification are discussed. Horizontal and vertical alignment are dealt with, as is design of cross-sections and channelization. An overview of pavement and other highway structures is included. The laboratory focuses on a series of highway design projects. *Prerequisite: Junior status or instructor's permission.*



**CE 352 Traffic Engineering** 3:0:0:3

Development and use of traffic engineering techniques to aid in planning, functional design and control of highway and street systems. Traffic studies, accident analysis, capacity analysis, sign and coordination, etc. Practical applications. *Prerequisite: junior status.*

**CE 354 Introduction to Transportation Planning Methods** 3:0:0:3

This course provides an overview of regional planning for transportation systems. Transportation planning organizations and processes are discussed and detailed. Data collection for regional planning, including use of census data, is discussed. Modeling of travel demand for forecasting is treated in detail. Population, land use, trip generation, trip distribution and traffic assignment models are presented and demonstrated. Economic evaluation of alternatives through benefit-cost and related analyses is discussed. The importance of integration of transportation modes in person-travel and freight-travel is emphasized. *Prerequisite: junior status or instructor's permission.*

**CE 391-392 Bachelor's Thesis in Civil Engineering** each 2 credits

Original research, design or plan for an approved engineering project. The thesis gives students an opportunity to apply knowledge and training gained in courses by approaching and successfully solving comprehensive problems. Conferences held regularly with an appointed member of the faculty. Thesis registration required each semester. Students must register for a thesis until completed. *Prerequisite: senior status.*

**CE 396 Civil or Environmental Engineering Internship** 2:0:0:2

Supervised, creative civil or environmental engineering work of at least two months' performance judged on the basis of written and oral reports presented to industrial and faculty supervisors. Regular faculty visitations and conferences arranged during internships. Open to students who have completed their junior year and have departmental approval prior to beginning the internship experience. *Prerequisite: Department head's approval.*

**CE 398 Project in Civil or Environmental Engineering**  
2 or 3 credits as arranged

Solution to civil or environmental engineering problem or detailed study of an advanced area of civil engineering under close supervision of an adviser. Before undertaking the project, interested students must submit a detailed written proposal of the problem they intend to investigate to the course director, along with the number of credits for which they wish to register. Results of the project must be submitted to the department as a formal report.

**CE 417 Foundations** 2:3:0:3

Site explorations and soil sampling; planning boring programs and interpretation of boring logs. Bearing capacities and footings and mats for granular soils and clays. Settlement of structures. Lateral earth pressure and proportions of retaining walls. Pile foundations. *Prerequisite: CE 333. Co-/Prerequisite: CE 452.*

**CE 435 Project Management for Construction** 3:0:0:3

The participants, processes and techniques required to maintain the life cycle of a construction project. Planning of construction operations, including cost estimating and economic evaluation of alternatives. Analysis of the construction bid process, contracting and related issues on ethics in project engineering. Productivity, safety and quality on the constructed project. Time scheduling of the project, including CPM and PERT. Trends in computer analysis of project information. *Prerequisite: senior status.*

**CE 441 Environmental Engineering I** 2:3:0:3

Water and wastewater quantities. Water quality. Water and wastewater treatment, stream assimilation, public health and environmental problems. Laboratory analyses of water and wastewater samples, treatment process tests. *Prerequisites: CE 223. Co-/Prerequisite: CE 340.*

**CE 442 Environmental Engineering II** 2:3:0:3

Integrated lecture and design periods covering water distribution systems, water filtration units and principal components of wastewater treatment plants for small communities. Introduction to air quality and solid waste problems. *Prerequisites: CE 340 and CE 341.*

**CE 450 Planning and Design of Civil Engineering Systems** 2:3:0:3

A comprehensive design project course, focusing on development of integrated civil engineering systems and including site planning; environmental, geotechnical and structural engineering; specifications; and estimation of construction costs and schedules. While all projects include some inclusion of all of the above elements, different project groups may focus on developments having a primary theme in one of the principal subdisciplines of civil engineering. Laboratory sessions involve group work on assigned projects, and periodic student reports on progress. All final projects will be professionally presented and defended by project team members. Lecture sessions are designed to provide specific information and techniques relative to the particular project(s) being studied. *Prerequisites: Senior status, CE 323, CE 331, CE 441 or equivalents. Co-requisites: Two of the following, or permission of undergraduate adviser: CE 452, CE 312, CE 417, CE 442.*

**CE 452 Reinforced Concrete Structures** 2:3:0:3

Fundamentals of analysis and design of reinforced concrete beams, columns, slabs and footings. *Prerequisite: CE 322.*

<b>GRADUATE COURSES</b>
-------------------------

**CE 781 Infrastructure Planning,  
Engineering and Economics** 2%:0:0:3

Methods for the identification, formulation, preliminary appraisal and detailed analysis of individual projects and systems of civil engineering projects. Different approaches appropriate for government agencies, public utilities, industrial firms and private entrepreneurs. Planning considers projects that satisfy single and multiple purposes and objectives, meet local and regional needs and take advantage of opportunities for development. Financial and economic analyses, including sensitivity and risk analysis. Mathematical models for evaluation of alternatives and optimization. Impacts of projects: environmental, social, regional economic growth, legal and institutional, and public involvement.

**CE 783 Infrastructure Rehabilitation:  
A Practical Approach** 2%:0:0:3

Focuses on the direct application of engineering principles required to address infrastructure rehabilitation needs. Emphasizes conceptual thinking, brainstorming techniques, team evaluation of alternative solutions, verbal and written communication and intensive classroom participation.

**STRUCTURAL MATERIALS  
AND ENGINEERING**

*Prerequisites for all courses: MA 108 and CE 323*

**CE 601 Theory of Structural  
Analysis and Design** 2%:0:0:3

Theories of structural analysis and its relationship to design. Classical structural mechanics, matrix procedures and numerical methods of solution. Analysis of statically indeterminate beams, frames, and trusses using force and displacement methods. Emphasis on elastic supports, movement of supports and temperature effects. *Prerequisite: CE 323.*

**CE 603-604 Special Topics in  
Structural Analysis I, II** each 2%:0:0:3

Specialized current topics of interest offered at irregular intervals by advance announcement. Graduate advisers may approve repeated registration for different topics. *Prerequisite: Consent of adviser.*

**CE 606 Bridge Engineering** 2%:0:0:3

Types of bridges. Geometric design of bridges. Construction materials and construction techniques. Simplified bridge analysis. Special problems in the design of steel and reinforced concrete bridges. Bridge maintenance techniques. Bridge inspection policy. Bridge rehabilitation procedures. Bridge management systems. Effects of wind and earthquakes on long-span bridges. *Prerequisites: CE 323, CE 331 and CE 352.*

**CE 613 Stability of Structures** 2%:0:0:3

Stability concepts. Investigation of buckling of structural configurations composed of beams, plates, rings, and shells. Effects of initial geometric imperfections, load eccentricities and inelastic behavior. Application of energy methods and numerical techniques. *Prerequisite: CE 601.*

**CE 614 Steel Structures** 2%:0:0:3

Compression members: elastic and inelastic buckling of columns and plates. Laterally beams: supported. Torsion of open and closed sections. Warping. Lateral torsional buckling of beams. Biaxial bending. Plate girders: stability of webs and flanges. Combined bending and axial load, instability analysis. Design of rigid and semirigid mechanisms of continuous beams and rigid frames. Elastic/plastic design criteria. *Prerequisite: CE 331 or equivalent.*

**CE 616 Finite Element Methods** 2%:0:0:3

Derivation of element stiffness matrices. Construction of general stiffness matrices in global coordinates. Application to problems in plane stress, plane strain, plates and shells under various loads. Emphasis on computer applications. *Co-/Prerequisite: CE 609.*

**CE 625 Structural Dynamics** 2%:0:0:3

Dynamic response of single degree of freedom systems. Theory of vibration of finite degree of freedom systems. Influence coefficient method. Analytical and numerical solution of dynamic response problems. Nonlinear analysis of single degree of freedom system. Emphasis on computer analysis of large complex systems. *Prerequisite: CE 609.* Also listed under ME 741.

**CE 641 Reinforced Concrete  
Structures** 2%:0:0:3

Ultimate strength design of reinforced concrete members. Biaxial bending and slender effects of reinforced concrete columns. Limit design, redistribution of moments. Design of slabs using yield line theory. Deep beams and shear walls. Analysis and design for torsion. *Prerequisite: CE 252. Co-/Prerequisite: CE 601.*

**CE 643 Prestressed Concrete** 2%:0:0:3

Principles and materials for prestressed concrete. Flexural strength of prestressed members. Design of pretensioned and post-tensioned beams, columns, and slabs. Effect of short-term and long-term deformations. Analysis and design of prestressed concrete structures. *Prerequisite: CE 641.*

**CE 651 Condition Assessment of  
Infrastructure Components** 2%:0:0:3

Overview of the condition assessment of structures for the purpose of determining safety and useful life, planning preventive maintenance, rehabilitation and retrofitting, and adaptive reuse. Mechanical properties, critical characteristics, common defects and effective condition assessment procedures for

concrete, steel, masonry and wood structures are discussed. Emphasis is on the principles and the applicability of non-destructive testing (NDT) techniques for existing structures. Reference is made to applicable codes, standards and industry practices. Documentation, presentation and report requirements are also covered. *Prerequisites: course each in engineering materials, reinforced concrete design and structural steel design.*

**CE 653 Investigation of Structural/Construction Failures** 2%:0:0:3

Review of significant failures. Overview of civil engineering design and construction practices, ethical standards and legal positions as necessary background to forensic engineering. Study of the process of engineering evaluation of structural defects and failures in construction and in service. Examination of the roles, activities and conduct of the forensic consultant and expert witness. Students are assigned actual cases of nonperformance or failure of steel, concrete, masonry, geotechnical and temporary structures in order to perform, discuss and report their own investigations under the guidance of the instructor. *Prerequisites: course each in engineering materials, concrete design, steel design, construction and soil mechanics and foundations.*

**CE 655 Earthquake Engineering** 2%:0:0:3

Engineering seismology, strong ground motion, earthquake magnitude, intensity and frequency. Structural response and seismic damage, elastic and inelastic static and dynamic modeling. Earthquake-load analysis, including response spectra, normal mode and direct integration techniques. Seismic design principles applied to building structures and special facilities. Code provisions for earthquakes, seismic design of steel and concrete structures, special provisions. Local site effects and design ground motions, liquefaction potential, soil improvement for remediation of seismic hazards. Seismic rehabilitation strategies for buildings. *Prerequisites: CE 625 or instructor's permission.*

**CE 782 Forensic Structural Engineering** 2%:0:0:3

Focuses on the direct application of engineering principles to the proper performance of civil engineering structures. Emphasizes lessons learned by analyzing structural failures and resulting outstanding practicing professional engineers.

**WATER RESOURCES ENGINEERING**

*Prerequisite for all courses: MA 108 and CE 223*

**CE 722 Hydrology** 2%:0:0:3

Hydrologic cycle. Meteorological considerations. Analyses of precipitation, runoff, unit hydrographs, flood routing and reservoir storage. Principles of groundwater hydrology. Introduction to frequency analysis of floods and droughts. *Prerequisite: adviser's consent.*

**CE 723 Groundwater Hydrology and Pollution** 2%:0:0:3

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 340 or adviser's consent.*

**CE 735-736 Special Topics in Water Resources and Hydraulic Engineering I, II** each 2%:0:0:3

Topics in water resources and hydraulic engineering such as hydroeconomic models; finite difference and finite element models; synthetic hydrology; conjunctive use of surface water and ground water; desalinated and recycled water; thermohydrologic and hydrometeorological problems; flushing of estuaries; hydrodynamics of oil pollution, sludge dumping, and sediment movement; environmental design of hydraulic structures, problems of macro projects. *Prerequisite: adviser's consent.*

**ENVIRONMENTAL ENGINEERING**

**CE 737 Environmental Chemistry and Microbiology I** 1:2:0:3

Introduction to the chemistry and microbiology of polluted and natural waters, including applications of principles developed.

**CE 739 Environmental Chemistry and Microbiology II** 1:2:0:3

Advanced topics in chemistry and microbiology of polluted and natural wastewater treatment.

**CE 742 Water and Wastewater Treatment I** 2%:0:0:3

Physical, chemical and biological principles involved in process design and treatment of water and wastewater. Topics include aeration, filtration, softening, chemical treatment, coagulation, flocculation, desalination, taste and odor control. *Co-/Prerequisite: CE 737.*

**CE 743 Water and Wastewater Treatment II** 2%:0:0:3

Continuation of CE 742. Topics include sedimentation, adsorption, aerobic and anaerobic biological treatment, sludge treatment and disposal. *Co-/Prerequisite: CE 739.*

**CE 745 Water and Wastewater Treatment Laboratory** 1:2:0:3

Laboratory 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. Warburg analysis of waste. *Co-requisite: CE 743.*

**CE 747 Analysis of Stream and Estuary Pollution** 2%:0:0:3

Dispersal and decay of contaminants introduced into lakes, streams, estuaries, and oceans. Effects of pollutants on chemical quality and ecology of receiving waters.

## DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

### **CE 752 Air Pollution** 2%:0:0:3

Causes and effects of air pollution. Methods of sampling. Interpretation of data. Meteorological aspects. Methods of air pollution control.

### **CE 753 Hazardous/Toxic Waste Management** 2%:0:0:3

Methods in the management of hazardous/toxic waste sites. Topics covered include health and safety, legal aspects, contamination of the environment, treatment processes, toxicology and risk assessment.

### **CE 754 Hazardous/Toxic Site Management** 2%:0:0:3

Treatment and disposal technologies for hazardous waste site remediation. In-situ and ex-situ processes. Physico-chemical processes, stabilization and solidification; biological processes including aerobic and anaerobic systems for degradation and detoxification; thermal processes and incineration; storage, land disposal and containment. Remediation planning and technology selection for hazardous waste containment and clean up for typical case studies. Decision-making framework and technology selection will be a key course component. The course will also involve case studies and a class project.

### **CE 770 Solid Waste Management** 2%:0:0:3

Engineering aspects of solid waste collection, transport and disposal, including incineration, sanitary landfill, composting, recovery and reutilization, and economic evaluation of factors affecting selection of disposal methods.

### **CE 771-772 Special Topics in Environmental Engineering I, II** 2%:0:0:3

Current topics including 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, and modeling natural waters and treatment systems. *Prerequisite: adviser's consent.*

## **GEOTECHNICAL AND GEO-ENVIRONMENTAL ENGINEERING**

### **CE 840 Geotechnics & Geomaterials** 2%:0:0:3

Index properties of soils, mechanical soil behavior, shear strength, stress-strain characteristics, drained and undrained soil behavior, permeability, seepage, groundwater flow and control, consolidation of soils. *Prerequisite: CE 333 or equivalent soil mechanics course.*

### **CE 841 Experimental Geotechnics & Site Monitoring** 2:1%:0:3

Soil behavior characterization (shear strength, flow, consolidation) using laboratory testing, in-situ testing, and geophysical methods. Field instrumentation, monitoring and performance evaluation techniques. *Prerequisites: CE 333, CE317 or equivalent.*

### **CE 842 Foundations & Ground Improvement** 2%:0:0:3

Foundation engineering practice, foundation rehabilitation, emerging ground improvement technologies. Selection, design analysis of appropriate ground improvement techniques for different foundation problems. Construction, monitoring, performance evaluation. *Prerequisites: CE317 and CE333.*

### **CE 843 Urban Geotechnology** 2%:0:0:3

Case histories on geotechnical design, construction, and rehabilitation in the urban environment; special construction problems and innovative solutions; unforeseen ground conditions, performance monitoring, remedial planning and implementation, geotechnical design and construction issues from a practicing engineers perspective. *Prerequisites: CE 317, CE 333, CE 842 or instructor's permission.*

### **CE 849 Environmental Geotechnics** 2%:0:0:3

Clay mineralogy, soil-water-contaminant interaction process, chemical transport through soils, hydraulic conductivity, diffusion and attenuation mechanisms, waste disposal systems, design of landfills, seepage barriers and cut-off walls, geoenvironmental site characterization techniques, soil remediation technologies. *Prerequisite: CE 333.*

### **CE 860 Special Topics in Geotechnical Engineering** 2%:0:0:3

Current topics of interest such as ground improvement, geotechnical earthquake engineering, site characterization and remediation. *Prerequisite: CE 840 and CE 841.*

### **CE 866 Advanced Foundation Design** 2%:0:0:3

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. *Prerequisite: CE 317 and CE 333.*

## **CONSTRUCTION MANAGEMENT**

### **CE 798-799 Special Topics in Infrastructure Systems and Construction** 2%:0:0:3

Current 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 utilization and design of infrastructure facilities and systems. Intelligent buildings and other modern constructed works. Temporary structures for construction and problems in construction engineering. New approaches in construction management.

**CE 825 Project Management for Construction** 2%:0:0:3

Topics specific to the development and coordination of 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 825.**

**CE 826 Construction Cost Estimating** 2%:0:0:3

Estimates and costs from the viewpoint of contractor or construction engineer, details of estimating with emphasis on labor, material, equipment and overhead costs. **Also listed under MG 826.**

**CE 827 Contracts and Specifications** 2%:0:0:3

Principles of contract law as applied to the construction industry and legal problems in preparing and administering construction contracts. **Also listed under MG 827.**

**CE 828 Risk Analysis** 2%:0:0:3

A thorough investigation of the ever-rising importance of risk analysis in project management. Analysis of qualitative and quantitative risk. Techniques in probability analysis, sensitivity analysis, simulation of risk and utility theory. Computational methods for calculating risk. An exposure to the complexity of real-world corporate and public problems through case investigations.

**CE 829 Construction Operations Analysis** 2%:0:0:3

Evaluation and model development of productivity, safety, quality and materials handling in construction operations. Principal methods for analysis and pre-planning of work activities, including the use of work sampling, questionnaires, and surveys. The implementation of video/timelapse photography in field studies, and the incorporation of crew balances, flow diagrams, process charts, and five-minute ratings for task measurements. The introduction of task analysis, including queuing theory, to the modeling and analysis of construction operations. Introduction to construction simu-

lation. Field implementation and projects. *Prerequisite: degree in civil engineering or adviser's consent.*

**CE 830 Information Systems in Project Management** 2%:0:0:3

Development of a strong understanding of contemporary tools for managing the vast array of information in the project life cycle. Information handling is reviewed both from the perspective of knowledge acquisition and knowledge representation. Information analysis as qualitative and quantitative. Interpretation of knowledge as deterministic versus stochastic. Introduction to decision making under risk. The implementation of spreadsheets, databases and expert systems as information systems communication tools for project information handling. A review of technologies such as CAD databases, geographic information systems, decision support systems and videogrammetry as tools for project automation. *Prerequisite: degree in civil engineering or adviser's consent.*

**CE 831 Engineering for Construction I: Methods and Technologies** 2%:0:0:3

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 as well as 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. *Prerequisite: degree in civil engineering, or adviser's consent.*

**CE 832 Engineering for Construction II: Design** 2%:0:0:3

In-depth analysis of design methods for construction operations. Earth pressure analysis and structural analysis. Design for sheet pile walls, cofferdams, underpinning systems, tieback systems and pipejacking systems. Details of a dewatering system design. Special studies in constructability and value engineering. *Prerequisite: CE 831 or instructor's permission.*

**HIGHWAY CONSTRUCTION, MATERIALS AND ENGINEERING****CE 796 Pavement Design and Analysis** 2%:0:0:3

Pavement types, design factors, traffic load analysis, pavement materials, stresses in flexible and rigid pavements, economic factors, pavement strategies, and design of flexible and rigid pavements. **Also listed under TR 722.**

**CE 797 Flexible and Rigid Pavements** 2%:0:0:3

Advanced course in the design and evaluation of flexible and rigid pavements for highway and airports including the system approach, pavement condition and performance, advanced traffic load analysis, properties of subbase, base, asphaltic, and concrete courses, climate and environmental effects and design strategies. AASHTO design procedure. Selected design procedures of highways and airport pavements. **Also listed under TR 723.**

**CE 814 Advanced Pavement Technologies** 2%:0:0:3

Advanced course on evolution and innovative recent paving technologies: AASHTO road test, pavement management system, concrete block pavements, pavement recycling, geotextiles in pavements, pavement rehabilitations, bituminous materials and modern materials. **Also listed under TR 725.**

**CE 828 Risk Analysis** 2%:0:0:3

A thorough investigation of the ever-rising importance of risk analysis in project management. Analysis of qualitative and quantitative risk. Techniques in probability analysis, sensitivity analysis, simulation of risk and utility theory. Computational methods for calculating risk. An exposure to the complexity of real-world corporate and public problems through case investigations.

**GRADUATE COURSES  
GIVEN INFREQUENTLY**

- CE 598 *Special Topics in Civil Engineering I*
- CE 599 *Special Topics in Civil Engineering II*
- CE 603 *Special Topics in Structural Analysis I*
- CE 604 *Special Topics in Structural Analysis II*
- CE 605 *Plate and Shell Structures*
- CE 609 *Computer Methods of Structural Analysis*
- CE 611 *Limit Analysis of Structures*
- CE 617 *Introduction to Modern Conc of  
Structural Safety*
- CE 621 *Advance Mechanics of Materials*
- CE 626 *Applied Structural Dynamics*
- CE 632 *Piping System Analysis and Design*
- CE 645 *Fracture Mechanical-Modeling & Design*
- CE 712 *Water Resources Projects*
- CE 715 *Open Channel Hydraulics*
- CE 716 *Applied Hydraulics*
- CE 724 *Advanced Groundwater Hydraulics and  
Pollution*
- CE 725 *Water Resources Math Modeling*
- CE 726 *Computer Application in Water  
Resources*
- CE 727 *Urban Hydrology*
- CE 728 *Optimization Method in Water Resources*
- CE 735 *Special Topics in Water Resources and  
Hydraulics Engineering I*
- CE 736 *Special Topics in Water Resources and  
Hydraulics Engineering II*
- CE 780 *Analysis of Uncertainty in Civil  
Engineering*
- CE 790 *Fire Protection Engineering*
- CE 791 *Infrastructure Systems Analysis*
- CE 797 *Flexible and Rigid Pavements*
- CE 798 *Special Topics in Infrastructure Systems  
and Construction I*
- CE 799 *Special Topics in Infrastructure Systems  
and Construction II*
- CE 820 *Project Management*
- CE 860 *Special Topics in Geotechnical  
Engineering*
- CE 862 *Physical and Chemical Soil Behavior*
- CE 864 *Slope Stability and Earth Retaining  
Structure*
- CE 868 *Soil Dynamics and Seismic Refiting*
- CE 869 *Rock Mechanical and Underground  
Structure*
- CE 881 *Special Topics in Highway Engineering  
and Pavement Technology I*
- CE 882 *Special Topics in Highway Engineering  
and Pavement Technology II*

**ADDITIONAL COURSES IN  
EXEC 21 PROGRAM  
(Executive Construction  
Management Program)**

Listed for information purposes only.  
These courses are not generally available  
for students in regular MS in civil  
engineering programs.

- CE 870 *Managing and Leading in the 21<sup>st</sup>  
Century*
- CE 871 *Construction and the Law*
- CE 872 *How to Succeed in Construction*
- CE 873 *Infrastructure Financing*
- CE 874 *International Engineering and  
Construction*
- CE 875 *Project: Employer-Focused Residency*
- CE 876 *Capital Program Management/Program  
Development*
- CE 877 *Dispute Avoidance Resolution*

---

## ENVIRONMENTAL ENGINEERING AND ENVIRONMENTAL SCIENCE PROGRAMS

---

The Department of Civil and Environmental Engineering offers graduate programs in environmental engineering and environmental science leading to the following degrees with environmental designation:

- Master of Science in Environmental Engineering
- Master of Science in Environmental Science\*

*\*Pending approval by New York State*

The department also offers the following graduate programs with environmental engineering majors, but with civil engineering designation:

- Master of Science in Civil Engineering
- Doctor of Philosophy in Civil Engineering

**Programs with environmental engineering and environmental science designations are described below. Programs with civil engineering designations are described in the "Civil Engineering" section of this catalog.**

The environmental field has grown to include widespread participation of engineers, health science professionals, scientists, architects, planners, economists and social scientists. The diversity of challenges in this field involve capabili-

ties to deal with rapidly expanding knowledge bases, a need to react to changing environmental criteria, and highly interdisciplinary teams that work collaboratively. Society's sensitivity to the environment has grown strong over the last several decades and has influenced virtually every profession in the country. In this context today, environmental engineering and environmental science are broad fields that deal not only with the transformations of mass and energy in the environment as a result of human or natural activities, but also with issues of how societies perceive and respond to this process of change. The programs offered by the department are professional degrees in the first two disciplines mentioned above—i.e., engineering and its closely allied field of science—that emphasize environmental engineering and science applications.

Graduates with degrees offered by the department are employed by governmental environmental regulatory and construction agencies; consulting firms that specialize in environmental engineering and planning; industrial firms whose factories or products have an impact on the air, water or land environments; and engineering, testing and control laboratories that are engaged in research and monitoring of environmental problems. These degrees may also be attractive to science teachers who wish to broaden the scope of the courses they teach.

Graduate programs in environmental engineering and environmental science are suitable for students having undergraduate degrees in the physical, chemical or biological sciences, or any engineering field. Most courses in these programs are attended by both science and engineering students, and the course materials and faculty are highly interdisciplinary, corresponding to the practice of these environmental professions.

Requirements for the master's degree include prescribed courses and approved elective courses. A project must be completed. A thesis may be substituted for project and elective courses. The PhD requires advanced study beyond the master's level and high-level original work. A thesis must be written and defended. Computer literacy is a requirement for all areas of specialization. In some cases, an undergraduate or graduate course may be included in the program to overcome deficiencies.

Students interested in graduate programs are advised to refer to the *Graduate Student Manual* (available from the office of the Department of Civil and Environmental Engineering) for further information on degree requirements and the latest revisions of curricula and courses.

**GRADUATE PROGRAMS**

**REQUIREMENTS FOR THE MASTER OF SCIENCE**

Two programs in the environmental field are offered, in addition to the MS in civil engineering. Students pursuing the MS in environmental science typically have undergraduate or graduate preparation in the field of science. Undergraduate courses may be recommended or required by the advisor to make up the deficiencies of students' academic preparedness. The MS in environmental engineering is designed for students with an undergraduate degree in engineering. Students with an undergraduate and/or graduate degree in science with a minimum background of one year of chemistry and physics, basic courses of calculus and differential equations will be admitted to the program with a requirement of 15 credits of additional undergraduate makeup or prerequisite courses. Students should consult with department advisers to determine the expected scheduling of such courses. Transfer credit for undergraduate courses and for nonengineering graduate courses from other institutions will not normally be allowed. Individual programs will depend on the previous preparation of the student and may be approved by a department committee. Students with a bachelor's in engineering may have the requirements partially or fully waived.

**Departmental Requirements**

	<b>Units</b>
CE 996 <i>Project for the Master of Science</i>	3
	3

**Environmental Science Requirements**

CE 737 <i>Environmental Chemistry &amp; Microb. I</i>	3
CE 739 <i>Environmental Chemistry &amp; Microb. II</i>	3
CE 742 <i>Water &amp; Wastewater Treatment I</i>	3
CE 743 <i>Water &amp; Wastewater Treatment II</i>	3
CE 751 <i>Environmental Health Engineering</i>	3
CE 752 <i>Air Pollution</i>	3
CE 753 <i>Hazardous/Toxic Waste Management or</i>	
CE 770 <i>Solid Waste Management</i>	3
	21

**Approved Electives**

At least 12 units of approved graduate courses  $\frac{12}{36}$   
Minimum Total Units

**MS PROGRAM IN ENVIRONMENTAL ENGINEERING**

**Departmental Requirement**

	<b>Units</b>
CE 996 <i>Project for the Master of Science</i>	3

**Environmental Engineering Graduate Course Requirements**

CE 722 <i>Hydrology</i>	3
CE 737 <i>Environmental Chemistry &amp; Microb. I</i>	3
CE 739 <i>Environmental Chemistry &amp; Microb. II</i>	3
CE 742 <i>Water &amp; Wastewater Treatment I</i>	3
CE 743 <i>Water &amp; Wastewater Treatment II</i>	3
CE 747 <i>Analysis of Stream &amp; Estuary Pollution</i>	3
CE 753 <i>Hazardous/Toxic Waste Management</i>	3
	21

**Approved Graduate Electives**

At least 12 units of approved graduate courses  $\frac{12}{36}$   
Minimum Total Units Graduate Studies

**CERTIFICATE IN HAZARDOUS WASTE MANAGEMENT**

The certificate program is designed to provide practicing engineers and environmental professionals with current engineering practices and management techniques and also provide framework to understand and interpret environmental law applicable to hazardous waste management. Students will be required to take two core courses and three elective courses to complete the certificate requirements.

**Core Courses**

CE 753 <i>Hazardous/Toxic Waste Management</i>	
CE 754 <i>Hazardous Site Remediation</i>	

**Elective Courses**

CE 723 <i>Groundwater Hydrology &amp; Pollution Control</i>	
CE 755 <i>Environmental Toxicology</i>	
CE 756 <i>Environmental Law</i>	
CE 849 <i>Environmental Geotechnology</i>	
CE 7xx <i>Approved Special Topic Courses</i>	

**REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY**

Students with exceptional scholastic ability may pursue a doctorate in civil engineering. An applicant for a doctorate in civil engineering must hold a master's degree in civil or environmental engineering. Applicants with degrees in other fields may be admitted with deficiencies as evaluated by a departmental graduate adviser and upon approval of the department head.

All doctoral students must complete a minimum of 90 units of work beyond the bachelor's degree. Minimum requirements of formal course work (not including guided readings, seminars, projects and theses) are 48 units beyond the bachelor's degree or 24 units beyond the master's degree. Generally, at least 12 units of formal course work must be completed at Polytechnic. PhD students must select a major field and two minor fields in consultation with the advisers. Each minor consists of 9 to 15 units of approved courses.

To qualify as PhD candidates, students must pass a written and oral qualifying examination on the major and one minor. The oral examination may be waived in exceptional cases by the department head upon the recommendation of the examining committee. Generally, students take the qualifying examination within their first year of full-time course work beyond the MS degree. Students are allowed a maximum of three attempts to pass the qualifying examination.

Students must submit and orally defend dissertation proposals within one semester after the initial registration for dissertation units or before going beyond 9 dissertation units.

Registration for a minimum of 30 units of dissertation research is required. Registration should be continuous until the dissertation has been completed and accepted.



<b>GRADUATE COURSES</b>
-----------------------------

**CE 737 Environmental Chemistry and Microbiology I** 2%:0:0:3

Introduction to the chemistry and microbiology of polluted and natural waters, including applications of principles developed.

**CE 739 Environmental Chemistry and Microbiology II** 2%:0:0:3

Advanced topics in chemistry and microbiology of polluted and natural wastewater treatment.

**CE 742 Water and Wastewater Treatment I** 2%:0:0:3

Physical, chemical and biological principles involved in process design and treatment of water and wastewater. Topics include aeration, filtration, softening, chemical treatment, coagulation, flocculation, desalination, taste and odor control. *Co-requisite: CE 737.*

**CE 743 Water and Wastewater Treatment II** 2%:0:0:3

Continuation of CE 742. Topics include sedimentation, adsorption, aerobic and anaerobic biological treatment, sludge treatment and disposal. *Co-requisite: CE 739.*

**CE 745 Water and Wastewater Treatment Laboratory** 1:2:0:3

Laboratory 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. Warburg analysis of waste. *Co-requisite: CE 743.*

**CE 746 Industrial Waste Treatment** 2%:0:0:3

Sources of industrial wastewaters and their treatability by physical, chemical and biological processes. Problems and solutions involved in combining municipal and industrial waste treatment. Status of government regulations imposed on industries in prevention of water pollution.

**CE 747 Analysis of Stream and Estuary Pollution** 2%:0:0:3

Dispersal and decay of contaminants introduced into lakes, streams, estuaries and oceans. Effects of pollutants on chemical quality and ecology of receiving waters.

**CE 748 Sanitary Engineering Design** 1:2:0:3

Design of water supply and wastewater treatment systems. Topics of special interest. *Co-requisite: CE 743.*

**CE 751 Environmental Health Engineering** 2%:0:0:3

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 752 Air Pollution** 2%:0:0:3

Causes and effects of air pollution. Methods of sampling. Interpretation of data. Meteorological aspects. Methods of air pollution control.

**CE 753 Hazardous/Toxic Waste Management** 2%:0:0:3

Methods in the management of hazardous/toxic waste sites. Topics covered include health and safety, legal aspects, contamination of the environment, treatment processes, toxicology and risk assessment.

**CE 754 Hazardous/Toxic Site Management** 2%:0:0:3

Treatment and disposal technologies for hazardous waste site remediation. In-situ and ex-situ processes. Physico-chemical processes, stabilization and solidification; biological processes including aerobic and anaerobic systems for degradation and detoxification; thermal processes and incineration; storage, land disposal and containment. Remediation planning and technology selection for hazardous waste containment and clean up for typical case studies. Decision-making framework and technology selection will be a key course component. The course will also involve case studies and a class project.

**CE 755 Environmental Toxicology** 2%:0:0:3

This course stresses basic concepts essential to the understanding of the action of exogenous chemical agents on biological systems. The course will cover the 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 will be discussed. Toxicokinetics, types of toxic responses and the current experimental methods of toxicity will also be discussed.

## DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

### **CE 756 Environmental Law 2½:0:0:3**

This course presents legal principles and issues relating to environmental law. Historical perspectives and case laws will be considered. The Clean Water Act, nonpoint sources and water quality Laws, Clean Air Act and its amendments, the National Ambient Air Quality and National Environmental Policy Act will be covered in this course. The above legislation and its impact on policy and technology will also be discussed.

### **CE 758 Air Pollution Engineering Control 2½:0:0:3**

Pollutant emissions control; analysis of pollutant properties, concentrations and boundary conditions; absorptive and reactive recovery processes for moving and stationary sources; formation and removal of gaseous oxides (NO, SO, CO, etc.) and of aerosols and other particulates. *Prerequisite: adviser's consent. Also listed under CH 752.*

### **CE 767 Environmental Impact Evaluation 2½:0:0:3**

An examination of legal and technical requirements in the preparation of environmental impact evaluations. Considerations include legal and technical requirements, the procedure and the interdisciplinary nature of the analysis. Topics include overall impact evaluation, problem definition, quantification of impact, methods used in analysis, field evaluations, mitigations, hearing procedures and management. Practical examples and case studies are used.

### **CE 770 Solid Waste Management 2½:0:0:3**

Engineering aspects of solid waste collection, transport and disposal, including incineration, sanitary landfill, composting, recovery and reutilization. Economic evaluation of factors affecting selection of disposal methods.

### **CE 771-772 Special Topics in Environmental Engineering I, II** *each 2½:0:0:3*

Current topics including 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, and modeling natural waters and treatment systems. *Prerequisite: instructor's permission.*

# TRANSPORTATION PROGRAM

Polytechnic offers graduate degree programs in transportation, leading to the degrees of:

## Master of Science

- *Transportation Planning and Engineering*
- *Transportation Management*

## Doctor of Philosophy

- *Civil Engineering*  
(Subtitle: *Transportation Planning and Engineering*)

The MS degrees are practice-oriented, with a strong foundation in underlying principles and methods.

The Transportation Program is housed within the Department of Civil and Environmental Engineering, which also provides a program in highway engineering as part of the master's degree in civil engineering.

Students and continuing professionals from a variety of disciplines undertake studies in transportation that lead to careers in transportation planning and design, operations, or management. Some may choose to pursue this in a dual degree program that can also lead to a Master of Urban Planning or a Master of Public Administration at New York University.

For those focusing on planning or engineering careers, the Polytechnic transportation programs have a strong foundation in traffic engineering, transportation planning, public transportation and intelligent transportation systems (ITS). Students may structure degree programs to build on these strengths.

For those pursuing management careers, Polytechnic transportation programs have strong foundations in transportation principles, economics and finance, and transportation policy and management.

The primary goal of the academic program is to educate transportation planners, engineers and managers who are able to plan, functionally design and operate facilities and systems which satisfy the demand for both passenger and freight transportation services.

The program stresses multimodal approaches to transportation and maintains strong course offerings in:

- *Transportation Planning and Analysis*
- *Traffic Engineering*
- *Transportation Management and Facility Operations*
- *Intelligent Transportation Systems*

Students are exposed to an atmosphere that provides a meaningful integration of theoretical and practical approaches. Classroom presentations, laboratory experiences and practical problem solutions strengthen the overall education.

## GENERAL REQUIREMENTS

### ADMISSION REQUIREMENTS

To be eligible for admission as graduate students, applicants must hold at least a baccalaureate degree from an acceptable institution. Students pursuing transportation planning and engineering degrees are expected to have a background in quantitative analytical skills.

All foreign students admitted to the transportation programs are required to take an examination in English before registration. Based upon evaluation of that examination, they may be required to take one (in rare cases, two) additional courses in English as a second language for which no graduate credit is given.

### GRADE REQUIREMENTS

To earn graduate degrees or certificates, Polytechnic requires that students have 3.0 grade-point averages or better in all graduate courses and in all guided studies (readings, projects, theses, dissertations). Averages are separately computed for courses and guided studies. Transfer credits from other institutions are not included in these averages.

In addition to Polytechnic grade

requirements, the transportation programs require overall averages of B or better in all required courses taken toward all degrees. Students may not repeat a course toward any of the transportation degrees more than once.

### ANALYTIC BACKGROUND

All applicants for Master of Science degrees must show evidence of quantitative analytic ability, generally including two years of college mathematics and a college-level course in statistics. If the student has not had a statistics course, one can be taken prior to admission.

All applicants for certificate programs must meet the same entrance requirements as master of science applicants.

All PhD applicants are expected to have a solid quantitative analytic background. They must take at least one course in graduate level statistics, regression analysis or design of experiments as part of their studies.

### COMPUTER LITERACY

Students will be exposed to uses of computers and computer packages in transportation as part of the the curricula. Emphasis is on personal and micro-computers. Students will use packages in highway capacity, traffic signal timing and coordination and travel demand models in required course work. Students have access to Polytechnic's personal computer laboratories with access to the Internet.

### ADVISING

In all graduate programs, the relationship between the student and the academic adviser is important. The academic adviser assists students in selecting courses and gives guidance in all academic matters. The academic adviser maintains checks on students' progress and makes recommendations when problems arise.

Students should meet with their academic adviser prior to each registration and at any other time they need advice or consultation. The student must have a detailed program of study formally approved by the academic adviser prior

to registration. Advisers also handle requests for waivers of certain degree requirements, such as required courses. Such waivers must be approved in writing by advisers and instructors of required courses and must be entered into students' departmental files. When such waivers are granted, students may be required to take other specific courses in their place, or to select additional electives.

Students registering for any guided studies (readings, project, thesis, dissertation) are assigned project advisers for each such activity. These are generally not the same as academic advisers, depending upon the subjects being studied. To register for guided studies, students must submit written proposals of the topics to appropriate project advisers and have academic advisers' written approval.

Doctoral students are not permitted to register for a dissertation until they have passed the PhD qualifying examination.

Students studying under research fellowships are assigned research advisers, normally the principal investigators of the projects which fund the fellowships.

While academic advisers consult with and give advice to students, students must ensure that requirements are fulfilled and submit all proper forms and applications when necessary.

**REQUIREMENTS FOR THE MASTER OF SCIENCE**

MS degrees in transportation planning and engineering, and in transportation management, each require 36 units of study beyond the bachelor's degree, of which 27 must be taken at Polytechnic.

**MASTER OF SCIENCE IN TRANSPORTATION PLANNING AND ENGINEERING**

The Master of Science in transportation planning and engineering is intended for practicing engineers, and features both fundamental theoretical material and its application to solving modern problems. Many courses are organized by application, so that the student sees a variety of techniques (geometric design, controls

and operations, management, etc) applied to solve focused problems.

In traffic engineering, for example, courses are organized along facility lines: intersections, freeways and rural highways, and arterials and networks. In each case, a variety of intervention techniques is applied to optimize operational efficiency and safety.

The program also includes a strong element focusing on Intelligent Transportation Systems. This rapidly emerging field applies telecommunications and information technology to the solution of a variety of transportation functions, from route guidance systems to automated toll collection to the automated highway.

Program requirements are outlined below:

**Required Courses**

- TR 605 *Travel Demand Forecasting* 3 credits
  - TR 607 *Urban Transportation Planning & Congestion Management* 3 credits
  - TR 609 *Transportation Economics and Finance* 3 credits
  - TR 681 *Traffic Studies and Characteristics* 3 credits
  - TR 683 *Intersections: Design and Control* 3 credits
  - TR 810 *Introduction to Intelligent Transportation Systems* 3 credits
- 18 credits**

**Elective Courses**

Select a minimum of 12 credits from among transportation course listings in the catalog. Remaining electives (a maximum of 6 credits) are free electives. Adviser approval is needed for all electives. **18 credits**

**MASTER OF SCIENCE IN TRANSPORTATION MANAGEMENT**

The Master of Science in transportation management is intended for practicing professionals dealing in transportation system, agency and/or facility management. It combines basic management skills with a working knowledge of techniques and approaches to optimizing transportation system results.

A new course in Intermodal Facilities has been added to emphasize another growing applications area for transportation managers.

Program requirements are summarized below:

**Required Courses**

- TR 609 *Transportation Economics and Finance* 3 credits
  - TR 850 *Transportation Management* 3 credits
  - TR 851 *Transportation Policy* 3 credits
  - TR 852 *Public Transportation Systems and Operations* 3 credits
  - TR 855 *Intermodal Facilities: Operations and Management* 3 credits
- 15 credits**

**Elective Courses**

- From general Management MS-level courses 6 credits
- From Transportation courses 9 credits
- Free Electives 6 credits
- All electives are subject to adviser approval **21 credits**

**TRANSFER CREDITS**

The residency requirement for MS degrees is 27 units, which means that a minimum of 27 units must be taken at Polytechnic. Students may transfer up to 9 units of acceptable courses from other institutions, subject to the department's approval. Students may apply for transfer credits after they complete 12 units of appropriate graduate courses at Polytechnic. To be eligible for transfer credits, the courses in question must be relevant to the transportation program, and students must have received a B or better. Courses graded on a pass-fail basis are not considered for transfer credits unless detailed course evaluations from the instructors are provided. All transfer requests must be accompanied by an official transcript from transferring institutions. Transfer credits are not included in computing grade-point average. Validation credits by examination may not be used for any transportation degrees.

**DUAL DEGREE PROGRAM WITH NYU**

The Transportation Program at Polytechnic has a Dual Degree Program with the Robert F. Wagner Graduate School of Public Service at New York University. Students may pursue an MS (transportation planning and engineering) or an MS (transportation manage-

ment) at Polytechnic, and a Master of Urban Planning (MUP) or a Master of Public Administration (MPA) at NYU. Because of course waivers or advanced standing, where appropriate, the two degrees may be obtained with some efficiencies in total units of study and in total time for two distinct degrees.

The two institutions also have an option in which students registered in any of the cited degree programs may take one or more courses from the pool of courses offered by the two cooperating institutions. Such registration is subject to prior approval by the academic adviser for the specific degree program in which students are enrolled.

Those interested in the Dual Degree Program must apply to that program specifically, by indicating this in a letter to the Polytechnic Transportation Program or to the NYU Robert F. Wagner Graduate School of Public Service, accompanied by application forms to both institutions. To aid in program planning, students are encouraged to apply initially, rather than to convert later to the Dual Degree Program. Those already enrolled in one of the degrees cited and interested in the Dual Degree Program should consult their academic advisers.

**DOCTOR OF PHILOSOPHY DEGREE IN TRANSPORTATION PLANNING**

The PhD in civil engineering with a concentration in transportation planning and engineering requires 90 units of graduate study beyond the bachelor's degree. The 90 units are made up of the following:

1. A 30-unit major in transportation including all courses required for the MS degree in transportation planning and engineering.
2. Two 15-unit minors in related areas, one of which is generally in quantitative methods. The second often focuses on a specific transportation area, such as transportation facility design, transportation management, or transportation infrastructure. The minors should support the dissertation topic.

3. A 30-unit dissertation, which must be an original piece of research that meaningfully advances an area of transportation study.

It must be stressed that these are minimum requirements. Many students, particularly those entering with advanced degrees in other fields, may require additional courses to support their dissertation development and to aid successful completion of the PhD qualifying examination. Applicants to the PhD program are urged to make appointments with PhD program academic advisers for individual consultations and recommendations.

Before being permitted to register for dissertation units, candidates must pass a comprehensive PhD qualifying examination. Given once a year, usually in June, it consists of written and oral portions. Copies of previous examinations are available on request from the Program Office to aid students in preparation for this examination.

Students normally take the qualifying examination after their first year of full-time course work (or their part-time equivalent) is completed. All students who wish to take the examination are permitted to do so once they have discussed their interest with the academic adviser. Subsequent attempts are at the discretion of the department; in no case are more than three attempts permitted.

There is no foreign language requirement.

The residency requirement for the PhD is 30 units, which must include the dissertation. Candidates are therefore only required to complete their dissertations at Polytechnic to earn a degree. Any and all graduate courses taken at other approved institutions which are appropriate for either majors or minors may be transferred, provided they are of graduate level and that grades of B or better were achieved.

In support of dissertation research, a doctoral committee is formed to advise each student. Because of the interdisciplinary nature of transportation research, advisory committees often include faculty members from other departments. Outside committee members with suitable backgrounds are permitted, from other universities or from industry.

Once students register for dissertation units, they must meet several requirements. Dissertation registration must be

continuous (excluding summers) until work is completed. Leaves of absence must be formally requested from the graduate office. Students must submit and orally defend dissertation proposals before registering for a second full-time semester of dissertation work, or before going beyond 9 units of combined full-time/part-time dissertation study. At the end of each semester of registration, students must submit written progress reports to their dissertation advisers. Upon completion, dissertations must be presented and orally defended before the faculty.

**CERTIFICATE PROGRAMS**

The Transportation Program offers graduate certificates to students completing 15 units in concentrated subareas of transportation planning, engineering or management. Certificate programs are geared to students who do not wish to commit themselves to full advanced degree programs. These may be students with bachelor's degrees who wish to specialize in other aspects of transportation, or those already holding advanced degrees who wish to develop additional specialties and receive formal certification for it. Students who enroll in certificate programs may apply for transfer to degree programs without loss of credits, assuming they are admitted to degree studies and that the courses taken are appropriate to the degree.

The Transportation Program offers the following certificates:

**Certificate Program in Traffic Engineering**

**Required Courses**

TR 681	<i>Traffic Studies and Characteristics</i>	3 credits
TR 682	<i>Freeways and Rural Highways: Design, Operations, and Management</i>	3 credits
TR 683	<i>Intersections: Design and Control</i>	3 credits
TR 684	<i>Arterials and Networks: Design, Operations and Management</i>	3 credits
TR 810	<i>Introduction to Intelligent Transportation Systems</i>	3 credits

**15 credits**

### Certificate Program in Transportation Planning

**Required Courses:**

TR 605	<i>Travel Demand Forecasting</i>	3 credits
TR 607	<i>Urban Transportation Planning and Congestion Management</i>	3 credits
TR 609	<i>Transportation Economics and Finance</i>	3 credits

**Select Two from Among:**

TR 701	<i>Public Transportation Systems and Operations</i>	3 credits
TR 810	<i>Introduction to Intelligent Transportation Systems</i>	3 credits
TR 851	<i>Transportation Policy</i>	3 credits
TR 920	<i>Transportation Analysis Methods</i>	3 credits
TR 921	<i>Traffic Assignment Models and Methods</i>	3 credits

**15 credits**

### Certificate Program in Transportation Management and Economics

**Required Courses**

TR 609	<i>Transportation Economics and Finance</i>	3 credits
TR 701	<i>Public Transportation Systems and Operations</i>	3 credits
TR 850	<i>Transportation Management</i>	3 credits
TR 851	<i>Transportation Policy</i>	3 credits
MG xxx	<i>Basic Management Course*</i>	3 credits

**15 credits**

### Certificate Program in Intelligent Transportation Systems

*(Pending approval by NYSED)*

**Required Courses**

TR 810	<i>Introduction to Intelligent Transportation Systems</i>	3 credits
TR 811	<i>Intelligent Transportation Systems: System Architecture</i>	3 credits
TR 813	<i>Intelligent Transportation Systems: GIS, GPS and Communications</i>	3 credits
TR xxx	<i>Transportation Electives*</i>	6 credits

**15 credits**

*Selected Topics courses may be included in MS and certificate requirements based upon the relevancy of the material and the approval of the graduate adviser.*

*\* Requires adviser approval.*

Units earned toward certificate programs are transferable to degree programs if applicable. No course, however, may be credited toward more than one certificate program.

Course substitution in certificate programs are permitted with the written approval of the assigned academic adviser.

## UNDERGRADUATE COURSES

The program offers an undergraduate course in traffic engineering, which is required for the BS(CE) and may be used as a technical elective where approved by advisers, or as a free elective. Students with suitable undergraduate records may also take graduate transportation courses in their senior year, if approved by their advisers. Graduate students may not take undergraduate courses for credit.

**TR 360 Traffic Engineering 3:0:0:3**

Development and use of traffic engineering techniques to aid in planning, functional design and control of highway and street systems. Traffic studies, accident analysis, capacity analysis, sign and coordination, etc. Practical applications. *Prerequisite: junior status. Also listed as CE 352.*

## GRADUATE COURSES

### TRANSPORTATION PLANNING, ANALYSIS AND EVALUATION

**TR 605 Travel Demand Forecasting 2½:0:0:3**

The theory and application of travel demand forecasting methods to predict the amount and nature of travel on urban transportation systems is the subject of this course. The course covers the four-step process of urban travel demand forecasting: trip generation, trip distribution, modal split and traffic assignment modeling. Models relating land use

activity to the transportation system will also be studied. Data collection and analysis for travel demand studies and an introduction to available software packages are also included.

**TR 607 Urban Transportation Planning and Congestion Management 2½:0:0:3**

The theory and practice of urban transportation planning is the focus of this course, with a specific attention to the methods and techniques used for alleviating traffic congestion. Travel demand and transportation systems management techniques are emphasized. Application areas include travel corridors, major activity centers and residential neighborhoods. This is a "hands on" and "how to" course. *Prerequisite: TR 605 or equivalent.*

**TR 609 Transportation Economics and Finance 2½:0:0:3**

Basic principles of engineering economics and their application to transportation analysis are covered. Banking principles of present worth, sinking funds and annualized cost are treated and applied. Annual cost, present worth and rate of return analysis methodologies are developed and applied to transportation examples. Unit costs of transportation facilities are studied. Comparison of public and private sector transportation operators and agencies is undertaken with respect to such issues as profit, depreciation and return on capital. A historical review of the financing of road systems, transit systems and other modes is conducted. Other subjects include privatization, balance sheets, financial control and cash flow. Preparation of a private-venture business plan is also treated.

**TR 920 Transportation Analysis I 2½:0:0:3**

This course will focus on regression and discrete choice models and their applications in transportation engineering. The first part of the course will be devoted to regression models by introducing estimation and model testing techniques. The second part of the course will concentrate on discrete choice models. Model estimation, tests and sampling methods will be covered. The applications of these two types of models will be selected from the transportation

demand, supply and management areas. *Prerequisites: Undergraduate calculus; undergraduate statistics or TR 681; or equivalents.*

**TR 921 Transportation Analysis II: Traffic Assignment Models and Methods** 2%:0:0:3

This course will introduce the formulation of traffic assignment (TA) models and practice the related functions provided in commonly used software packages. The first part of the course will include introduction to the traffic assignment problem, optimization methods and their formulation and application to the traffic assignment problem. Based on the mathematical structure of TA solutions, hands-on experience using case studies will be provided. *Prerequisite: TR 605 or equivalent.*

**TRAFFIC ENGINEERING**

**TR 681 Traffic Studies and Characteristics** 2%:0:0:3

This course focuses on the characteristics of traffic flow and their quantification and analysis through field studies of various sorts. Parametric measures—speed, flow, density, headway, spacing, etc—will be defined and illustrated. Uninterrupted and interrupted flow characteristics will be compared and discussed, including historic trends. Basic study methodologies for traffic volumes, speeds, travel times, parking and accidents will be treated. Statistical analysis and manipulation of field data will be treated in detail.

**TR 682 Freeways and Rural Highways: Design, Operation and Management** 2%:0:0:3

This course presents an integrated treatment of freeway and rural highway facilities. Beginning with the functional classification of such highways and their use, the course presents an overview of issues from geometric design and characteristics through capacity and level of service analyses to modern management techniques and systems applied to freeways and rural highways. Various aspects of signing and marking for freeways and rural highways are discussed and illustrated. *Pre-requisite: TR 681 or equivalent.*

**TR 683 Intersections: Design and Control** 2%:0:0:3

This course presents an integrated overview of design and control issues surrounding at-grade intersections within a surface network of streets and arterials. Options for intersection control are discussed and guidelines for making decisions are presented. Sight distance and warrant studies are detailed. Deployment of signs and markings at intersections is treated. Signalization of isolated intersections and signal timing are treated in detail. Actuated signal installation and timing are covered. *Co-requisite: TR 681 or equivalent.*

**TR 684 Arterials and Networks: Design, Operation and Management** 2%:0:0:3

This course focuses on the design, operation, control and management of arterials and street networks. Management and control strategies for preserving arterial function, including access management measures, curb management and other regulations, will be treated. Progressive signal systems for arterials and various network signalization strategies will be covered in detail. Tools for signal progression and network analysis will be described and illustrated, including CORSIM, PASSER and TRANSYT 7F. *Prerequisites: TR 681, TR 683 or equivalents.*

**TRANSPORTATION MANAGEMENT AND FACILITY OPERATIONS**

**TR 850 Transportation Management** 2%:0:0:3

This course provides an overview of the transportation management field. Levels of management and unique objectives of management in the transportation sector are presented and discussed. The structures of private and public transportation organizations are analyzed. Management practices are treated from the views of management within organizations, management of public resources, legislative and legal contexts in the transportation field and operational management.

**TR 851 Transportation Policy** 2%:0:0:3

Analysis of the major policies, regulations and controls established or imposed by federal, state and local governments that currently affect the transportation industry. All modes are considered and case studies are extensively used.

**TR 852 Public Transportation Systems: Planning, Operation and Management** 2%:0:0:3

This course is intended to provide a basic, yet comprehensive, understanding of the technology of modern public transportation systems and the planning, operational and management issues that are critical to such systems. Operational characteristics of various modes and the supporting elements of infrastructure needed to sustain them are treated. Critical management issues such as maintenance practices, scheduling and dispatching, street management, procurement and labor relations are broadly outlined and discussed. Planning, capital programming and policy issues are also covered.

**TR 855 Intermodal Facilities: Operations and Management** 2%:0:0:3

This course is designed to offer an introduction and overview of intermodal freight operations and planning issues to engineers, architects, planners and managers involved in the planning of intermodal facilities. The course will deal with the physical layout of freight terminals, cargo receiving and delivery operations, storage areas, loading and discharging systems and equipment requirements. The role of information systems, the impact of ITS technology for terminal traffic flow and procedures for optimal utilization of land resources through reduction of dwell time will all be covered.

**INTELLIGENT  
TRANSPORTATION SYSTEMS**

**TR 810 Introduction to Intelligent  
Transportation Systems 2%:0:0:3**

This course will give a compact introduction to Intelligent Transportation Systems (ITS) by first providing a system framework for ITS. Working within this framework, lectures will be provided for each identified subsystem component. In this course, the system components for intelligent transportation infrastructure include freeway management systems, traffic signal control systems, transit management systems, incident management systems, electronic toll collection systems, electronic fare payment systems, regional multi-modal traveler information centers, emergency response systems, rail highway grade crossing systems, commercial vehicle operations and rural ITS.

**TR 811 Intelligent Transportation  
Systems: System Architecture 2%:0:0:3**

This course introduces the concept, framework, basic subsystems and data flow provided in typical ITS architecture. Beginning with the introduction to the mission and vision of architecture, the course presents the various components of the architecture. Based on the knowledge of the architecture, the course presents various issues for using the architecture in deploying specific ITS systems. *Co-requisite: TR 810 or with instructor's permission.*

**TR 812 Intelligent Transportation  
Systems: GIS, GPS and  
Communications 2%:0:0:3**

This course introduces Geographic Information Systems (GIS), Global Position Systems (GPS) and communications applied in Intelligent Transportation Systems (ITS). The course will first focus on the fundamental concepts that serve as the foundation of GIS. The hands-on experience will be gained through laboratory and project work using the ArcView GIS package. After GIS, the course will introduce GPS

Satellite-based positioning system developed and operated by the U.S. Department of Defense widely used in the civilian community for applications ranging from navigation to GIS data acquisition. The course will introduce various communications media, technologies, architectures and options, and presents techniques to guide the students through a communication system design.

**SPECIAL TOPICS AND  
PROJECTS**

**TR 860-863 Selected Topics in  
Transportation I-IV 2%:0:0:3**

Periodic presentation of topical material of current interest. Topics such as parking and pedestrian issues, functional design of various types of facilities (terminals, ports, airports, etc), current legal and legislative issues, transportation safety and others are presented. For each offering, a specific topic or topics is specified and is shown on the student's transcript. Material presented often becomes the basis for new courses when interest in the topic proves to be continuous. *Prerequisite: Instructor's permission.*

**TR 901-902 Readings in  
Transportation I-II 3 credits each**

An individual subject is studied under the supervision of a faculty member, resulting in a written report. Subjects must supplement topics given in regular courses and the prior approval of the instructor is required before registration. *Prerequisite: Instructor's permission.*

**TR 962 Master's Project in  
Transportation Planning and  
Engineering 3 credits each**

An independent project in transportation planning and engineering leading to a comprehensive report demonstrating professional competence. Reports must be orally defended and submitted in acceptable written (unbound) form. *Prerequisite: Adviser's approval and degree status.*

**TR 963 Master's Internship in  
Transportation 3 credits each**

Internships with relevant transportation organizations leading to a report demonstrating the student's professional competence. Reports must be orally defended and submitted in acceptable written (unbound) form. *Prerequisite: Adviser's approval and degree status.*

**TR 966 Master's Project in  
Transportation Management 3 credits each**

An independent project in transportation management leading to a comprehensive report demonstrating professional competence. Reports must be orally defended and submitted in acceptable written (unbound) form. *Prerequisite: Adviser's approval and degree status.*

**TR 999 Dissertation for the  
Degree of Doctor of Philosophy 3 credits each**

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 are required to take an oral examination on the subject of the dissertation and related topics and must submit a formally bound written document. *Prerequisites: degree status, passage of qualifying examination, adviser's approval.*



# DEPARTMENT OF COMPUTER AND INFORMATION SCIENCE

*Head:* Stuart Steele

Computers are now used in practically every area of human endeavor, and are radically changing both the way we live our lives and our notions of the limits of human capabilities. Job opportunities in computer and information science 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.

Polytechnic's Department of Computer and Information Science offers programs of studies leading to the BS, MS and PhD in computer science, the BS in information management, the MS in distributed information systems engineering and joint programs with the Department of Electrical Engineering leading to the BS in computer engineering, and the MS in telecommunication networks. The department also offers an Advanced Certificate in software engineering.

The faculty of the Department of Computer and Information Science is involved in research at the frontiers of many key areas of computer science; for example, the development of techniques for the design and management of long distance communication networks, such as telephone and computer networks; the development of tools to insure that complex, critical software functions correctly without potentially devastating errors; the development of methods for the analysis and transmission of document images, e.g., bank checks; the development of new data formats for storing and accessing huge amounts of scientific data gathered daily from NASA's satellites; the use of computer science techniques to predict protein structure; and the development of techniques for large parallel and distributed computer systems that will supply the computing power necessary for the future's scientific challenges.

The faculty also work closely with the CATT (Center for Advanced Technology in Telecommunications) and

the CALC (Center for Applied Large-Scale Computing) at Polytechnic. These centers, with large external funding, support research and activity in their areas of special interest.

Students in the Department of Computer and Information Science have access to a wide variety of computer and software systems. These support PC and UNIX technology along with highly distributed networks. Various software engineering environments exist in the development of modern software applications. In addition, there is a state-of-the-art database laboratory and a parallel and distributed systems undergraduate laboratory available for student use. Multimedia and Web-based laboratories are also available.

## UNDERGRADUATE PROGRAMS

### COMPUTER SCIENCE

The undergraduate program in computer science is accredited by the Computer Science Accreditation Commission (CSAC) of the Computing Sciences Accreditation Board (CSAB), a specialized accrediting body recognized by the Council on Postsecondary Accreditation (COPA) and the U.S. Department of Education. The program in computer science offers a curriculum that prepares students for a professional career as computer scientists or graduate studies in computer science leading to research or teaching careers. The undergraduate program in computer science is offered on the Brooklyn and Farmingdale campuses.

The program in information management provides students with the educational background and skills to qualify for entry-level positions in the business world. Unlike computer science, where mathematics, science, and software development are emphasized, information management is business oriented. This program is offered on the Farmingdale campus.

### COMPUTER ENGINEERING

The computer engineering curriculum provides the fundamental knowledge and techniques that graduates will need to be competent in the design of computer systems. A computer engineer will be equally comfortable working with computer hardware and software. The computer engineering program is accredited by the Accreditation Board for Engineering and Technology (ABET).

The undergraduate program in computer engineering is administered by the Department of Electrical Engineering. See that department in this catalog for information.

### INFORMATION MANAGEMENT

The Information Management Program is an interdisciplinary course of study administered by the Department of Computer Science, in conjunction with the Department of Management. The program deals with the design, operation and maintenance of systems that serve the information needs of business and manufacturing organizations.

## GRADUATE PROGRAMS

The Department of Computer and Information Science offers MS and PhD degree programs in computer science, an MS degree program in information systems engineering, a joint program with the Department of Electrical Engineering leading to an MS in telecommunication networks, and an advanced certificate in software engineering.

The computer science MS program is intended to develop competence in a broad range of fundamental areas, including data structures and algorithms, programming languages, compilers, architecture, operating systems and artificial intelligence. This degree is offered on all three campuses.

The PhD program in computer science is intended to develop competence in a broad range of areas as well as expertise in one or more specific areas as well as critical thinking ability and the ability to 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.

The MS program in telecommunication networks prepares graduates for a professional career in the design, management and operation of telecommunication networks. This program includes a wide variety of courses ranging from fundamental topics to recent technological advances in the field of telecommunication networks.

The program in information systems engineering is intended to provide education for industry people faced with the challenges and opportunities of integrating computers and communication systems. This program combines courses from electrical engineering, computer science, social science and management. This program is offered on the Westchester campus.

The advanced certificate in software engineering consists of a series of five graduate-level courses designed to give students the knowledge and skills they need to compete successfully in the software development arena. The courses in this program can also be applied to the MS in computer science for students who desire to continue further in their studies.

## FACULTY

### PROFESSORS

**Ivan T. Frisch**, Professor of Electrical Engineering and Computer Science and Executive Vice President and Provost  
PhD, Columbia University  
*Information systems, computer networks and network control*

**Aaron Kershenbaum**, Professor of Computer Science  
PhD, Polytechnic Institute of Brooklyn  
*Algorithms, telecommunications network design*

**Paul F. Pickel**, Professor of Computer Science  
PhD, Rice University  
*Mathematical programming, computer graphics, artificial intelligence*

**Richard Van Slyke**, Professor of Electrical Engineering and Computer Science  
PhD, University of California at Berkeley  
*Combinatorial optimization, information network design, algorithms*

### ASSOCIATE PROFESSORS

**Boris Aronov**, Associate Professor of Computer Science  
PhD, New York University  
*Algorithms, computational and combinatorial geometry*

**Phyllis G. Frankl**, Associate Professor of Computer Science  
PhD, New York University  
*Software testing and analysis*

**Lisa Hellerstein**, Associate Professor of Computer Science  
PhD, University of California at Berkeley  
*Computational learning, complexity theory*

**Nasir Memon**, Associate Professor in Computer Science  
PhD, University of Nebraska  
*Pulse compression, computer security, image processing*

**Vassilis J. Tsotras**, Associate Professor of Electrical Engineering and Computer Science  
PhD, Columbia University  
*Database systems, access methods, parallel databases, computer networks*

**Joel Wein**, Associate Professor of Computer Science  
PhD, Massachusetts Institute of Technology  
*Parallel and distributed computation, combinatorial optimization, scheduling theory, algorithms, network optimization*

**Edward K. Wong**, Associate Professor of Computer Science  
PhD, Purdue University  
*Computer vision, image analysis, pattern recognition*

### ASSISTANT PROFESSORS

**Yi-Jen Chiang**, Assistant Professor of Computer Science  
PhD, Brown University  
*Computer graphics, computer algorithms*

**Alex Delis**, Assistant Professor of Computer Science  
PhD, University of Maryland at College Park  
*Database management systems, analysis of systems, and software engineering*

**Torsten Suel**, Assistant Professor in Computer Science  
PhD, University of Texas  
*Database, parallel computation, algorithms*

### INDUSTRY FACULTY

**Ifay Chang**, Industry Professor of Computer Science; Executive Director of Polytechnic Research Institute for Development and Enterprise  
PhD, University of Rhode Island  
*Information system development and applications, Internet technologies and applications, distance teaching and learning*

**David R. Doucette**, Industry Professor of Computer Science  
PhD, Polytechnic Institute of Brooklyn  
*Systems integration, software engineering, operating systems*

**Robert J. Flynn**, Industry Professor of Computer Science  
PhD, Polytechnic Institute of Brooklyn  
*Computer architecture, operating systems*

**Linda Anne Grieco**, Industry Associate Professor  
PhD, Rutgers University  
*Programming and computer software*

**Haldun Hadimioglu**, Industry Associate Professor of Electrical Engineering and Computer Science  
PhD, Polytechnic University  
*Computer architecture, high-performance systems*

**Barry Jones**, Industry Associate Professor of Electrical Engineering and Computer Science  
MS, Marist College  
*Electromechanical systems, real-time computer systems*

**Stuart Steele**, Industry Professor of Computer Science and Department Head  
PhD, Pennsylvania State University  
*Software engineering and management, programming languages, real-time systems*

**Fred Strauss**, Industry Associate Professor of Computer Science  
MS, Polytechnic University

#### RESEARCH FACULTY

**Gad M. Landau**, Research Professor of Computer Science  
PhD, Tel-Aviv University (Israel)  
*Algorithms, string matching, computational biology, pattern recognition, communication networks*

#### INSTRUCTORS

**Ronald Feddersen**, Instructor in Computer Science  
MS, Polytechnic University

**Evan Gallagher**, Instructor in Computer Science  
MS, New York University  
*Computer architecture, high performance systems*

**Eamon Howley**, Instructor in Computer Science  
BS, State University of New York at Binghamton

**Tak Ip Cheung**, Instructor in Computer Science  
MS, Polytechnic University

**Cira Morgillio**, Instructor in Computer Science  
MS, Polytechnic University

#### ADJUNCT FACULTY

**Hamid Ahmadi**, Adjunct Professor  
PhD, Columbia University

**Kenneth R. Aupperle**, Lecturer  
MS, Polytechnic Institute of New York

**Maurice Karnaugh**,  
PhD, Yale University

**Edward Lancevich**, Adjunct Professor  
PhD, Polytechnic Institute of New York

**Clifford Marshall**, Adjunct Professor  
PhD, Columbia University

**Charles Palmer**, Adjunct Associate Professor  
PhD, Polytechnic University

**Dinesh Verma**, Adjunct Assistant Professor  
PhD, University of California at Berkeley

#### EMERITUS FACULTY

**Arthur E. Laemmel**,  
Professor of Electrical Engineering and Computer Science  
BEE, Polytechnic Institute of Brooklyn  
*Computer architecture, coding, digital circuits*

**James T. LaTourrette**,  
Professor of Electrical Engineering and Computer Science  
PhD, Harvard University  
*Computer languages and algorithms, computer software*

**Stanley Preiser**, Professor of Mathematics and Computer Science  
PhD, New York University  
*Numerical analysis, theory of computation, applied mathematics, software engineering*

**Henry Ruston**, Professor Emeritus of Electrical Engineering and Computer Science  
PhD, University of Michigan  
*Software engineering, programming languages*

**Martin L. Shooman**, Professor of Electrical Engineering and Computer Science  
DEE, Polytechnic Institute of Brooklyn  
*Software engineering, software, hardware and system reliability and safety*

**Edward J. Smith**, Professor Emeritus of Electrical Engineering  
DPE, Polytechnic Institute of Brooklyn  
*Computer organization, switching and automata*

---

# COMPUTER SCIENCE PROGRAM

---

Computer science (CS) is the study of the theory and practice of how to design, build and use computers. The field of study 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 and Information Science.

## UNDERGRADUATE PROGRAM

This program in computer science is accredited by the Computer Science Accreditation Commission (CSAC) of the Computing Sciences Accreditation Board (CSAB), a specialized accrediting body recognized by the Council on Postsecondary Accreditation (COPA) and the U.S. Department of Education. The program in computer science offers a curriculum that prepares students for a professional career as computer scientists or graduate studies in computer science leading to research or teaching careers. The undergraduate program in computer science at Polytechnic is based on the principle that a well-rounded graduate should have a rigorous education in the fundamentals of computer science, including significant exposure to the design and operation of computers, solid training in related mathematics and scientific disciplines, and a broad general education including the development of communications skills.

## OVERVIEW OF THE UNDERGRADUATE CURRICULUM

Our curriculum addresses (1) the core/common knowledge that should be required of all CS graduates and (2) a set of other important topics in CS that one can choose to study depending on individual interests and career goals. For the required computer science core, courses are chosen in the following six areas: theoretical foundations of computer science, algorithms, data structures, software design, the concepts of programming languages, and computer elements and architecture. For the computer science elective courses, we offer a wide range of advanced topics, including java programming, parallel and distributed processing, database systems design, computer graphics and uniprogramming.

Our program allows students to get a balanced education in the three processes of computing discipline: theory, abstraction and design/skill. Theory provides the underlying mathematical or scientific principles that apply to the discipline of computing. In the abstraction process, we develop models for potential algorithms, data structures, architectures and so forth. In the design process, we engage in the development of a computer system or software, using the necessary computer skills (e.g., proficiency in a particular programming language or database package).

Undergraduates in computer science at Polytechnic University have the advantage of being in a department with a strong graduate division. This means that the undergraduate students study in a rich intellectual environment where many of their instructors are engaged in state-of-the-art research. This significantly contributes to the quality of education and provides highly motivated undergraduates with the opportunity to engage in advanced projects with first-rate researchers. Computer science is not considered to be an engineering discipline, and we are not obligated to follow the core curriculum. However, we support the goals of the common freshman year and have designed a set of CS requirements that are compatible with

the common freshman year in the core. This makes it easier for freshmen who are undecided about their majors to switch in or out of CS in their later years.

For further details and descriptions of the core program and the courses that compose the core, see the section of this catalog entitled "University Degree Requirements."

## The Computer Science Component (45 credits)

One of the distinctive features of the computer science component is the balance of emphasis on subjects related to the design of computers and theoretical computer science. For example, students study switching and digital systems, computer organization and architecture, as well as data structures, software development, database systems, operating systems, C++ and object oriented technologies, advanced algorithms and the principles of programming languages. The department believes that this balance of emphasis is important in preparing graduates for a professional or research career.

Students entering Polytechnic have different levels of computer experience so the Department of Computer and Information Science has established two different levels of the introductory CS 200 course (Introduction to Programming Methodology): inexperienced and experienced. The experienced level is designed for students who already know some of the basics, such as keyboards, simple prompts, input/output, variables and simple loops, and therefore would be bored if these were covered slowly. The inexperienced course will be paced for first-time users and will go more slowly through the basic material.

Computer science is an ever changing field, so we regularly offer selected topics courses in current areas of computer technology. Offering of selected topics courses is announced by the department every semester.

**The Mathematics Component***(17 credits)*

Mathematics is essential to the CS curriculum. It forms the basis for understanding computer architecture and organization, principles of programming languages, algorithms, compilers and operating systems. The mathematics sequence is designed to enhance the integration of mathematics with the computer science component. If students did not have a chance to learn high school math well (as determined by the Polytechnic placement examination in mathematics), they will be placed in a precalculus course to prepare them for the calculus sequence. The physics sequence begins in the second term of the freshman year to take advantage of their preparation in mathematics.

**Basic Science Component***(13 credits)*

Basic courses in physics and chemistry provide a well-rounded education in science. Computer scientists find that their training in basic science plays an important role in their career, by allowing them to understand the theoretical principles of new devices.

**Basic Engineering Component***(3 credits)*

Today, computers are used in all disciplines of engineering. Applications range from computer simulation of wind tunnels, to computer-aided-design (CAD) of automobile parts, to loadflow analysis of electric power circuits, etc. It is important that a computer scientist can communicate with engineers from different disciplines to understand their needs. The course EG 101 (Introduction to Engineering I) introduces computer science students to practical design experience in various disciplines of engineering.

**Humanities and Social Sciences Component***(34 credits)*

Courses in the humanities and social sciences are an important part of the curriculum. Career advancement is not only based on technical skills and knowledge, it is equally based on the ability to communicate effectively and the ability to

apply the wisdom that results from a serious study and appreciation of the humanities and social sciences. Thus, in addition to basic humanities and social sciences courses, the department requires students to take HU 347 (Ethics and Technology) and TC 110 (Professional Report Writing).

**The Technical Elective and Free Elective Components***(6 credits and 3 credits respectively)*

It is important for students to have the opportunity to explore other subject areas or to delve into areas in more depth. This is the purpose of having 6 credits of technical electives and 3 credits of free electives.

**HONORS PROGRAM**

Full-time students may apply for the BS/MS Accelerated Honors Program which leads to the simultaneous award of a bachelor's and a master's degree. Depending on the student's preparation and objectives, completion of the two degrees may come as early as the end of three and three-quarter calendar years of study, or as late as five and one-half years. But each program is individually designed in cooperation with a departmental BS/MS Accelerated Honors Program adviser to allow for varied transfer and AP credits, co-op program participation, professional summer jobs, and other goals consistent with an honors program. Possible BS/MS combinations with CS degrees include BSCS plus MSCS, BSCompE plus MSCS and BSEE plus MSCS.

To be admitted to the program, students must have outstanding qualifications. Each student who applies is individually interviewed. Students must complete 16 to 20 credits each semester, maintain technical and overall grade-point averages of 3.5 and display a record essentially free of course repetitions and withdrawals.

The required courses for the two degrees include all courses required for the individual BS and MS degrees, and all curriculum footnotes apply. Required credits are the sum of the credits for the two degrees, except that 3 technical or free elective credits are excused. Six credits of Master's Thesis are usually required, and a special 9-week full-time summer honors research project at the end of the second or third year is urged, if offered.

Acceleration may be achieved through summer course work; research participation; extra course loads; careful course sequencing; and advanced placement credit in such courses as MA 106/107 (AP Calculus BC, grade of at least 4, preferably 5); and CS 200 (AP Computer Science A, grade of 4 or 5; or AP Computer Science AB, grade of 4 or 5).

**TRANSFER STUDENTS**

Transfer students are accepted into the computer science BS program on the same basis described in the catalog under admissions. In addition, the department requires that at least 21 credits in computer science (including CS Electives) and CS 398 be taken at Polytechnic.

Graduates of technology programs may be able to fulfill the requirements for the Bachelor's in computer science in two to three-and-one-half years, depending on the scope and level of their previous education. Consult an undergraduate adviser for details.

Courses taken at other schools may or may not be granted transfer credit based on evaluation of the content and level of material covered. Periodic re-evaluation of courses at other institutions may lead to a variation in the amount of credits granted from year to year. Thus, students completing the same program, but in different years, may receive different amounts of transfer credit. Consult a computer science undergraduate adviser for current information. All computer science courses will be evaluated by the Department of Computer and Information Science. Transfer students must arrive and present their records for evaluation at least one week before the regular registration period for their first semester.

**DEPARTMENTAL STANDARDS, PROBATIONS, AND I (Incomplete) GRADE**

Computer scientists are professionals who are expected to achieve work of acceptable quality and quantity within a specified time. Similarly, Polytechnic students need to assure timely academic progress. It is this ability, the ability to work and to achieve, which is most desired by prospective employers.

To remain in good standing, computer science majors must satisfy the following requirements. These requirements are in addition to the University

requirements for a minimum term and cumulative 2.00 grade-point average in all courses.

The following requirements apply to all CS students:

1. An average of C (2.00) or greater in all CS courses.
2. A grade of C- or better in the following courses: MA 106 Calculus I, MA 107 Calculus II, CS 200 Introduction to Programming Methodology, CS 201 Data Structures and Algorithms, CS 336 Digital Logic and State Machine Design.
3. Students may repeat a course in which they earned a substandard grade, but no CS course may be taken more than 3 times (grades of W and AUDIT are not counted for the purpose of this rule).
4. A course in which a grade of I is received may not be used to satisfy any prerequisites until the incomplete is resolved. See "Policies on Grading and Grades for the University" in 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 CS program and courses. If students have any questions, they should feel free to discuss them with an adviser, and preferably in a timely fashion so that good solutions can be found to any problems that may arise.

## INFORMATION

Curricula and prerequisite changes, new courses, special sections and other last minute announcements are posted on the bulletin boards outside the Department of Computer and Information Science office in Brooklyn and in Farmingdale. Each student is responsible for keeping informed.

### List of CS Electives

CS 205	Assembly/Machine Language
CS 206	Compiler Design
CS 239	Advanced UNIX System Programming
CS 275	Theory of Computation
CS 308	Intro. to Database Systems
CS 316	Microprocessors
CS 341	Intro. to Distr. and Parall. Sys.
CS 342	Alg. for Distr. and Parall. Sys.
CS 391-4	Selected Topics in Computer Science

CS 398	Advanced Project in CS
CS 653	Interactive Computer Graphics
CS 661	Artificial Intelligence I
EL 536	Principles of Commun. Networks
EL 547	Introduction to VLSI Design
MA 358	Introductory Numerical Analysis

## THE MASTER OF SCIENCE IN COMPUTER SCIENCE

**Entrance Requirements:** For entrance into the Master of Science degree programs, an undergraduate degree in computer science, mathematics, science, or engineering, with a superior undergraduate record from an accredited institution is required. Applicants having degrees in other fields will be considered for admission on an individual basis. Generally, entering students are expected to have knowledge of mathematics through calculus.

### Additional entrance requirements are as follows:

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.

It is anticipated that 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 will satisfy the entrance requirements for the master's degree program.

Students having superior academic credentials but lacking sufficient background are admitted in conditional status pending satisfactory completion of several individually specified preparatory courses. In some cases such students will be invited to an interview to determine the necessary 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 an essential ingredient for success in pursuing 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 Polytechnic regulations published in the catalog. A maximum of 9 units may be applied to the MS degree from previous graduate work at an acceptable institution.

### Master's Degree Requirements

To satisfy the requirements for the master's degree, the student must complete a total of 36 units as described below, with an overall average of B. In addition, a B average is required in the core course group, as indicated below. The average of B is required for all graduate courses taken. Students with an exceptionally strong undergraduate computer science background may be allowed to replace required courses with more advanced electives. Permission of the graduate director is required.

### Requirements:

#### 1. Core Requirements (B average required)

CS 603	Design and Analysis of Algorithms
CS 613	Computer Architecture I
CS 623	Operating Systems I
CS 637	Programming Languages
CS 641	Compiler Design and Construction I

In certain rare circumstances, and with the approval of the graduate director, other CS or EE courses may be used to fulfill the core requirement.

#### 2. Analytical Requirement

One of the following courses:

CS 600	Fundamentals of Computer Science
CS 675	Theory of Computation

Students who can demonstrate a strong background in discrete mathematics will be encouraged to take CS 675 instead of CS 600. Under special circumstances, with permission of the graduate director, students who can demonstrate a strong background in discrete mathematics may be permitted to substitute a graduate math course for CS 675.

#### 3. Two one-year course sequences from the following list:

CS 603, CS 604:	Design and Analysis of Algorithms I and II
CS 606	and either CS 607 or CS 608: Software Engineering I and either Software Engineering II or Principles of Database Systems
CS 613, CS 614:	Computer Architecture I and II
CS 623, CS 624:	Operating Systems I and II
CS 641, CS 642:	Compiler Design and Construction I and II
CS 661	and either CS 662 or CS 664 or CS 665 or

## Curriculum for the Bachelor of Science in Computer Science

Note: Courses marked "c" require work on various computer systems. Courses marked "d" include major design/computer projects.

### FRESHMAN YEAR

#### Fall Semester

Course No.	Subject	Hours/Week				Cr.
		Class	Lab	Rec.	Cr.	
CM 101	General Chemistry I	3	0	0	2 1/2	
CM 111	General Chemistry Lab I	0	1 1/2	0	1/2	
CS 200	Intro. to Prog. Methodology	3c	0	1	3	
EG 101	Introduction to Engineering I	1	3c	1	3	
HU 101/103	Writing and Humanities I	3(6)	0	0	3	
MA 106	Calculus I	3	0	2	4	
SL 101	Freshman Seminar	1	1	0	0	
						16

#### Spring Semester

Course No.	Subject	Hours/Week				Cr.
		Class	Lab	Rec.	Cr.	
CS 201	Data Struct. and Algorithms	3c	0	1	3	
HU 200	Writing and Humanities II	3	0	0	3	
MA 107	Calculus II	3	0	2	4	
PH 107	Mechanics	3	0	1	3	
	HU/SS Elective					3
						16

### SOPHOMORE YEAR

#### Fall Semester

CS 220	Object Orientated Prog.	3d	0	0	3	
HU 118	Public Speaking	1	0	0	1	
MA 108	Diff. Equ. and Num. Methods	3	0	0	3	
PH 108	Elec., Magnetism and Fluids	3	0	1	3	
PH 118	Lab for PH 108	0	1 1/2	0	1/2	
SS 104	Contemporary World History	3	0	0	3	
	Approved Technical Elective	5			3	
						16 1/2

#### Spring Semester

HU 110	Professional Report Writing	3	0	0	3	
MA 341	Discrete Comp. Structures	3	0	0	3	
PH 109	Waves, Optics, and Thermo.	3	0	1	3	
PH 119	Lab for PH 109	0	1 1/2	0	1/2	
CS 336	D.L. & State Mach. Design	3d	0	0	3	
	CS Elective	3	0	0	3	
						15 1/2

### JUNIOR YEAR

#### Fall Semester

CS 202	Advanced Algorithms	3c	0	0	3	
MG 310	Proj. Plan. & Qual. Mgmt. or Approved Mgmt. Course <sup>1</sup>	3	0	0	3	
CS 337	Comp. Arch. and Org.	3d	0	0	3	
MA 222	Intro. to Prob. and Statistics	3	0	0	3	
	SS Elective <sup>2</sup>	3	0	0	3	
						15

#### Spring Semester

CS 306	Software Engineering	3d	0	0	3	
CS 312	Programming Languages	3	0	0	3	
HU 347	Ethics and Technology	3	0	0	3	
	CS Elective	3	0	0	3	
	Approved Technical Elective <sup>3</sup>				3	
						15

### SENIOR YEAR

#### Fall Semester

CS 238	Operating Systems	3d	0	0	3	
	HU/SS Elective <sup>4</sup>	3	0	0	3	
	SS Elective <sup>5</sup>	3	0	0	3	
	CS Elective	3	0	0	3	
	Free Elective	3	0	0	3	
						15

#### Spring Semester

CS 398	Advanced Project in CS	d			3	
	HU Elective <sup>6</sup>	3	0	0	3	
	CS Elective	3	0	0	3	
	CS Elective	3	0	0	3	
	HU/SS Elective	3	0	0	3	
						15

Total credits required for graduation:

124

#### Remarks:

- MA 222 may be replaced with MA 223 (Intro to Probability) AND MA 224 (Intro to Math. Statistics); the extra 3 credits may be used to satisfy the approved technical electives or the free electives requirement.
- For students who follow the core curriculum in their freshman year, EG 102 may be used to satisfy the approved technical electives or the free electives requirements, and CM 102/CM 112 may be used to satisfy the free electives requirements.
- The HU/SS electives must be non-skill courses, except for HU 116, which may be used as an HU elective. Of the required SS electives, at least one must be other than SS 184, SS 189, or SS 250.
- CS 653, CS 661, EL 536 and EL 547 are senior/first-year-graduate level courses.
- The approved technical electives are technical courses approved by the department. In general, a course offered by the math, management, or an

engineering department is an approved elective, provided it contains enough technical (or management) content that does not duplicate materials studied in other courses. The free electives are courses offered by any department, provided they do not duplicate materials studied in other courses.

- Specific information about HU/SS electives, approved technical electives and free electives are updated and published periodically by the CIS department.
- Advanced Projects in CIS are supervised large projects in a specialized area of CS. This course may be repeated one time for credits. Details on the offering of these projects are published by the department periodically.
- With departmental approval, certain other selected CS courses may also be used as CS electives. Approval will depend on the course content.
- Approved management courses include MG 300, MG 301 and MG 305.

## DEPARTMENT OF COMPUTER AND INFORMATION SCIENCE

CS 667: Artificial Intelligence I and either Artificial Intelligence II or Vision and Scene Analysis or Expert Systems and Knowledge Engineering or Neural Network Computing  
EL 536, EL 537: Principles of Communication Networks and Protocols for LAN

In certain circumstances, and with the approval of the graduate director, other course sequences may be used to fulfill this requirement.

### 4. Approved elective courses, of which a maximum of 6 units may be a thesis.

**Thesis** - Exceptional students may elect to write a master's thesis, for which no more than 6 units may be earned toward the degree. Such students should find an appropriate adviser who has agreed to monitor the thesis research. Such research need not be original, but should adequately demonstrate the student's proficiency in the subject material. An oral defense of the master's thesis with at least three professors in attendance is required.

### **THE DOCTORAL DEGREE IN COMPUTER SCIENCE:**

Graduate students who have exhibited a high degree of scholastic proficiency and given evidence of ability for independent scholarly work may consider extending their goals toward the degree of doctor of philosophy.

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 include GRE general exam scores, 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 Three Parts:**

- A) Courses and qualifying exams;
- B) Selection of an adviser, survey of research area and oral presentation of survey paper;
- C) Preparation and defense of a scholarly dissertation which embodies an original research contribution.

In order to maintain PhD candidacy reasonable progress must be made, including taking and passing the qualifying exam in a timely manner.

### **A) Courses and Qualifying Exam Courses**

A minimum of 90 units of graduate work beyond the BS, including at least 24 units of dissertation and at least 60 units of course work is required for the PhD.

Qualitative rather than quantitative considerations will determine the final approval of the program of graduate study; however, the following should be included:

- a. The basic MS requirement in computer science;
- b. A major concentration in a computer science area;
- c. A minor concentration in an area other than computer science (a minimum of four courses).

Requirements b and c must be approved by the Department of Computer and Information Science.

### **Qualifying exam:**

The qualifying exam is given once a year and consists of three parts:

- 1) Algorithms and theory of computation,
- 2) Architecture and operating systems,
- 3) Programming languages and compilers, and computer applications.

The exams are based on a reading list available from the department. Each section of the exam is largely, but not entirely, supported by several courses. However, the reading list of the exam, not the syllabus of the supporting courses, determines the required knowledge.

Students entering Poly with a bachelor's will normally take the exam within two years. Students entering Poly with a master's in computer science are advised to take the qualifying exams within a year from entering the PhD program.

### **B) Choosing an adviser and the formation of a committee**

After passing the qualifying exam, students should begin preparing to conduct thesis research. The first step is choosing an adviser and agreeing on a research area. In a second step a faculty commit-

tee, chosen by the head of the program, will be formed.

To develop depth of knowledge in a specific area and to demonstrate written and oral communication skills, each PhD student must write a survey paper and give an oral presentation to the committee. The committee will judge the paper based on the writing, the content, the critical thinking exhibited, the oral presentation and the student's ability to answer questions in the area surveyed. The topic of the survey paper will be chosen in consultation with the adviser, who will also instruct the student about the format and acceptable content of the survey paper. The paper should be completed within one year of finishing the qualifying exams. In order for the student to be able to complete the survey paper requirement in a timely manner, students whose spoken or written English language skills are deficient are required to remedy these deficiencies as soon as possible. One way to do this is by taking ESL and/or public speaking courses offered by the Department of Humanities and Social Sciences.

### **C) Dissertation**

The third and most substantial aspect of the PhD program is the thesis. The thesis 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 and committee. It is strongly recommended that at least one paper on the research be submitted to a refereed archival journal. When the adviser determines that sufficiently significant research results have been obtained and that the thesis has been written in an acceptable way, a thesis defense, consisting of an oral presentation by the candidate and questions by the committee, will be scheduled. Additional requirements for the PhD thesis are available from the office of the Dean of Graduate Studies.

## **GRADUATE CERTIFICATE IN SOFTWARE ENGINEERING**

### **Description**

In response to the tremendous growth of the software development industry, Polytechnic University has introduced a



new certificate program in software engineering. This course module will give students the knowledge and skills needed to compete successfully in this arena. Topics that are 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 are designed to equip the computer science professional for an advanced software development career. In addition, students choose two other courses from a variety of electives which are offered on a rotating basis. The Elective courses cover areas of current interest to the software engineering community, and allow students to customize their education.

### **Course Requirements for the Software Engineering Certificate (15 credits)**

#### **CORE COURSES - 9 credits**

CS 606	Software Engineering I
CS 607	Software Engineering II- Advanced Project
CS 608	Principles of Database Systems

#### **ELECTIVES - 6 credits**

Electives can be chosen from the following list of courses: CS 618 Fault Tolerant Computers, CS 681 Information, Privacy, and Security, or approved selected topics courses related to software engineering.

The list below shows some recent offerings of selected topics which would qualify for this certificate:

- Software Validation, Verification and Testing
- Object-Oriented Design in C++
- Open Systems Software and Protocols
- Client Server Infrastructure in an OO Environment
- Human Factors in Computer Interface Design

Entrance requirements for the certificate program are the same as for the MS program. For students having superior academic credentials but lacking sufficient background in computer science, there are three prerequisite courses (CS 530 Introduction to Computer Science, CS 540 Data Structures and Algorithms, and CS 600 Foundations of Computer Science) which must be taken to prepare for courses in the software engineering certificate. These prerequisite courses are offered every year on all campuses.

## UNDERGRADUATE COURSES

Students are advised to consult the *Schedule of Classes* for changes in prerequisites in effect after publication of this catalog. Students may not register for any junior- or senior-level courses until all freshmen requirements are completed. 3:0:0:3 means that the course meets for 3 lecture hours, 0 laboratory hours, and 0 recitation hours each week and that a total of 3 credits (or units for graduate courses) are awarded upon successful completion of the course.

### **CS 200 Introduction to Programming Methodology 3:0:1:3**

Introduction to programming methodology, including tools, techniques, methodologies and algorithmic language. Computers and programming; the algorithmic language; pseudocode; problem solving and program structure. Compiling, running and debugging a program. Constants, variables, data types, assignments, arithmetic expressions, input and output. Top-down design and procedures. Selection and loops. Functions. Enumerated and subrange data types. Arrays, records, sets files. Recursion, searching, and sorting. *Prerequisite: None. Co-requisites: MA 105 or 106. A C- grade is required if this course is used as a prerequisite.*

### **CS 201 Data Structures and Algorithms 3:0:1:3**

Introduction to data structures. Program specification and design. Abstract data types; stacks and queues. Dynamic storage allocation. Sequential and linked implementation of stack and queues. Topics of discrete mathematics. Selecting elements from a set, searching methods, sequential and binary. Binary trees, binary search trees and general trees. Hashing. Computational complexity. Sorting algorithms, comparison of sorting techniques and analysis. *Prerequisites: CS 200 (C- required); MA 105 (preferably MA 106). Co-requisites: MA 106 (preferably MA 107). C- grade required by BSCS and BSCompE majors.*

### **CS 202 Advanced Algorithms 3:0:0:3**

The design, implementation and analysis of algorithms. Topics in discrete mathematics, big O notation, establishing and solving simple recurrence equations. Searching and Sorting. Balanced binary search trees. Hashing. Priority queues. Algorithms on Strings: Knuth Morris Pratt. Algorithms on graphs: DFS, BFS, connected components, topological sort, single-source shortest paths, all-pairs shortest paths, transitive closure, minimum spanning tree. Design paradigms: divide and conquer, dynamic programming, greedy algorithms. *Prerequisites: CS 201 (C- grade required by BSCS majors) and junior status.*

### **CS 205 Assembly Language and Systems Programming 3:0:0:3**

Internal representation of numeric and character data. 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 re-entrant code. Traps and interrupts. *Prerequisite: CS 201. (C- required.)*

### **CS 206 Compilers 3:0:0:3**

Grammars, lexical analysis, parsing theory and algorithms, intermediate languages, storage assignment, stack machines and run-time organization. A large programming project is required. *Prerequisites: CS 201 (C- required) and CS 205 (C- required). Suggested co-requisites: CS 202 and CS 312.*

### **CS 220: Object-Oriented Programming with C++ 3:0:0:3**

Basic concepts of object-oriented programming. C++ as a better C. The C++ data types, input and output. Classes, member functions and control of access. Constructors and destructors, operator overloading. Inheritance and derived classes. Polymorphism and virtual functions. The C++ I/O library. Advanced features. Applications. *Prerequisites: CS 201 (C- required).*

**CS 604 Design and Analysis of Algorithms II** 2½:0:0:3

Advanced design and analysis techniques: 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 NP-completeness and approach to finding (approximate) solutions to NP-complete problems. Selected additional topics that may vary. *Prerequisite: CS 603.*

**CS 606 Software Engineering I** 2½:0:0:3

Software development and modeling tools. Software architecture, requirements, design, validation, reliability estimation and management. Top-down, object-oriented, modular and domain-specific design. Design tools and representation techniques. Definition of various code metrics and their use in program development and screening. Specification-based and program-based testing techniques. Path testing, system testing. Error, reliability and mean-time-between failure models. Team programming and programming in the large. *Prerequisites: CS 540*

**CS 607 Software Engineering II** 2½:0:0:3

A continuation of the material begun in CS 606 with emphasis on student projects. Software management principles. Cost estimation models. Approaches to fault-tolerant software. Students will be organized into project groups and will plan and design a software system using manual and computerized development tools. Class presentations, exams and term project. *Prerequisite: CS 606.*

**CS 608 Principles of Database Systems** 2½:0:0:3

Database management system overview. Data independence and abstraction. Physical database organization, and access methods. Data models, the entity-relationship model, the network, hierarchical and relational models. Relational database design, functional dependencies and normalization. Query processing and optimization. Concurrency control and recovery. Security and integrity. Distributed and object-oriented databases. *Prerequisites: CS 308 or instructor's permission and CS 600.*

**CS 613 Computer Architecture I** 2½:0:0:3

Uniprocessor computer architectures: performance and cost, instruction set design and measurements, basic processor implementation techniques, simple pipeline techniques, memory hierarchy design and computer arithmetic. *Prerequisite: CS 580.*

**CS 614 Computer Architecture II** 2½:0:0:3

Computer architectures that exploit parallelism: pipelining, super-scalar, vector processors, overview of parallel machines and selected parallel computing topics, such as, MIMD and SIMD machines and their interconnection structures. *Prerequisite: CS 613.*

**CS 616 Microprocessors** 2½:0:0:3

Microprocessor-based high-performance systems. Advanced microprocessors. Memory management and caching techniques. Backplane techniques. Advanced I/O concepts. Multiprocessor configurations. Software impact of new architectures and organizations. RISC/CISC tradeoff. *Prerequisite: CS 613.*

**CS 618 Fault-Tolerant Computers** 2½:0:0:3

Introduces a variety of hardware and software techniques for designing and modeling fault-tolerant computers. Topics include coding techniques (Hamming, SECDED, SECCED, etc.); majority voting schemes (TMR); software redundancy (N-version programming); software recovery schemes; network reliability design and estimation. Introduces probabilistic methods for reliability modeling. 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. *Prerequisite: CS 336 or CS 580.*

**CS 623 Operating Systems I** 2½:0:0:3

Operating systems for uniprocessors: processes, mutual exclusion, job scheduling, memory, storage hierarchy, file systems and analytical modeling of computer systems. *Prerequisite: CS 590.*

**CS 624 Operating Systems II** 2½:0:0:3

Operating systems for parallel and distributed computers: concurrent programming, process synchronization, deadlocks, distributed computing, networks, distributed concurrency control and analytical modeling of computer systems. *Prerequisite: CS 623.*

**CS 627 Performance Evaluation of Computer Systems** 2½:0:0:3

Modeling and performance analysis of computer systems. Introduction to queuing network models and elements of queuing analysis. Exact and approximate analytical techniques, simulation and operation analysis. Examples in modeling multiprogramming operating systems, interactive systems and flow control in computer networks. *Prerequisite: EL 531 or MA 223 and instructor's permission.*

**CS 637 Programming Languages**  
2%:0:0:3

The structures, notations and semantics of conventional programming languages. Issues of scoping, binding, type structure and parameter passing. Abstract data types. Programming in the large. Language support for parallelism. Implementation issues. Functional, logic and object-oriented languages. *Prerequisites: CS 540.*

**CS 641 Compiler Design and Construction I**  
2%:0:0:3

Compiler organization. Lexical analysis, syntax analysis, abstract syntax trees, symbol table organization, code generation. Introduction to code optimization techniques. *Prerequisites: CS 540, CS 580 and CS 600.*

**CS 642 Compiler Design and Construction II**  
2%:0:0:3

Further considerations of syntactic analysis, semantic analysis and code optimization techniques. *Prerequisite: CS 641.*

**CS 653 Interactive Computer Graphics**  
2%:0:0:3

This course introduces students to the fundamentals of computer graphics. Topics covered include graphics software and hardware, window-to-viewport mapping, 2-D clipping, dynamic techniques, interactive techniques, 2-D and 3-D transformations, viewing transformation, 3-D rendering, 3-D clipping, Z clipping, raster graphics, space curves and surfaces, hidden line removal, etc. *Prerequisites: CS 540 and MA 153, or equivalent.*

**CS 661 Artificial Intelligence I**  
2%:0:0:3

This course introduces students to the many concepts and techniques in artificial intelligence. Topics covered include problem spaces and search, heuristic search techniques, predicate logic, game playing techniques, planning, learning, natural language processing and machine perception. *Prerequisite: CS 540.*

**CS 662 Artificial Intelligence II**  
2%:0:0:3

Further study of automation of intellectual processes. Automatic theorem proving. Expert systems. Simulation of verbal learning behavior. Learning machines, adaptive systems, robots, decision-making problems. Adequacy of existing theoretical treatments. *Prerequisite: CS 661.*

**CS 664 Computer Vision and Scene Analysis**  
2%:0:0:3

This course introduces students to the many techniques, applications and current research areas in computer vision and scene analysis. Topics include polyhedral scene analysis, early processing, image segmentation (edge detection and region growing), 2-D and 3-D geometric structure representation, 3-D object recognition, depth measurement and analysis, image motion analysis and model-based and knowledge-based vision systems. *Prerequisites: CS 540 and MA 153, or equivalents, or of instructor's permission.*

**CS 665 Expert Systems and Knowledge Engineering**  
2%:0:0:3

This course introduces students to the various techniques used in building an expert system. An introduction to the rule-based programming language OPS5 will be given, and a prototype expert system will be built using it. Topics covered include: knowledge representation methods, production systems, inference procedures, uncertainty and evidence combination, expert systems architectures and control, knowledge acquisition, programming languages for expert systems and various case studies. *Prerequisites: CS 661 and programming experience.*

**CS 667 Neural Network Computing**  
2%:0:0:3

An introduction to neural network models and their applications. 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 com-

parisons to non-neural approaches. Decision systems, nonlinear control, speech processing and vision. *Prerequisite: CS 540. Some familiarity with matrix notation and partial derivatives is recommended.*

**CS 671 Switching and Automata I**  
2%:0:0:3

Analysis and synthesis of combinational and sequential switching circuits. Boolean algebras, switching functions, minimization, single and multiple output networks, realization of functions. Finite-state sequential machines, state-transition diagrams, machine and state equivalence, incompletely specified machines, state reduction, machine realizations. *Prerequisite: CS 600.*

**CS 675 Theory of Computation**  
2%:0:0:3

Computability and decidability. Computable and primitive recursive functions. The Halting Problem. Recursively enumerable sets. Relationships between languages, grammars and machines. Solvable and unsolvable linguistic questions. *Prerequisite: CS 600 or instructor's permission.*

**CS 681 Information, Privacy and Security**  
2%:0:0:3

Introduction to security and privacy issues associated with information systems. Cost/risk tradeoffs. Technical, physical and administrative methods of providing security. Control of access through technical and physical means. Identification and authentication. Encryption, including the Data Encryption Standard (DES) and public key systems. Management of encryption systems, including key protection and distribution. Privacy legislation and technical means of providing privacy. *Prerequisite: graduate status.*

**CS 682 Network Management and Security**  
2%:0:0:3

Human aspects of network management; performance measures; classical and vendor network management systems; unified systems; OSI network management; fault and performance; configuration control; security; encryption. *Prerequisite: EL 635.*

## DEPARTMENT OF COMPUTER AND INFORMATION SCIENCE

### CS 684 Network Protocols I

2%:0:0:3

ISO syntax, addressing in Transmission Control Protocol/Internet Protocol (TCP/IP) and ISO. Address space management. Mapping of physical addresses to Internet addresses and the Address Resolution Protocol (ARP), Reverse Address Resolution Protocol (RARP) and Bootstrap Protocol (BOOTP). Fundamentals of the connectionless datagram delivery services IP and ISO IP. Comparisons with X.25 and X.75, routing protocols: Interior Gateway Protocol (IGP) and Exterior Gateway Protocol (EGP). Discussion of Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol (BGP) and Interdomain Routing Protocol (IDRP). The transport layer: ISO TP-1 through TP-3, analysis of User Datagram Protocol (UDP) and TCP. Introduction to ISO TP-4 and comparison with TCP. *Prerequisite: EL 536 (formerly EL 635).*

### CS 685 Network Protocols II

2%:0:0:3

Introduction to Multicasting, Internet Group Management Protocol (IGMP) and Multicast Backbone (MBONE), domain name services, remote login applications in TCP/IP and ISO. TELNet, VTAM and Rlogin; File Transfer and Access (FTP, TFTP, Network File System NFS); Introduction to mail handling systems (822, simple mail transfer protocol, multipurpose Internet mail extensions, X400), X500 and directory services. Introduction to Internet management (Simple Network Management Protocol and SNMP v2, management information bases, CMIP and CMOT) TCP/IP and ISO futures. *Prerequisite: CS 684.*

### CS 687 Project in Telecommunication Networks

2%:0:0:3

This course is a design course where students design, develop and test communications software. It builds on the knowledge and software skills developed in the prerequisite, Network Protocols I, where students are taught both the theory and implementation of common telecommunications protocols and perform basic experiments as part of the course work. It is expected that students will work in small groups on a project under the direction of a professor. A telecommunication networks laboratory will provide the students with basic equipment such as workstations, X-terminals, Ethernet Local Area Networks (LANs), LAN analyzers, routers and bridges. Other equipment may be added to this list based on availability and need. *Prerequisite: CS 684 and permission of instructor.*

### CS 901-912 Selected Topics in Computer Science

each 2%:0:0:3

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 in databases, performance analysis, computer simulation, human and computer interaction, cryptography with financial applications and biometric identification. (See computer science graduate mailing for detailed description of each particular offering.) *Prerequisite: specified when offered.*

### CS 941-942 Readings in Computer Science I, II

each 2%:0:0:3

Intended primarily for advanced graduate students who wish to study in a specialized area under the supervision of a faculty member. Permission of graduate director is required. Regular meetings with the adviser. Examination or term report required. *Prerequisite: regular graduate status.*

### PROJECT AND THESIS: STUDENTS MAY REGISTER AND MAY GET CREDIT FOR THESE COURSES MORE THAN ONCE.

### CS 996 Advanced Project in Computer Science

2%:0:0:3

This course permits the student to perform research in computer science with a narrow scope than a master's thesis. The acceptance of a student by a faculty adviser is required before registration. An oral examination on the project report is required. *Prerequisite: regular status.*

### CS 997 Thesis for Degree of Master of Science

3 units

Exceptional students may elect to write a master's thesis for which no more than 6 units may be earned toward the degree. Such research should adequately demonstrate the student's proficiency in the subject material. Oral thesis defense with at least three professors in attendance plus a formal, bound thesis volume are required. Thesis registration must be continuous. *Prerequisite: regular status and satisfactory grades in prescribed courses.*

### CS 999 Dissertation for Degree of Doctor of Philosophy

3 units

Original investigation of computer science problem. Must demonstrate creativity and include features of originality and utility worthy of publication in a recognized journal. Candidate must successfully defend dissertation orally. Registration of 24 units required (continuous dissertation registration required). *Prerequisite: passing of qualifying examination and approval of the Department of Computer and Information Science.*

---

# INFORMATION MANAGEMENT PROGRAM

---

*Director:* David R. Doucette

The Information Management (IM) Program is an interdisciplinary course of study administered by the Department of Computer and Information Science, in conjunction with the Department of Management. The program deals with the design, operation and maintenance of systems that serve the information needs of business and manufacturing organizations.

This degree prepares you for the world of tomorrow, where competition will require technical people to know more about business and requires managers to have real knowledge of technology. This program was designed with the needs of industry in mind, whether the opportunities are in health care systems, banking, finance or technical firms. Since this is not an engineering degree, it does not require the intensive math and science associated with that career path. It does, however, have a much firmer foundation in the technological world than a general business degree. If you are convinced, as we are, that the basis for tomorrow's growth is technology and that it will pervade business, then consider this degree, which provides the following:

- a firm knowledge of computer applications, including database structures, software engineering management, systems integration, networking and redesigning business processes to fully integrate technology.

- a foundation in management and economics, including basic principles, organizational structure and behavior, quality management, project management and control, financial principles, life cycle costing and macroeconomics.
- a broad education to prepare you for life-long growth, including required courses in history, psychology, the humanities and communications, plus electives to allow you to customize your education and acquire the technical strength to excel.
- a foundation in math and science to help you understand the physical world and to communicate effectively with technical specialists, by offering two courses each of advanced math and physics, plus two entry-level courses in engineering design.
- project management knowledge through real-world systems integration and design projects in the junior and senior years, while working on teams with experienced mentors.
- work experience through internships, summer jobs, and/or part-time employment, arranged with the help of our Office of Career Services and corporate advisers.

## UNDERGRADUATE PROGRAM

Polytechnic offers a program of study leading to the Bachelor of Science in information management. The program's objectives are to provide students with the educational background and skills to qualify for entry-level positions in the business world. Unlike computer science, where mathematics, science and software development are emphasized, information management is business oriented.

This in-depth program enables interested students to move into project leadership positions within one to five years after entering industry without additional courses. Finally, the program provides a solid foundation for the student who wishes to pursue graduate study, either in computer science or management.

## Typical Course of Study for the Bachelor of Science in Information Management

Note: Courses marked "c" require work on various computer systems. Courses marked "d" include major design/computer projects.

### FRESHMAN YEAR

#### Fall Semester

Course No.	Subject	Class	Hours/Week			Cr.
			Lab	Rec.	Cr.	
CS 200	Intro to Prog. Methodology	3c	0	1	3	
EG 101	Intro. to Engineering I	1	3c	1	3	
MA 106	Calculus I	3	0	2	4	
HU 101	Writing/Hum. I (or HU103)	3(6)	0	0	3	
SS 104	Contemporary World History	3	0	0	3	
SL 101	Freshman Seminar	1	1	0	0	
						16

#### Spring Semester

Course No.	Subject	Class	Hours/Week			Cr.
			Lab	Rec.	Cr.	
CS 201	Data Structures/Algorithms	3c	0	1	3	
EG 102	Intro. to Engineering Design <sup>1</sup>	1	3c	1	3	
MA 107	Calculus II	3	0	2	4	
HU 200	Writing and Humanities II	3	0	0	3	
PH 107	Mechanics <sup>2</sup>	3	0	1	3	
CP 101	Cooperative Ed. Seminar	1	0	0	0	
						16

### SOPHOMORE YEAR

#### Fall Semester

CS 220	Object-Oriented Prog.	3cd	0	0	3	
PH 108	Elec., Magnetism & Fluids <sup>3</sup>	3	0	1	3	
PH 118	Lab for PH108 <sup>3</sup>	0	1½	0	¾	
HU 118	Public Speaking Seminar	1	0	0	1	
SS 250	Basic Economics	3	0	0	3	
MG 300	Management Process	3	0	0	3	
	Approved Elective <sup>4</sup>				¾	
						16½

#### Spring Semester

HU 110	Professional Report Writing	3	0	0	3	
SS 254	Economic Issues	3	0	0	3	
MG 301	Organizational Behavior	3	0	0	3	
	Computer Science Elective				3	
	Approved Elective <sup>4</sup>				¾	
						15

### JUNIOR YEAR

#### Fall Semester

MA 222	Intro. to Probab. and Statistics	3	0	0	3	
MG 310	Proj. Planning & Qual. Mgmt	3	0	0	3	
	Computer Science Elective				3	
SS 189	Introduction to Psychology	3	0	0	3	
	HU Elective				3	
						15

#### Spring Semester

CS 306	Software Engineering	3d	0	0	3	
CS 381	IM Junior Project	d			3	
MG 305	Foundations of Business Sys.	3	0	0	3	
	Computer Science Elective				3	
	Approved Elective <sup>4</sup>				¾	
						15

### SENIOR YEAR

#### Fall Semester

CS 308	Intro to Database Systems	3d	0	0	3	
CS 580	Computer Architecture & Org. <sup>2½</sup>	0	0	3		
CS 382	IM Senior Project I	d			3	
	HU Elective				3	
	Approved Elective <sup>4</sup>				¾	
						15

#### Spring Semester

CS 383	IM Senior Project II	d			3½	
	Computer Science Elective				3	
	HU/SS Elective				3	
	Approved Elective <sup>4</sup>				¾	
	Free Elective <sup>5</sup>				¾	
						15½

**Total credits required for graduation:**

**124**

**Note for PE10x Physical Education - Sports and Teams (all teams):** Physical Education is not required, but all students are invited to participate in such activities as sports, weightlifting, intramural teams and extramural teams as many semesters and as many times per semester as they please.

1) **SI01 Freshman Seminar (Freshman I):** A course on the Polytechnic experience, study suggestions, clubs and sports, curricular options and other topics. Required for students who enter Polytechnic with fewer than six transfer or advanced standing credits, and recommended for all students during their first semester.

2) **Free Elective (Senior II):** A free elective is a course given by any department, provided it does not duplicate material studied in other courses. It must advance the student's education and have departmental approval.

3) **Approved Electives:** There are five non-CS elective courses which require departmental approval. At least one of them should be chosen from business, for example, SS 137, MG 866, MG 868, IE 300, IE 319, IE 380 and Software Engineering Management. A list of approved electives is available at the Department of Computer and Information Science office. Seniors may be eligible to take certain graduate courses, based upon their academic standing. Graduate numbers listed are for illustration only.

4) The requirement of EG 102 may be replaced with an approved elective, giving the degree six approved electives instead of five. Note: students can still take EG 102 as an approved elective if they wish.

5) With adviser approval, the student can substitute 7½ credits of other science courses in place of PH 107, PH 108 and PH 118.

## **REQUIREMENTS FOR THE BACHELOR OF SCIENCE IN INFORMATION MANAGEMENT**

The curriculum, requiring 124 credits, has three major components: computing; management and system analysis; and the humanities and social sciences. In addition, there are three projects plus a number of electives, allowing the student an extremely wide range of choice, and a program that can be customized to their individual interests.

### **The Computing Component (27 credits)**

This component contains a core of computer technology plus a selection of electives, allowing a student to pursue any special interests. Required courses include programming methodology, data structures and algorithms, computer architecture, software engineering and databases.

### **The Management Component (15 credits)**

This component provides the basic technology of management, including topics such as accounting principles, organizational behavior, project management and financial management. This component gives the student an appreciation for the challenges facing management, both in terms of basic principles as well as new trends such as Total Quality Management (TQM).

### **The Humanities and Social Sciences Component (31 credits)**

This component gives the student the necessary broader education and communication skills to be effective in team situations and provide the clarity of explanation that management requires. This component consists of 22 credits of core courses plus 9 credits of electives, giving program flexibility.

### **Projects (9½ credits)**

Projects allow the student to pursue specific areas of study in depth and find original solutions to problems. Students may have faculty advisers from both the Department of Computer and Information Science and the Department of Management, depending on the subject they choose.

## **STANDARDS, PROBATIONS AND I (Incomplete) GRADE**

Professionals in information management are expected to achieve work of acceptable quality and quantity within a specified time. Similarly, Polytechnic students need to assure timely academic progress. It is this ability, the ability to work and to achieve, which is most desired by prospective employers.

To remain in good standing, information management majors must satisfy the following requirements. These requirements are in addition to the University requirements for a minimum term and cumulative 2.00 grade-point average in all courses.

The following requirements apply to all information management students:

- An average of C (2.00) or better in all CS and MG courses, computed as a unified group
- A grade of C- or better in the following courses: Calculus I (MA 106), Calculus II (MA 107), Introduction to Programming Methodology (CS 200) and Data Structures and Algorithms (CS 201).

Students may repeat a course in which they earned a substandard grade, but no CS or MG course may be taken more than three times (grades of W and Audit are not counted for the purpose of this rule).

A course in which a grade of I is received may not be used to satisfy any prerequisites until the Incomplete is resolved. See "Policies on Grading and Grades" for the University in 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 IM program and related courses. If students have any questions, they should feel free to discuss them with an adviser. Preferably the student should do this in a timely fashion so that appropriate solutions can be found to any problems that may arise.

# INFORMATION SYSTEMS ENGINEERING PROGRAM

*Director:* Robert Flynn

*Administrative Director:* LaVerne Clark

The Information Systems Engineering (ISE) Executive Degree Program is designed for professionals who want to be leaders in designing, developing and running today's information systems using the latest software tools and methodologies.

The program provides rigorous training in computer science, management and electrical engineering with an emphasis on 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 in understanding machine organization, operating systems and networking. They need enabling training in software engineering, databases and groupware. They need to understand the role of middleware and the role of management.

It is important to understand not just how to design software systems but how to lead the efforts of people who will accomplish the design. The viability of solutions and understanding the associated human interface issues are not luxuries any more.

Students selected to participate in the program are experienced working professionals in computing or telecommunications with two or more years of working experience.

Polytechnic University started this Master of Science program in 1987 as a joint effort between the Department of Computer and Information Sciences and New York State's Center for Advanced Technology in Telecommunications (CATT). It is a rigorous two-year, four-semester program consisting of 13 courses and an independent project.

The program is given in an executive format; that is, classes meet every other weekend for two full days, Friday and Saturday, at Polytechnic's Westchester Graduate Center in Hawthorne, New York. Breakfast, lunch and coffee breaks are provided. All classes are videotaped with the tapes made available for viewing either at home or on campus.

An all-inclusive fee covers tuition, fees, textbooks and other educational material, meals on class days and access to videotape of classes and lectures.

## 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 the field of computing and/or telecommunications.

Applications are accepted throughout the year, but admission is for the fall semesters only. Admission is contingent on an interview with the program 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 13 courses, including two half courses totaling 36 credits plus an independent research project, which must be completed in the second year of the program. The courses constituting the curriculum appear below:

### FALL

#### First Semester

- CS 606 *Software Engineering*
- CS 613 *Computer Architecture*
- MG 690 *Management Process and Decision Making*

### SPRING

#### Second Semester

- CS 608 *Databases*
- EE 536 *Principles of Communications Networks*
- MG 691 *Leadership, Motivation and Communications*

### FALL

#### Third Semester

- CS 684 *Network Protocols*
- CS 690 *Groupware*

#### Two of the following four half semester courses:

- CS 914 *Usability Engineering*
- CS 919 *Selected Topics in Information Systems*
- MG 694 *Project Management*
- MG 695 *Economics for Business Decisions*

### SPRING

#### Fourth Semester

- CS 623 *Operating Systems*
- CS 682 *Network Management and Security*
- CS 691 *Integrated Development Environments*

*A project course CS 996 is also required for the degree. The project is typically begun after the second semester and completed at the end of the fourth semester. The project is generally conducted in cooperation with the student's employer. Its goal is to integrate the techniques and the tools of the program in ways that reward the student and the employer.*



**THE FOLLOWING COURSES  
ARE OFFERED AS PART  
OF THE INFORMATION  
SYSTEMS ENGINEERING  
PROGRAM:**

**CS 690 Groupware** 2%:0:0:3

Groupware is middleware that is designed to allow many people to work together. It often incorporates business processes with communications in order to support the policies of enterprises. In dealing with the general issue of group software, one can address the objects of collaboration and sharing. Thus, one may include here a discussion of multimedia interfaces, communications, information sharing and object technologies. *Prerequisite: regular graduate status.*

**CS 691 Integrated Development Environment** 2%:0:0:3

This course includes methodologies for systematically developing distributed and centralized information systems. Both two- and three-tier systems are discussed. Relevant standards, such as CORBA, Active X, OpenDoc and Web-based tools, may be covered. The relationship of the standards and tools to the design and the software architecture are considered. *Prerequisite: regular graduate status.*

**CS 914 Usability Engineering**  
2%:0:0:1%

The World Wide Web is both a network and a human interface. The usefulness of the interface it presents can be measured. This course presents the role of cognitive psychology in computer interface design. It combines both human factors and engineering tools in its approach to effective interface design and usability.

*For additional course descriptions, also see the sections "Computer and Information Science," "Electrical Engineering" and "Management."*

**MG 690 Management Process and Decision Making** 2%:0:0:3

Introduction to issues and concepts in organizational and administrative behavior with an emphasis on continually changing organizations in the information sectors. Management processes for flexible and innovative information businesses. The evolution of technology-intensive industries and information business organizations. The role of information technology in the growth of the modern firm. Human resource management and organization development in information-intensive firms.

**MG 691 Leadership, Motivation and Communication** 2%:0:0:3

Organizational and individual behavior. Managing technical professionals. Teams, communication and group decision making. Leadership. Conflict and negotiation. Organizational development and culture. Managing change and creating innovative environments.

# TELECOMMUNICATION NETWORKS PROGRAM

Telecommunications is a rapidly growing field. From the military communications networks of the early 1950s, telecommunications technology has evolved to find applications in almost all areas of modern society including, banking, reservation systems, office information systems, corporate networks, and the Internet and World Wide Web, among others. Recent challenges include gigabit optical networks, multimedia communications and wireless network access.

The rapid evolution of telecommunications technology demands a broad educational background including today's technological breakthroughs. Polytechnic's master's program in telecommunication networks contains a wide variety of courses ranging from fundamental topics to recent technological advances.

## REQUIREMENTS FOR THE MASTER OF SCIENCE

Admission to the Master of Science in telecommunication networks program 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 recommended. Applicants having comparable degrees in other fields will be considered for admission on an individual basis. Generally, entering students are expected to have a basic knowledge of computer fundamentals such as programming in C++, data structures and computer architecture.

Students having superior academic credentials but lacking sufficient background are admitted in conditional status pending satisfactory completion of several individually specified preparatory courses. These preparatory courses include CS 530 (Introduction to Computer Science), CS 540 (Data Structures and Algorithms) and CS 580: (Computer Architecture and Organization), however, no credit will be allowed for any of the preparatory courses towards this degree (other courses may be required). In some cases such students

will be invited to an interview to determine the necessary 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.

Admission with advanced standing is accepted in accordance with Polytechnic regulations published in this catalog. A maximum of 9 units may be applied to the MS in telecommunications networks from previous graduate work at an acceptable institution.

To satisfy the requirements for the master's degree, the student must complete a total of 36 units as described below, with an overall average of B. In addition, a B average is required in the core courses group, as indicated below. Students with an exceptionally strong telecommunications background may be allowed to replace required courses with more advanced electives. Permission of the graduate adviser is required for all courses.

### 1. Core Courses

EL 536	<i>Princ. of Commun. Networks (formerly EL 635)</i>
EL 637	<i>Local and Metrop. Area Networks</i>
CS 613	<i>Computer Architecture I, or CS 623 Operating Systems I</i>
CS 627	<i>Perform. Eval. of Computer Sysys.</i>
CS 682	<i>Network Management and Security</i>
CS 684	<i>Network Protocols I or</i>
EL 537	<i>Protocols for Local Area Networks (an other approved core elective course)</i>

21 Units

In certain rare circumstances, and with approval of the program's director, other CS and EE courses may be used to fulfill the core requirement. For students with the appropriate background, CS 627 may be replaced by EL 735 (Communications Networks I.) Students may not take both CS 684 and EL 537.

### 2. Project Requirements

#### CS 687 Project in Telecommunication Networks or EL 995 Advanced Project I

All students in the MS in Telecommunication Networks program are required to take a project course, either CS 687 or EL 995. A project adviser must be obtained and a project plan approved before registering. The project should be completed in one semester. If not, it must be completed in the next semester, and the student will have to register for 0.5 credits. After obtaining the graduate adviser's approval, a student may substitute CS 687 with a traditional EE or CS master's thesis or project, as long as it is telecommunications-related. If the thesis option is chosen, additional thesis credits will count towards the free elective courses.

3 Units

### 3. Program Elective Courses

Students are required to take two courses (not already counted towards the core requirement) from the following list of optional courses:

CS 603	<i>Design and Analysis Algorithms I</i>
CS 613	<i>Computer Architecture I</i>
CS 623	<i>Operating Systems I</i>
CS 685	<i>Network Protocols II</i>
CS 606	<i>Software Engineering I</i>
CS 608	<i>Principles of Database Systems</i>
EL 638	<i>SONET/ATM-Based Broadband Networks</i>
EL 639	<i>Wireless Communication Systems Fundamentals</i>
EL 735	<i>Communications Networks I</i>
EL 736	<i>Communications Networks II</i>
EL 737	<i>Broadband Packet Switching</i>
EL 930	<i>Wireless Information Systems Lab</i>
MG 652	<i>Telecommunications Regulation, Policy and Law</i>
MG 654	<i>Economics of Information Systems</i>

6 Units

### 4. Free Elective Courses

Any two graduate elective courses from EE or CS, approved by a program adviser.

6 Units of free electives

Total: 36 Units

# DEPARTMENT OF ELECTRICAL ENGINEERING

*Head:* David Goodman

The Department of Electrical Engineering is well known worldwide for the significant contributions that its faculty members have made and are making to science and technology. It is also known for its quality of education—its graduates occupy positions of leadership all over the world. This reputation has been confirmed periodically in surveys of members of the profession. A recent Gourman Report ranked the department 12th at the undergraduate level and 24th at the graduate level.

We offer a rare combination of excellent research, in areas such as telecommunications and electrical power, and innovative teaching programs, such as *Writing Across the Curriculum*. Furthermore, the department exhibits unparalleled attentiveness to industry needs, with the development of our Wireless Communications and Multimedia Labs.

Our main mission is to serve as first choice for studies and research in electrical engineering and to educate our students to become leaders in their chosen fields.

Our vision is to further enhance our scholarship and reputation by increasing the quality of faculty. At the same time, it is essential to keep abreast of changes in the marketplace, especially in the metropolitan area, which will help make our students leaders in their fields.

The department continues to stress those areas in which it has clearly demonstrated exceptional strength: telecommunications, wireless communications, high-speed integrated networks, computer engineering, digital and image signal processing, control, electric power, electro-optics and plasmas. Interaction among these areas and greater synergy with other departments at Polytechnic enhances our faculty and student body as a whole.

## DEGREES OFFERED BY THE DEPARTMENT OF ELECTRICAL ENGINEERING

### *Bachelor of Science\**

- Electrical Engineering
- Computer Engineering\*\*

### *Master of Science*

- Computer Engineering\*\*, \*\*\*
- Electrical Engineering
- Electrophysics
- System Engineering
- Telecommunication Networks\*\*

### *Doctor of Philosophy*

- Electrical Engineering

*BS/MS Honors Program* - There are seven options for qualified students to jointly earn two degrees following an accelerated schedule: BS/MS Electrical Engineering/Electrical Engineering; BS/MS Electrical Engineering/Computer Science; BS/MS Computer Engineering/Electrical Engineering; BS/MS Computer Engineering/Computer Science; BS/MS Electrical Engineering/Telecommunications Networks; BS/MS Computer Engineering/Telecommunication Networks.

*Dual Major EE/CompE* - 143 credit Bachelor of Science Program

*Institute of Electrical and Electronics Engineers, Inc. (IEEE)* - Professional Organization, Student Chapter *Eta Kappa Nu* - Electrical Engineering Honor Society

*\*Accredited by the Accreditation Board for Engineering and Technology (ABET).*

*\*\*Offered in conjunction with the Department of Computer and Information Science.*

*\*\*\*Pending approval by New York State.*

### *SPECIALTY LABS*

In recent years Polytechnic's electrical engineering faculty members have developed new and novel senior/graduate level laboratories. These formal lab courses consist of a combination of lectures, lab experiments and project work. They provide our students with a rich set of elective choices, opportunity to work on their senior projects with faculty researchers, valuable hands-on experience to enhance and supplement material they learn in their lecture classes, and forums to practice their oral and written communication skills. These new labs include the Multimedia Information Communications & Processing Lab (EL 514), Local Area Networks Lab (EL 537), Wireless Information Networks Lab (EL 930), Machinery Lab (EE 204/205), VLSI Lab (EE 213; EL 547; EL 590), Robotics/Control Lab (EE 214/215), and Microwave Lab (EL 970).

**The Wireless Lab**, located at both the Brooklyn and Farmingdale campuses, provides formal experiments 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** at Brooklyn is equipped with PC-based multimedia workstations, providing students with hands-on experience with the acquisition, processing and communications of voice, image and video as well as multimedia document creation.

**The Local Area Networks Lab**, located at both Brooklyn and Farmingdale, includes a set of weekly experiments using X-terminals, Ethernet LANs, routers and bridges, and associated software to conduct a variety of LAN/WAN experiments and projects.

**The VLSI activity** at both Brooklyn and Farmingdale treats Very Large-Scale Integrated circuit design, performance analysis, and circuit characterization using modern VLSI CAD tools such as VHDL. The design of MOS, CMOS,

## DEPARTMENT OF ELECTRICAL ENGINEERING

and BiCMOS logic, standard cells and gate arrays, and mixed (analog/digital) circuits are studied.

**The Machinery Lab** at Brooklyn provides projects and structured experiments on electrical machinery and power-related laboratory measurements. These include transformers, induction motors, synchronous machines, dc machines, DC/DC converters and AC/AC cycloconverters.

**The Control/Robotics Lab** at Brooklyn provides a variety of experiments and project work focusing on feedback control, data acquisition and computer control.

**The Microwave Lab** at Farmingdale treats the design, fabrication and testing of passive and active circuits and antennas using modern CAD and measurement software and hardware.

### CATT

Through the Center for Advanced Technology in Telecommunications (CATT), electrical engineering faculty and students participate in New York State designed and funded resource to industry for research, education and technology transfer in telecommunications and information systems. Pioneering research includes accomplishments in the following areas: ATM; Broadband ISDN; network bridging, design software, and reliability, packet switched network design tool, real time systems; traffic planning and capacity engineering; UNIX networks design work bench; wireless and image communications; digital filtering; image compression and pattern recognition.

## IMPORTANT PHONE NUMBERS

### Brooklyn

Graduate Office  
718/260-3590

Undergraduate Office  
718/260-3480

### Long Island

Graduate and Undergraduate Office  
516/755-4263

### Westchester

Graduate Office  
914/323-2000

### FACULTY

#### PROFESSORS

**Henry L. Bertoni**, Professor of Electrophysics  
PhD, Polytechnic Institute of Brooklyn  
*Wireless electromagnetics*

**Robert R. Boorstyn**, Professor of Electrical Engineering  
PhD, Polytechnic Institute of Brooklyn  
*Communication networks*

**Frank A. Cassara**, Professor of Electrical Engineering  
PhD, Polytechnic Institute of Brooklyn  
*Electronic circuits, wireless communication systems*

**David C. Chang**, Professor of Electrical Engineering and President  
PhD, Harvard University  
*Electromagnetics, microwave integrated circuits*

**H. Jonathan Chao**, Professor of Electrical Engineering  
PhD, Ohio State University  
*Design of VLSI chips for telecommunications*

**Ivan T. Frisch**, Professor of Electrical Engineering and Computer Science and Executive Vice President and Provost  
PhD, Columbia University  
*Information systems, computer networks, network control*

**David Goodman**, Professor of Electrical Engineering and Department Head  
PhD, Imperial College, University of London

**Szu-Ping Kuo**, Professor of Electrical Engineering and Electrophysics  
PhD, Polytechnic Institute of New York  
*Magneto-hydrodynamics*

**S. Unnikrishna Pillai**, Professor of Electrical Engineering  
PhD, University of Pennsylvania  
*Signal processing and communications*

**Leonard G. Shaw**, Professor of Electrical Engineering  
PhD, Stanford University  
*Signal processing, reliability*

**Zivan Zabar**, Professor of Electrical Engineering  
ScD, Technion (Israel)  
*Power electronics, electric drives, power systems*

#### ASSOCIATE PROFESSORS

**Nirod K. Das**, Associate Professor of Electrical Engineering  
PhD, University of Massachusetts  
*Electromagnetics, antennas, microwave integrated circuits*

**Zygmunt J. Haas**, Associate Professor of Electrical Engineering  
PhD, Stanford University  
*Wireless protocols, telecommunications*

**Ramesh Karri**, Associate Professor of Electrical Engineering  
PhD, University of California at San Diego  
*VLSI, CAD, computer engineering*

**Farshad Khorrarni**, Associate Professor of Electrical Engineering  
PhD, Ohio State University  
*Robotics, control systems*

**I-Tai Lu**, Associate Professor of Electrical Engineering  
PhD, Polytechnic Institute of New York  
*Electromagnetics, acoustics, wireless communication*

**Shivendra S. Panwar**, Associate Professor of Electrical Engineering  
PhD, University of Massachusetts  
*Communication networks*

**Malathi Veeraraghavan**, Associate Professor of Electrical Engineering  
PhD, Duke University  
*Wireless protocols, networks, telecommunications*

**Peter Voltz**, Associate Professor of Electrical Engineering  
PhD, Polytechnic Institute of New York  
*Communications and signal processing*

**Yao Wang**, Associate Professor of Electrical Engineering  
PhD, University of California at Santa Barbara  
*Image coding, pattern recognition*

#### ASSISTANT PROFESSORS

**Dariusz Czarkowski**, Assistant Professor of Electrical Engineering  
PhD, University of Florida  
*Power electronics, power quality*

**Onur Guleryuz**, Assistant Professor of Electrical Engineering  
PhD, University of Illinois at Urbana-Champaign  
*Image and video coding and processing, statistical signal models*

**Zhong-Ping Jiang**, Assistant Professor of Electrical Engineering  
PhD, Ecole des Mines de Paris  
*Control systems*

**Ivan Selesnick**, Assistant Professor of Electrical Engineering  
PhD, Rice University  
*Signal processing*

#### INDUSTRY FACULTY

**Mokhtar Boukli**, Assistant Industry Professor of Electrical Engineering  
PhD, Polytechnic University  
*Communication systems, fiber optics*

**Mohammed Kouar**, Associate Industry Professor of Electrical Engineering  
PhD, Polytechnic University  
*Electronic circuits, communication systems*

**Joel B. Snyder**, PE, Senior Industry Professor of Electrical Engineering and Computer Science  
MEE, Polytechnic Institute of Brooklyn  
*Microprocessor systems, data acquisition and transmission, signal processing*

#### ADJUNCT FACULTY

**Shalom S. Bergstein**, Lecturer  
PhD, Polytechnic Institute of Brooklyn

**Tushar Bhattacharjee**, Lecturer  
PhD, Jadavpur University (India)

**Charles Bolen**, Lecturer  
MS, Polytechnic University

**Matthew Campisi**, Lecturer  
MS, Polytechnic University

**X. K. Chen**, Adjunct Assistant Professor  
PhD, Polytechnic University

**Robert DiFazio**, Lecturer  
PhD, Polytechnic University

**Jalal Gohari**, Lecturer  
BS, City College of New York

**Robert Gordon**, Lecturer  
PhD, Polytechnic University

**Sidney Hantler**, Lecturer  
PhD, University of Michigan

**Howard Hausman**, Lecturer  
MS, Polytechnic Institute of Brooklyn

**Michael Henderson**, Lecturer  
MS, Rensselaer Polytechnic Institute

**Jun Hong**, Lecturer  
PhD, Polytechnic University

**Jehuda Ish-Shalom**, Lecturer  
PhD, Massachusetts Institute of Technology

**Parviz Kermani**, Lecturer  
PhD, University of California at Los Angeles

**Michael Knox**, Lecturer  
MS, Polytechnic University

**Symeon Papavassiliou**, Lecturer  
PhD, Polytechnic University

**Dimitrios Pendarakis**, Lecturer  
PhD, Columbia University

**George Sullivan**, Lecturer  
MS, Polytechnic University

**Fred Winter**, Lecturer  
PhD, Polytechnic University

#### EMERITUS FACULTY

**Leonard Bergstein**, Professor of Electro-Optical Sciences  
PhD, Polytechnic Institute of Brooklyn

**Leo Birenbaum**, Associate Professor of Electrical Engineering and Electrophysics  
MS, Polytechnic Institute of Brooklyn

**Donald Bolle**, Professor of Electrical Engineering and Provost Emeritus  
PhD, Purdue University  
*Guided wave propagation, nonreciprocal devices*

**Joseph J. Bongiorno Jr.**, Professor of Electrical Engineering  
DEE, Polytechnic Institute of Brooklyn  
*Multivariable feedback control systems*

**Edward S. Cassedy**, Professor of Electrical Engineering  
DrEng, Johns Hopkins University  
*Power, plasmas, energy economics*

**Bernard R. S. Cheo**, Professor of Electrical Engineering  
PhD, University of California at Berkeley

**Leopold B. Felsen**, University Professor  
DEE, Polytechnic Institute of Brooklyn  
*Propagation and diffraction, optics*

**Enrico Levi**, Professor Emeritus of Electrophysics  
DEF, Polytechnic Institute of Brooklyn

## DEPARTMENT OF ELECTRICAL ENGINEERING

**Nathan Marcuvitz**, University  
Professor Emeritus  
DEE, Polytechnic Institute of Brooklyn

**Maurice C. Newstein**, Professor of  
Electrophysics  
PhD, Massachusetts Institute of  
Technology

**Arthur A. Oliner**, Professor Emeritus  
of Electrophysics  
PhD, Cornell University

**Athanasios Papoulis**, University  
Professor  
PhD, University of Pennsylvania

**Philip E. Sarachik**, Professor of  
Electrical Engineering  
PhD, Columbia University

**Jerry Shmoys**, Professor Emeritus of  
Electrical Engineering  
PhD, New York University

**Theodor Tamir**, University Professor  
PhD, Polytechnic Institute of Brooklyn  
*Electromagnetics, electro-optics*

**Wen-Chung Wang**, Professor of  
Electrical Engineering and  
Electrophysics  
PhD, Northwestern University

**Dante C. Youla**, University Professor  
MS, New York University  
*Networks, control systems, system theory*

# COMPUTER ENGINEERING PROGRAM

The Computer Engineering Program is an interdepartmental program administered jointly by the Departments of Electrical Engineering and Computer and Information Science. The program listings for computer science, electrical engineering, electrophysics, information system engineering, systems engineering and telecommunications may also be of interest.

The mission of the Computer Engineering Program is to provide an outstanding and up-to-date education in computer systems with an emphasis on hardware and software. To achieve this goal, the department incorporates into the educational experience the latest trends in the marketplace and in technology, combining traditional disciplines of electronics, communications, control and computer programming with newer courses such as Local Area Networks; Wireless Networks; ASIC (Applications Specific Integrated Circuit) and VLSI (Very Large-Scale Integrated) Circuit Design; Image Processing; Parallel Machines; Java Programming; and Encryption.

A strong design faculty has been developed through the sponsored research programs, many of which are coordinated in our Center for Advanced Technology in Telecommunications (CATT), by faculty experienced in industrial projects, and through our Polytechnic Research Institute for Development and Enterprise (PRIDE). Joint administration of this program has fostered interdisciplinary research involving faculty from the Electrical Engineering and the Computer and Information Science Departments.

Computer-Aided Design (CAD) programs are used in many undergraduate courses to emphasize possibilities for large-scale design, corrections for nonlinearities, trade-offs, real-time simulations, etc. Also, interdepartmental projects in Photonics (Physics), in Electric Vehicles (Mechanical Engineering) and Smart Materials (Metallurgy) permit the student to apply broad technical knowledge for practical problems while providing valuable experience in team engineering.

Design is first introduced in the freshman engineering program and projects. As sophomores, CompE students are

exposed to design principles and techniques in Digital Logic and State Machine Design. Computer engineering students in their junior year take several courses with design content. Computer Architecture includes computer design fundamentals and assignments such as designing an ATM Machine or automatic bowling scorer. Computer Hardware incorporates a high level of design in both the lectures and lab. Operating Systems includes a design project where students design a small operating system. Advanced hardware design students learn how to use advanced CAD tools. Further uses of design concepts are utilized in the electronics labs. All seniors are required to do a Senior Design Project under the direction of a faculty adviser.

Polytechnic University recognizes that people are needed to design the computers, computer-controlled systems and devices that affect our everyday lives. The computer engineering curriculum provides the fundamental knowledge and techniques that graduates will need to be competent in (1) the design of computer systems and (2) the advanced use of computers. A computer engineer will be equally comfortable working with computer hardware and software.

The BS program contains a technical concentration consisting of two technical electives and a concentration laboratory/project that allows the student to develop a professional specialization. A careful selection will stimulate learning, develop depth, prepare for continuing education and attract prospective employers. Your project will be a mature piece of work, your own achievement, developed with the guidance of your adviser. You will prepare a proposal, create your design, test it, revise it, write a professional report and present your results publicly. The suggestions below are examples, and many others may be constructed with adviser approval:

- Advanced Hardware Design
- Computer Communications Networks
- Control and Robotics
- Data Communications

- Microcontroller System and Interface Design
- VLSI Design
- Advanced Computer Architecture
- Artificial Intelligence and Expert Systems
- Computer Graphics
- Digital Image Processing
- Software Design and Engineering
- Computer Electronics

The Bachelor of Science in computer engineering is accredited by the Accreditation Board for Engineering and Technology (ABET).

## Notes to BS Curriculum

Course descriptions appear in the "Electrical Engineering" and other sections of the catalog. Please obtain updates of the Curriculum and Curriculum Notes prior to each registration from your departmental advising office. These represent official corrections to this catalog.

### 1. Writing and Speech across the Curriculum

The Writing Placement Exam is required to determine the best way for you to get started. If you are placed in HU 101, you immediately take this course and continue with the following sequence each fall and spring semester without a break: SS 104, HU 200, TC 110; and you must also be sure to complete HU 118 before the senior year. Similarly, if placed in HU 103, follow with HU 200 (or SS 104), SS 104 (or HU 200), TC 110; and also take HU 118. If placed in HU 009, follow with HU 101, SS 104, HU 200, TC 110; and also take HU 118. If placed in HU 008, follow with HU 103, HU 200, SS 104, TC 110; and also take HU 118.

Writing and speech will be integrated into your grade in all courses—especially Humanities, Social Science, EG 101, EG 102, EE 192, EE 195, EE 188, EE 189, and the Senior Laboratory and Design Project courses. The Writing and Speech Center, sponsored by the Department of Humanities, is prepared to give you extra assistance by appointment; participation will not affect your grade, unless required by your instructor.

## Curriculum of Study for the Bachelor of Science in Computer Engineering

See Notes 1, 2, 3, 8.

### FRESHMAN YEAR

#### Fall Semester

Course No.	Subject	Class	Hours/Week			Cr.
			Lab	Rec.	Cr.	
HU 101	Writ. and Hum. I (or HU 103) <sup>1</sup>	3	0	0	0(3)	3
EG 101	Introduction to Engineering	1	3	1		3cd
CS 200	Prog. Method. ("C" Lang.)	3	0	1		3c
MA 106	Calculus I (Harvard Math)	3	0	1		4c
CM 101	Gen. Chem. I	2½	0	0		2½
CM 111	Gen. Chem. Lab. I (Alt Wks)	0	1½	0		½
SL 101	Freshman Seminar	1	0	1		0
PE 10x	Sports and Teams (Optional)	0	1½	0		0
						16

#### Spring Semester

Course No.	Subject	Class	Hours/Week			Cr.
			Lab	Rec.	Cr.	
SS 104*	Contemporary World History <sup>1</sup>	3	0	0		3
MA 107	Calculus II (Harvard Math)	3	0	1		4c
EG 102	Intro. to Engineering Project	1	3	1		3cd
CM 102	Gen. Chem. II	2½	0	0		2½
CM 112	Gen. Chem. Lab. II (Alt Wks)	0	1½	0		½
PH 107	Mechanics	3	0	1		3
CP 101	Intro. to Co-op. Prog. (Optional) <sup>1</sup>	0	0	0		0
PE 10x	Sports & Teams (Optional)	0	1½	0		0
						16

### SOPHOMORE YEAR

#### Fall Semester

HU 200*	Writing & the Humanities II <sup>1</sup>	3	0	0		3
EE 101	Elec. Circ. I (dc & transients)	3	0	1		3
CS 201*	Data Structures ("C" Lang.)	3	0	1		3c
MA 108	Diff. Eqns. & Num.	3	0	0		3c
PH 108	Elec., Magnetism & Fluids	3	0	1		3
PH 118	Lab. for PH 108 (Alt. Wks.)	0	1½	0		½
PE 10x	Sports & Teams (Optional)	0	1½	0		0
						15½

#### Spring Semester

TC 110	Professional Report Writing I <sup>1</sup>	3	0	0		3
EE 102	Electric Circuits II (ac)	3	0	1		3
EE 192	Soph. EE Lab. (Alt. Wks.)	½	1½	0		1c
MA 109	Multidimensional Calc.	3	0	0		3c
CS 336*	Dig. Logic & State-Mach. Des.	3	0	1		3cd
PH 109	Waves, Optics & Thermo.	3	0	1		3
PH 119	Lab for PH 109 (Alt Wks)	0	1½	0		½
PE 10x	Sports and Teams (Optional)	0	1½	0		0
						16½

### JUNIOR YEAR

#### Fall Semester

*	HU Elective OR SS Elective <sup>2</sup>	3	0	0		3
PH 234	Intro. to Modern Physics	2	0	0		2
EE 111	Electronics I	3	0	1		3
CS 205*	Assembly & Mach. Lang.	3	0	1		3
CS 337*	Comp. Architecture & Org.	3	0	0		3d
EE 188	Comp. Hardware Lab.	2	3	0		3cd
PE 10x	Sports and Teams (Optional)	0	1½	0		0
						17

#### Spring Semester

*	HU Elective <sup>2</sup>	3	0	0		3
HU 118	Public Speaking Seminar	1	0	0		1
EE 112	Electronics II	4	0	0		4cd
CS 220*	Object-Oriented Prog. (C++)	3	0	1		3cd
*	CompE Conc. Elective I					3
EE 189*	Comp. Interface/Firmware Lab. I	6	0	0		3cd
PE 10x	Sports and Teams (Optional)	0	1½	0		0
						17

### SENIOR YEAR

#### Fall Semester

*	SS Elective <sup>2</sup>	3	0	0		3
CS 238	Operating Systems	3	0	0		3cd
EL 590	Adv. Hardware Design	3	0	0		3cd
*	CompE Conc. Elective II					3
EE 271	Proj. Planning & Present. I <sup>1</sup>	1	0	0		½
EE 195*	Elec. Lab for EE 111 & 112 <sup>1</sup>	1	3	0		2cd
PE 10x	Sports and Teams (Optional)	0	1½	0		0
						14½

#### Spring Semester

*	SS Elective <sup>2</sup>	3	0	0		3
	TECH ELEC. (CS, EE, Engg, MA, Science)	3				
*	EE/CS ELEC with Design					3d
MA 222*	Probab. & Stats. (or MA223)	3	0	0		3
EE 272	Proj. Planning & Pres. II <sup>1</sup>	1	0	0		½
	Senior Des. Proj. in CompE <sup>1</sup>					3cd
PE 10x	Sports and Teams (Optional)	0	1½	0		0
						15½

**Total credits required for graduation:**

**128**

\* Asterisked courses and others may sometimes be replaced in a different semester so that electives may be more easily scheduled, provided all pre-requisites and co-requisites are fulfilled.

See Notes to Curriculum on following page. The "See Notes" column above is keyed to these Notes. Courses marked "c" use computers; "d" include design.



## 2. The Core Curriculum in the Humanities and the Social Sciences

Please see the catalog section titled "University Degree Requirements" for further information. You must take one humanities elective, two social science and one additional elective in either.

## 3. Engineering Ethics across the Curriculum

Topics in engineering ethics will be included in classes, laboratories, senior project and seminars, including such topics as social concern, responsibility, safety, environmental impact, legality, total quality management (TQM) and other topics designed to stimulate professional maturity. We also suggest you consider humanities or social science electives in ethics, including possibly HU 347, Ethics & Technology; or HU-346, Ethical Theories; SS 138, Technology, Environment and Society; SS 226, Problems of American Foreign Policy; or others.

## 4. Senior Laboratory and Senior Design Projects

Electrical engineering and computer engineering have extensive facilities in such areas as CAD/VLSI, communications, computer interfacing, computerized numerical methods/statistics, control/robotics, electromagnetics/microwaves, digital signal processing, electronics, image processing, local area networks (LAN), machinery/power, microcomputers, multimedia, network management, optical electronics, plasmas, software design, ultrasonics and wireless communication systems. Also at students' disposal is the Center for Advanced Technology in Telecommunications (CATT). Appropriate EE- or CompE- related senior projects offered by other departments are also possible. Which laboratories are offered in any given year depends on the campus and the interests expressed by a sufficient number of students.

Informal and formal written and public oral presentations will help prepare you for professional careers. Planning, analysis, design, ethical considerations and testing are guided by a staff member. You will frequently work in large groups or pairs to develop interaction skills essential to good engineering, or you may work individually, with adviser approval. To ensure that you have time to complete your written report and final testing in a fully professional manner,

your instructor may award the incomplete (I) grade, extending no more than four weeks beyond the last day of final exams, if your progress has been good and the work is nearly completed; the final oral presentation, however, must be completed at the regularly scheduled time. See Note 4 under Electrical Engineering.

## 5. Graduation Requirements

The University requires a 2.0 grade-point average in all courses taken and specifies other general requirements in the section "University Degree Requirements," which describes the core curriculum for all engineering majors, including placement procedures in writing, mathematics and programming as well as course credits by transfer, advanced placement and credit by examination.

You are also required to have grades of at least C- in EE 101, EE 102, CS 200, CS 201, CS 205, CS 336, and CS 337 before proceeding to any course for which they are prerequisite, and a technical GPA of 2.00 based on all courses prefixed EE, CS or EL. As a senior, you may elect graduate courses labeled EL 5xx, but not CS 5xx. You may elect other graduate courses, provided you have a GPA of at least 2.7, B grades in related courses and adviser permission. If you are chosen to be a senior honors or a BS/MS honors student, you may speak with your departmental adviser to consider modifying senior requirements for outstanding educational reasons.

The number and distribution of credits required for graduation that are in effect when you enter Polytechnic generally remain in effect for eight calendar years (or proportionately less for transfer students), provided you remain in good standing. As the curriculum is modified, the department will make every effort not to increase the number of required credits.

## 6. Good Standing, Probation and Disqualification

A university degree represents mature growth toward responsibility and professional achievement. Study and depth of understanding well beyond the requirements at many high schools prepare you for an engineering environment after graduation. This environment encompasses, on the one hand, mutual cooperation among fellow professionals, and on the other hand, an expectation that you

will contribute your share to each project—to help solve a problem which has not yet been solved. You will have no teacher to give you the "answer." You must have sufficient knowledge and reasoning ability to select from a host of reference materials that information which is applicable and correct, and to reject unprofessional data.

To remain in good standing in the department, you must maintain, term-by-term and cumulatively, a technical GPA and a University GPA of at least 2.00; fail no courses; earn at least C- in each of the four courses specified above; fulfill all course pre-/co-requisites; and remove any incomplete (I) grades within 30 days of the last day of final exams. In any courses that your adviser permits you to repeat more than once, a grade of C must be earned. If you are facing difficulties, whether educational or personal, please consult your instructor or a departmental adviser at the earliest possible time. We will try to help you.

If you do not meet these conditions, you are on departmental probation. Students on probation must register during regular registration, not advance registration. Probation conditions may require you to repeat courses (including courses in which you received transfer credit and courses in which you received a grade of C or less at Polytechnic); specify your credit load and permissible withdrawals; or take other remedial programs. (If you take HU 008 or HU 103, and have difficulty learning English as a second language, you are permitted to fail each course once without being placed on probation. This will only apply if you provide written evidence from your instructor that you have attended class and any required tutoring, submitted and corrected your assignments conscientiously in timely fashion and taken all exams.)

If you do not meet Departmental Probation requirements, fail twice to earn the required grade in any one course or do not conform to the University Student Code of Practice, you are subject to being disqualified from working toward the BSCompE or taking any further EE courses. The action taken depends on your particular case. If you are disqualified, you may appeal in writing. You may apply for readmission after two terms (fall, spring or summer) have passed if you show evidence of improved chance of success.

## DEPARTMENT OF ELECTRICAL ENGINEERING

Exceptions may occasionally be made, in writing, by a departmental adviser.

### 7. Dual Undergraduate Degrees and Dual Majors

**Dual Degree:** You may earn two undergraduate degrees, one the BS in computer engineering and one a degree in a field not closely allied—such as mechanical engineering, environmental engineering, the humanities, social sciences, physics, mathematics or others—by attending at least one additional year and by satisfying the requirements of both degrees. If you wish the second degree to be in electrical engineering or computer science, you should consider a master's degree such as the MS in electrical engineering (be sure to take EE 105, EE 106, EE 140, EE 160 for the BS in computer engineering) or the MS in computer science (consult with Department of Computer and Information Science).

**Dual Major:** You may earn, with departmental permission, a single undergraduate degree in closely related subjects, which will require about half a year to a year of extra courses. Example: BS in EE and CompE (15 additional credits); BS in EE and CS.

### 8. Advanced Technical Courses:

A Computer Engineering Concentration is required, including a Senior Design Project and two additional courses chosen in consultation with your adviser, to develop an area of depth and specialization. Some possible areas are suggested under "Concentration for the BS in Computer Engineering" below, but others may be constructed (with permission of the department adviser). Courses may sometimes be reordered to allow for flexible scheduling on your part or on the part of the department. All such adjustments require that prerequisites be met.

### CONCENTRATIONS FOR THE BS IN COMPUTER ENGINEERING

Suggested concentrations suitable for the BS in computer engineering, provided prerequisites and sufficient student enrollment are met:

**\* Advanced Computer Architecture:** Intended for those who wish to specialize in the design and development of computers and computer systems.

Includes courses in computer architecture, input output systems, switching and automata, parallel processing, operating systems and projects.

**VLSI Design:** Intended for those who wish to specialize in the design and development of integrated circuits. Includes courses in advanced digital electronics, semiconductor technology, solid-state circuits, VLSI systems, architecture design and projects.

**Microcontroller Systems and Interfaces:** Intended for those who wish to specialize in the design and development of embedded systems. Includes courses in advanced digital electronics, computer architecture, switching and automata, electronics laboratory and projects.

**\* Controls and Robotics:** Intended for those who wish to specialize in the design and development of computerized control systems and automation products. Includes courses in signals and transforms, feedback system principles, control system design, system theory and feedback control, robotics, robotics/control lab and projects.

**\* Data Communications:** Intended for those who wish to specialize in the design and development of components and systems for data communications and networks. Includes courses in signals; systems and transforms; principles of analog and digital communication systems; signal processing; principles of communication networks; information privacy and security; digital and data communications; wireless communications lab; and projects.

**Computer Graphics:** Intended for those who wish to specialize in the design and development of components and systems for computer generated graphics. Includes courses in advanced algorithms, computer architecture, interactive computer graphic and projects.

**\* Electrical Engineering:** Intended ONLY for those who wish to eventually pursue graduate studies toward an MSEE degree. Includes courses in signal systems and transforms, principles of analog and digital communication systems, electromagnetic waves and projects.

**\* Artificial Intelligence and Expert Systems:** Intended for those who wish

to specialize in the design and development of artificial intelligence systems. Includes courses in artificial intelligence, pattern recognition, expert systems/knowledge engineering, computer vision, neural networks, design and analysis of algorithms and projects.

*\* All suggested concentrations are available at the Brooklyn campus provided there is sufficient student enrollment in specific courses. Only those concentrations marked with an asterisk are available at Farmingdale campus as well as Brooklyn.*

### COMPUTER-AIDED DESIGN

In the classroom, design methodologies are discussed. Sometimes a device is built in the laboratory for testing, but more often the engineer makes a mathematical simulation of very high accuracy using a computer. Circuits for the touch-tone telephone were designed this way, for example.

The computer-aided design (CAD) facilities and programs are available to students for transistor circuit design, communication filter and network design, power system load flow, logic-circuit testing and simulation, integrated-circuit chip layout, control-system design, image processing, optimal expansion of power systems, microwave element design, printed-circuit-board layout, and others as needed for courses or project.

### PART-TIME UNDERGRADUATE PROGRAM

Some of the courses required in the undergraduate electrical engineering program can be completed in the evening by attending classes Monday through Thursday from 6:00 PM to 10:40 PM., on a part-time basis. Such undergraduate evening courses are offered at both Brooklyn and Farmingdale, but part-time students will have to take most of their courses during the day to complete the degree.

Full-time and part-time students are subject to the same academic standards. Transfer between full-time and part-time status is possible at any time.

### TRANSFER STUDENTS

Transfer credits for courses taken at other schools are based on evaluation of content and level. Students completing the same program, but in different years,

may receive different amounts of transfer credits. 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 Polytechnic. Transfer credits are awarded only for grades of C or higher.

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 Polytechnic undergraduate adviser at the beginning of their pre-engineering program.

Graduates of technology programs may be able to fulfill the requirements for the BS in computer 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.

### **THE BS/MS ACCELERATED HONORS PROGRAM**

The BS/MS Accelerated Honors Program leads to the simultaneous awarding of a bachelor's and master's degree. Depending on the student's preparation and objective, the two degrees may be completed in as few as four years of study. Each program is individually designed in cooperation with the departmental BS/MS Accelerated Honors Program adviser to allow varied transfer and AP credits, co-op program participation, professional summer jobs and other goals consistent with the Honors Program.

Possible BS/MS combinations include BS in electrical engineering plus MS in electrical engineering, MS in electrophysics, MS in systems engineering, MS in telecommunications networks or MS in computer science. Also see the section in "Electrical Engineering."

Incoming freshmen who have superior admissions qualifications are invited to participate in the Accelerated Honors Program. Later admission may be considered after the student completes one year at Polytechnic. Students must complete 16 to 20 credits each semester, maintain a 3.5 overall and technical

average, particularly in key courses, and display a record free of course repetitions and withdrawals.

The required courses for the two degrees include all courses required for the individual BS and MS degrees, except for the senior projects, and all curriculum footnotes apply. Required credits are the sum of the credits for the two degrees minus the senior project credits. Nine credits of Master's Thesis are required (6 if the master's in computer science is elected).

Acceleration may be achieved through summer course work, extra course loads, careful course sequencing or credit by examination. Students may also achieve acceleration through advanced placement credit in such courses as MA 106/107, (AP Calculus BC grade of at least 4, preferably 5); and CS 200 (AP Computer Science A, grade 5; or AP Computer Science AB, grade of 4 or 5; the language C is required for full AP credit).

### **SENIOR HONOR STUDENTS**

A full-time student whose performance during the first three years is outstanding will be named as a Senior Honor Student and is permitted to replace some of the required senior technical courses with other courses, usually more advanced, which are directed toward the student's professional goals.

### **GUIDANCE FOR BS IN COMPUTER ENGINEERING STUDENTS**

Your instructors will help you during hours posted on their doors or by appointment. Extensive help is available for students taking Project or Thesis. Computer engineering advisers will be glad to advise on courses and program adjustments resulting from academic needs or personal problems.

The Office of Special Services sponsors a peer tutoring program. The Learning Center provides drop-in tutoring in mathematics and physics. Personalized career counseling is available at no charge.

The Freshman Seminar, SL 101, introduces you to Polytechnic and its curricula. Many courses provide extra hours or special programs on a regular basis. These include English for foreign and other students needing additional help, HU 008, HU 009, HU 103, HU 118, MA 105, MA 106, 107, EG 101,

102, PH 107, 108, 109, EE 101, 102, and CS 200. You are urged to join the student branch of the Institute for Electrical and Electronics Engineering (IEEE) and to use their lab. Many ethnic clubs help students adjust to our electrical engineering program.

### **INFORMATION**

Undergraduate advising handouts, available to all students, contain further details on honors, probation, approved electives, projects, elective concentrations, course offerings and other matters of interest. Curriculum and prerequisite changes, new courses, special sections, and other last minute announcements are posted on the bulletin boards outside the undergraduate office of the Department of Electrical Engineering, and Department of Computer and Information Sciences on the Brooklyn and the Farmingdale campuses. All students are responsible for keeping informed.

### **UNDERGRADUATE COURSES**

Students are requested to consult departmental handouts and the Schedule of Classes for changes of courses, course content, and prerequisites in effect after the publication of this catalog.

General prerequisites: students may not register for any junior- or senior-level courses until all freshman and most sophomore requirements are completed. Knowledge of computer programming at the level of CS 200 is assumed in all EE courses. In the listing of course credits and hours, the symbol "c" indicates significant computer usage, and "d" signifies design.

### **GRADUATE PROGRAMS**

For information about the MS degree program in Computer Engineering, contact Dr. Ramesh Karri at 718/260-3595 or e-mail ramesh@poly.edu or contact the Department of Electrical Engineering at 718/260-3056.

# ELECTRICAL ENGINEERING PROGRAM

The mission of the Electrical Engineering Program is to provide a well-rounded education in fundamental areas of the profession, with sufficient depth to allow graduates to pursue a career in practice or to continue with graduate work at a leading institution. To achieve this goal, the department keeps abreast of changes in technology by combining older disciplines—such as electromagnetics, electronics, communications, control, computer-aided design and computer programming—with newer areas—such as wireless communications, microwave engineering, imaging processing and VLSI (very large-scale integrated) circuit design.

Four years of courses and laboratories lead to the design project in the senior year. But arriving at this stage includes many steps.

A strong design faculty has been developed through sponsored research programs, such as the Center for Advanced Technology in Telecommunications (CATT), a World Wide Web lab, Polytechnic Institute for Development and Enterprise (PRIDE), the Institute of Imaging Sciences (IIS) and many small-group sponsored-research projects.

- A careful three-semester advising program leads students into challenging areas, with suitable prerequisite preparation. Some 50 electives are available to undergraduates to provide depth and specialization, often in commercially viable areas such as local area networks and the Internet
- Because much 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 non-linearities, trade-offs, real-time simulations and many others.
- In seeking design projects, students must consult with faculty to develop topics in detail. Current topics include:
  - Fuzzy Control of DC Servo Moto
  - Vibration Isolation Platform with Piezo Interface
  - Speech Data Compression Using DSP Card

- Client/Server Fax Communication
- Auto- and Cross-Correlation of PN Codes
- Conversion of Wheelchair from Tethered to Wireless Control
- Microstrip Antenna

- Design is first introduced in the freshman engineering program and projects include design of an underwater retriever, thermal isolator and physical design using mathematical models.

The Electrical Engineering Program keeps abreast of market changes through the Visiting Committee (representing outside industries); hiring of industry professors and adjuncts; frequent contacts with alumni; encouraging faculty to work in industry part-time or while on sabbatical; and review of professional journals. Where possible, classroom work challenges students to apply their knowledge to current design situations. Also, interdepartmental projects in photonics (with physics), in electric vehicles (with mechanical engineering) and in smart materials (with metallurgy) permit the student to apply broad technical knowledge to practical problems.

Industry's present need for the system approach in engineering is also reflected in the curriculum by senior projects such as control and robotics, advanced hardware design, imaging, wireless communications, power electronics and areas mentioned above. The economic aspects of engineering are addressed by allowing undergraduates to choose electives, such as macro/micro economics, organizational behavior and management process. Cost evaluation is required in the design projects for Introduction to Engineering Design. Senior projects emphasize time management and planning. For exceptional undergraduate students, opportunity for advanced study is offered in two programs: one is the BS/MS Honors Program, which requires the student to work on a research project equivalent to 6 or 9 credit hours; the other, in effect during the summer months, allows undergraduates to work on research projects with graduate students and their advisors. Twelve-month co-op programs and dual majors are

encouraged.

Mathematics is coherently developed using analytic, digital (Maple) and graphical procedures, and applied to all later courses. Physics and chemistry provide breadth and depth in mechanics, electromagnetics, waves and thermodynamics. For breadth, modern physics is required. Almost all these basics are applied to courses taken through the senior year.

The engineering disciplines are developed in two-course sequences to allow time for the basic theory (such as Laplace) to be applied to control design. This two-course-sequence viewpoint covers software, circuit design, electronics, control, electromagnetics, hardware and communications.

## THE ELECTRICAL ENGINEERING PROFESSION

Electrical engineering is a rapidly growing profession that has evolved from its early beginnings in electric power generation and distribution through the development of telecommunications, radio, television, control, materials, computers and health care. Because of the advances electrical engineers have brought about in power distribution, computers and communications, the world is a far different place than it was a mere 100 years ago. Their inventions have made the world a smaller, safer place. Reporting and images from distant places make world events part of our daily life.

While undergraduate and graduate students in electrical engineering concentrate on these areas, graduates eventually apply their training to such diversified fields as electronic design bioengineering, city planning, astronautics, radio astronomy, system engineering, image processing, telemetering, World Wide Web, computer design, management and patent law. As students mature and realize their abilities, their professional lives may center on engineering, government, sales or education.

The electrical engineering faculty at

## Curriculum of Study for the Bachelor of Science in Electrical Engineering

(for Freshman entering Summer 1996 or later)

### FRESHMAN YEAR

#### Fall Semester

Course No.	Subject	Class	Hours/Week			Cr.
			Lab	Rec.	Cr.	
IU 101	Writ. and Hum. I (or HU 103) <sup>1</sup>	3	0	0(3)	3	
CS 200	Progr. Method. (C Lang.)	3	0	1	3c	
EG 101	Introduction to Engineering	1	3	1	3cd	
MA 106	Calculus I	3	0	1	4c	
CM 101	Gen. Chemistry I	2½	0	0	2½	
CM 111	Gen. Chem. Lab. I (Alt. Wks.)	0	1½	0	½	
SL 101	Freshman Seminar	1	0	1	0	
PE 10x	Sports and Teams (Optional)	0	1½	0	0	
						16

#### Spring Semester

Course No.	Subject	Class	Hours/Week			Cr.
			Lab	Rec.	Cr.	
SS 104*	Contemporary World Hist. <sup>1</sup>	3	0	0	3	
PH 107	Mechanics	3	0	1	3	
EG 102	Intro. Engineering Project	1	3	1	3cd	
MA 107	Calculus II (Harvard Math)	3	0	1	4c	
CM 102	Gen. Chemistry II	2½	0	0	2½	
CM 112	Gen. Chem. Lab. II (Alt. Wks.)	0	1½	0	½	
CP 101	Intro. to Co-op. Prog. (Optional)	1	0	0	0	
PE 10x	Sports & Teams (Optional)	0	1½	0	0	
						16

### SOPHOMORE YEAR

#### Fall Semester

HU 200*	Writing & the Humanities II <sup>1</sup>	3	0	0	3	
EE 101	Elec. Circ. I (dc & transients)	3	0	1	3	
CS 201*	Data Structures (C Lang.)	3	0	1	3c	
MA 108	Diff. Eqns. & Numerical Meth.	3	0	0	3c	
PH 108	Elec., Magnetism & Fluids	3	0	1	3	
PH 118	Lab. for PH 108 (Alt. Wks.)	0	1½	0	½	
PE 10x	Sports & Teams (Optional)	0	1½	0	0	
						15½

#### Spring Semester

TC 110	Professional Report Writing I <sup>1</sup>	3	0	0	3	
EE 102	Electric Circuits II (ac)	3	0	1	3	
MA 109	Multidimensional Calc. (Maple)	3	0	0	3c	
CS 336*	Dig. Logic & St.-Mach. Dsgn.	3	0	1	3cd	
PH 109	Waves, Optics & Thermody.	3	0	1	3	
PH 119	Lab. for PH 109 (Alt. Wks.)	0	1½	0	½	
EE 192	Sophomore EE Lab. (Alt. Wks.)	½	1½	0	1c	
PE 10x	Sports and Teams (Optional)	0	1½	0	0	
						16½

### JUNIOR YEAR

#### Fall Semester

*	HU Elective OR SS Elective <sup>2</sup>	3	0	0	3	
PH 234	Intro. to Modern Physics	2	0	0	2	
EE 111	Electronics I	3	0	1	3	
EE 105	Signals, Sys. & Transforms	3	0	1	3c	
CS 337*	Computer Architecture & Org.	3	0	0	3d	
EE 188	Computer Hardware Lab.	2	3	0	3cd	
PE 10x	Sports and Teams (Optional)	0	1½	0	0	
						17

#### Spring Semester

*	HU Elective <sup>2</sup>	3	0	0	3	
HU 118	Public Speaking Seminar <sup>1</sup>	1	0	0	1	
EE 112	Electronics II	4	0	0	4cd	
EE 106*	Feedback Systems	3	0	0	3cd	
EE 160*	Electromag. Lines & Waves	3	0	0	3	
EE 195*	Electronics Lab. for EE111 & 112	1	3	0	2cd	
PE 10x	Sports and Teams (Optional)	0	1½	0	0	
						16

### SENIOR YEAR

#### Fall Semester

*	SS Elective <sup>2</sup>	3	0	0	3	
MA 223*	Introduction to Probability	3	0	0	3	
EE 140*	Communication Systems	3	0	0	3	
	EE/CS Elective				3c	
EE 261	EE Proj. Planning & Pres. I <sup>1</sup>	1	0	0	½	
	Senior Lab in EE <sup>2</sup>				3d	
PE 10x	Sports and Teams (Optional)	0	1½	0	0	
						15½

#### Spring Semester

*	SS Elective <sup>2</sup>	3	0	0	3	
*	EE Elective				3	
*	EE/CS Elective with Design				3d	
*	Elective in Machinery, EMT, Materials, or Optics				3	
EE 262	EE Proj. Planning & Pres. II <sup>1</sup>	1	0	0	½	
	Senior Design Project in EE <sup>2</sup>				3cd	
PE 10x	Sports and Teams (Optional)	0	1½	0	0	
						15½

**Total credits required for graduation:**

**128**

\* Asterisk courses and others may sometimes be placed in a different semester so that elective courses and sequences may be more easily scheduled, provided prerequisites are met.

See Notes to Curriculum below, keyed to superscripts. Courses marked "c" use computers; "d" include design.

Polytechnic covers a wide range of fields. Principal areas of teaching and research are microelectronic devices and systems; computer engineering and computer science; telecommunications; speech and image processing; electro-optics and electroacoustics; microwave engineering; personal communications; power systems and energy conversion; plasma science and engineering; and system and control engineering.

### UNDERGRADUATE PROGRAMS

The program for the degree Bachelor of Science in electrical engineering gives students broad-based preparation for a career in electrical engineering in any of its specialization and readies them for immediate employment in industry, business and government, or for further graduate education. The program (both campuses) is accredited by the Accreditation Board for Engineering and Technology (ABET).

#### Notes to above BSEE Curriculum

*Please obtain updates of the Curriculum and Curriculum Notes prior to each registration, from your departmental advising office. These represent official corrections to this catalog.*

#### 1. Writing and Speech across the Curriculum

The Writing Placement Exam is required to determine the best way for you to get started.

If you are placed in HU 101, you immediately take this course, and continue with the following sequence each fall and spring semester without a break: SS 104, HU 200, TC 110; and you must also be sure to complete HU 118 before the senior year. Similarly, if placed in HU103, follow with HU 200 (or SS 104), SS 104 (or HU 200), TC 110; and also take HU 118. If placed in HU 009, follow with HU 101, SS 104, HU 200, TC 110; and also take HU 118. If placed in HU 008, follow with HU 103, HU 200, SS 104, TC 110; and also take HU 118.

Writing and speech will be integrated into your grade in all courses—special-

ly in humanities, social science, EG 101, EG 102, EE 192, EE 195, EE 188, and the senior laboratory and design project courses. The Writing and Speech Center, sponsored by the Department of Humanities, is prepared to give you extra assistance by appointment; participation will not affect your grade, unless required by your instructor.

#### 2. The Core Curriculum in the Humanities and the Social Sciences

Please see catalog section "University Degree Requirements" for further information.

You must take one humanities elective, two social science and one additional elective in either.

#### 3. Engineering Ethics across the Curriculum

Topics in engineering ethics will be included in classes, laboratories, senior project, and seminars—including such topics as social concern, responsibility, safety, environmental impact, legality, total quality management (TQM), and other topics designed to stimulate professional maturity. We also suggest you consider humanities or social science electives in ethics, including possibly HU 347, Ethics & Technology; or HU 346, Ethical Theories; SS 138, Technology, Environment, and Society; SS 226, Problems of American Foreign Policy; or others.

#### 4. Senior Laboratory and Senior Design Projects

The Electrical Engineering and Computer Engineering Programs have extensive facilities in such areas as CAD/VLSI, communications, computer interfacing, computerized numerical methods/statistics, control/robotics, electromagnetics /micro-waves, digital signal processing, electronics, image processing, local area networks, machinery/power, microcomputers, multimedia, network management, optical electronics, plasmas, software design, ultrasonics and wireless communication systems. The Center for Advanced Technology in Telecommunications (CATT) and the Center for Applied Large-Scale Computing (CALC) are also available for students' uses. Appropriate EE- or CompE-related senior projects offered by other departments are also possible.

Which laboratories are offered in any given year depends on the campus and the interests expressed by a sufficient number of students.

Informal and formal written and public oral presentations will help prepare you for professional careers. Planning, analysis, design, ethical considerations and testing are guided by a staff member. You will frequently work in large groups or pairs to develop interaction skills essential to good engineering, or you may work individually, with adviser approval. To ensure that you have time to complete your written report and final testing in a fully professional manner, your instructor may award the incomplete (I) grade, extending no more than four weeks beyond the last day of final exams, if your progress has been good and the work is nearly completed; the final oral presentation, however, must be completed at the regularly scheduled time.

#### 5. Graduation Requirements

The University requires a 2.0 grade-point average in all courses taken and specifies other general requirements in the section "University Degree Requirements," 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.

You are also required to have grades of at least C- in EE 101, EE 102, CS 200 and CS 336 before proceeding to any course for which they are prerequisites, and a technical GPA of 2.00 based on all courses prefixed EE, CS or EL. As a senior, you may elect graduate courses labeled EL5xx, but not CS5xx. You may elect other graduate courses, provided you have a GPA of at least 2.7, B grades in related courses and adviser permission. If you are chosen to be a senior honors or a BS/MS honors student, you may speak with your departmental adviser to consider modifying senior requirements for outstanding educational reasons.

The number and distribution of credits required for graduation that are in effect when you enter Polytechnic generally remain in effect for eight calendar years (or proportionately less for transfer students), provided you remain in good standing. As the curriculum is modified, the department will make every effort not to increase the number of required credits.

## 6. Good Standing, Probation and Disqualification

A university degree represents mature growth toward responsibility and professional achievement. Study and depth of understanding well beyond the requirements at many high schools prepare you for an engineering environment after graduation. This environment encompasses, on the one hand, mutual cooperation among fellow professional; and on the other hand, an expectation that you will contribute your share to each project—to help solve a problem which has not yet been solved. You will have no teacher to give you the “answer.” You must have sufficient knowledge and reasoning ability to select from a host of reference materials that information which is applicable and correct, and to reject unprofessional data.

To remain in good standing in the department, you must maintain, term-by-term and cumulatively, a technical GPA and a University GPA of at least 2.00; fail no courses; earn at least C- in each of the four courses specified above; fulfill all course pre-/co-requisites; and remove any incomplete (I) grades within 30 days of the last day of final exams. In any courses that your adviser permits you to repeat more than once, a grade of C must be earned. If you are facing difficulties, whether educational or personal, please consult your instructor or a departmental adviser at the earliest possible time. We will try to help you.

If you do not meet these conditions, you are on departmental probation. Students on probation must register during regular registration, not advance registration. Probation conditions may require you to repeat courses (including courses in which you received transfer credit and courses in which you received a grade of C or less at Polytechnic); specify your credit load and permissible withdrawals; or take other remedial programs. (If you take HU 008 or HU 103, and have difficulty learning English as a second language, you are permitted to fail each course once without being placed on probation. This will only apply if you provide written evidence from your instructor that you have attended class and any required tutoring, submitted and corrected your assignments conscientiously in timely fashion and taken all exams.)

If you do not meet departmental probation requirements, fail twice to earn

the required grade in any one course or do not conform to the University Student Code of Practice, you are subject to being disqualified from working toward the BSEE or taking any further EE courses. The action taken depends on your particular case. If you are disqualified, you may appeal in writing. You may apply for readmission after two terms (fall, spring, or summer) have passed if you show evidence of improved chance of success.

Exceptions may occasionally be made, in writing, by a departmental adviser.

## 7. Dual Undergraduate Degrees and Dual Majors

**Dual Degree:** You may earn two undergraduate degrees, one the BS in electrical engineering and one a degree in a field not closely allied—such as mechanical engineering, environmental engineering, the humanities, social sciences, physics or mathematics—by attending at least one additional year and satisfying the requirements of both degrees. If you wish the second degree to be in computer engineering or computer science, you may consider a master's degree such as the MS in electrical engineering (with electives in EL/CS/MA selected to emphasize your interests) or the MS in computer science.

**Dual Major:** you may earn, with departmental permission, a single undergraduate degree in closely related subjects, which will require about half a year to a year of extra courses. Example: BS in EE and CompE (15 additional credits); BS in EE and CS.

## 8. Advanced Technical Courses

With adviser approval, students having a coherent serious educational plan may sometimes take an advanced technical elective in place of EE 140, EE 180 or CS 337. In Brooklyn, courses may be delayed to allow a technical elective to be taken in senior semester one. EE 180 will be offered in senior semester two, and one of the EE/CS technical electives will be moved to senior semester one. All such adjustments require that prerequisites be met.

Examples of recent senior design projects that have challenged our students include:

- *Multimedia System Design*
- *Modes of a Laser with Interactive Frequency Doubler*
- *Propagation of UHF Signals in Cities*
- *Neural-Type Optimization*
- *Pseudo-Random Coding for Wireless Propagation*
- *Continuous Phase-Modulation Digital Signaling*
- *Compact, Low-Field, High-Harmonic Gyrotron*
- *Pulsed Hollow-Cathode Lasers*
- *Flashover in Crossed Electric and Magnetic Fields*
- *Small-Scale Model of Coilgun*
- *Power Electronics*
- *Picosecond Optoelectronics for Ultrashort Pulses*
- *Numerical Methods for Optical Microscopy*
- *Morphological Analysis and Coding of Images*
- *Radar and Sonar Signal Processing*
- *Telecommunication Management Workstation*
- *Expert System for Computer Music*
- *Hardware Design of a DSP Processor*
- *Digital Simulation of an Analog System*
- *Computer-Aided Instruction for Digital Signal Processing*
- *Local Area Networks (LAN)*
- *The Processing of Images from Incomplete Data*
- *Wireless Information Networks*

## COMPUTER-AIDED DESIGN

In the classroom, design principles are discussed. Sometimes a device is built in the laboratory for testing, but more often the engineer makes a mathematical simulation of very high accuracy using a computer. Circuits for the touch-tone telephone were designed this way, for example.

The computer-aided design (CAD) facilities and programs available to students include SPICE for transistor circuit design; communication filter and network design; power system load flow; logic-circuit testing and simulation; integrated-circuit chip layout; control-system design; image processing; optimal expansion of power systems; microwave element design; printed-circuit-board layout; and others as needed for courses or projects.

### **PART-TIME UNDERGRADUATE PROGRAM**

Some of the courses required in the undergraduate electrical engineering program can be completed in the evening by attending classes Monday through Thursday from 6:00 PM to 10:40 PM, on a part-time basis. Such undergraduate evening courses are offered at both Brooklyn and Farmingdale, but part-time students will have to take most of their courses during the day to complete the degree.

Full-time and part-time students are subject to the same academic standards. Transfer between full-time and part-time status is possible at any time.

### **TRANSFER STUDENTS**

Transfer credits for courses taken at other schools are based on evaluation of content and level. Students completing the same program, but in different years, may receive different amounts of transfer credits. 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 Polytechnic. Transfer credits are awarded only for grades of C or higher.

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 Polytechnic undergraduate adviser at the beginning of their pre-engineering program.

Graduates of technology programs 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.

### **THE BS/MS ACCELERATED HONORS PROGRAM**

The BS/MS Accelerated Honors Program leads to the simultaneous awarding of a bachelor's and master's degree. Depending on the student's preparation and objective, the two degrees may be completed in as few as four years of study. Each program is individually designed in cooperation with the departmental BS/MS Accelerated Honors Program adviser to allow varied transfer and AP credits, co-op program participation, professional summer jobs and other goals consistent with the Honors program.

Possible BS/MS combinations include BS in electrical engineering plus MS in electrical engineering, MS in electrophysics, MS in systems engineering, MS in telecommunications networks or MS in computer science. Also see the section in "Computer Engineering."

Incoming freshmen who have superior admissions qualifications are invited to participate in the Accelerated Honors Program. Later admission may be considered after the student completes one year at Polytechnic. Students must complete 16 to 20 credits each semester, maintain a 3.5 overall and technical average, particularly in key courses, and display a record free of course repetitions and withdrawals.

The required courses for the two degrees include all courses required for the individual BS and MS degrees, except for the senior projects, and all curriculum footnotes apply. Required credits are the sum of the credits for the two degrees minus the senior project credits. Nine credits of Master's Thesis are required (6 if the master's in computer science is elected).

Acceleration may be achieved through summer course work, extra course loads, careful course sequencing or credit by examination. Students may also achieve acceleration through advanced placement credit in such courses as MA 106/107, (AP Calculus BC grade of at least 4, preferably 5); and CS 200 (AP Computer Science A, grade 5; or AP Computer Science AB, grade of 4 or 5; the language C is required for full AP credit).

### **SENIOR HONOR STUDENTS**

A full-time student whose performance during the first three years is outstanding will be named as a senior honor student and is permitted to replace some of the required senior technical courses with other courses, usually more advanced, which are directed toward the student's professional goals.

### **GUIDANCE FOR BS IN ELECTRICAL ENGINEERING STUDENTS**

Your instructors will help you during hours posted on their doors or by appointment. Extensive help is available for students taking Project or Thesis. Electrical engineering advisers will be glad to advise on courses and program adjustments resulting from academic needs or personal problems.

The Office of Special Services sponsors a peer tutoring program. The Learning Center provides drop-in tutoring in mathematics and physics. Personalized career counseling is available at no charge.

The Freshman Seminar, SL 101, introduces you to Polytechnic and its curricula. Many courses provide extra hours or special programs on a regular basis. These include English for foreign and other students needing additional help: HU 008, HU 009, HU 103, HU 118; MA 105, MA 106, MA 107; EG 101, EG 102; PH 107, PH 108, PH 109; EE 101, EE 102; and CS 200. You are urged to join the student branch of the Institute for Electrical and Electronics Engineering (IEEE) and to use their lab. Many ethnic clubs help students adjust to our electrical engineering program.

### **INFORMATION**

Undergraduate advising handouts, available to all students, contain further details on honors, probation, approved electives, projects, elective concentrations, course offerings and other matters of interest. Curriculum and prerequisite changes, new courses, special sections, and other last minute announcements are posted on the bulletin boards outside the department of Electrical Engineering and Department of Computer and Information Science in Brooklyn and Farmingdale. All students are responsible for keeping informed.



## GRADUATE PROGRAMS

The Department of Electrical Engineering offers graduate programs leading to the degrees of master of science and doctor of philosophy in the areas listed in the table at the beginning of this section. The programs leading to degrees in electrical engineering are described in the following paragraphs. Other sections of this catalog describe the programs in electrophysics, system engineering and telecommunications networks.

The requirements for graduate degrees in electrical engineering are quite general. Each student may follow a program in any one of a variety of fields, including those described in the following paragraphs. For up-to-date information, please refer to the *EE Department Graduate Student Manual*, which is revised annually and is available from the EE Graduate Office.

Outstanding students should apply for financial aid in the form of research fellowships, teaching fellowships, or partial tuition remission.

**Telecommunications and Networking** — Telecommunications and networking deals with various communications systems, such as telephone, television, radio transmission, radar, space communications, facsimile and image transmission, and networks such as data networks, local area networks and the Internet. The range of our interests include the design of components, such as ATM switches and receivers, the design of systems and networks, performance, analysis, modeling and protocols.

**Signal Processing** — Signal processing deals with the generic problem of extracting the useful/desired information (signal) from the received data in the presence of uncertainties such as noise and other distortions. The techniques are applicable to any information processing situation and they involve analysis and design of signals, channels and receiving systems as well as task-oriented signal processing algorithms.

**Systems and Control** — System engineers are concerned with modeling and predicting the behavior of large systems from a knowledge of the component parts. Examples include air-traffic control systems, health-care delivery

systems, and systems to monitor and control pollution of the environment. Control engineers are concerned with all aspects of automatic regulation of system performance. 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, electric motor control and chemical process control.

**Electronics and VLSI** — The discipline of electronics and VLSI involves the design and implementation of circuits used in microcomputers, telecommunications, signal processing and control systems. Such circuits are being designed at Polytechnic using state-of-the-art computer facilities and design tools, and the circuits are being fabricated with modern technologies such as CMOS, bipolar and GaAs.

**Fields and Waves** — Studies in fields and waves include electromagnetic and acoustic wave radiation and propagation under a variety of conditions, including nonlinear, 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 is involved with the breakdown and ionization of gases and the interaction of the resultant plasma with electromagnetic waves. Such studies have application to the propagation of high-power radio waves in the atmosphere and the ionosphere.

**Power Systems and Energy Conversion** — Studies in power and energy include not only the traditionally important generation, conversion and distribution of electrical power but also such modern topics as power electronics, ion plasmas for the generation of electrical energy and the realization of electromagnetic propulsion.

### **REQUIREMENTS FOR THE MASTER OF SCIENCE**

Admission to the master's program requires a bachelor's in electrical engineering, from an accredited institution, with a superior undergraduate academic record.

Students not meeting all these requirements will be considered for

admission on an individual basis and may be admitted subject to the completion of appropriate undergraduate courses to remove deficiencies in preparation. A student who also desires to obtain a Polytechnic BS in electrical engineering must do so first, before beginning studies for a master's in the Department of Electrical Engineering.

Applicants lacking an electrical engineering bachelor's degree who are otherwise sufficiently prepared for admission without undergraduate deficiencies may nevertheless be required to take specified undergraduate and introductory level graduate electrical engineering courses. Such graduate courses count toward the master's degree. A student with a BS in a field other than electrical engineering may also want to consider the departmental master's programs in electrophysics, system engineering or telecommunication networks.

To satisfy the requirement for the MS in electrical engineering, the student must complete a total of 36 units of courses, as described below. An overall grade point average of B in all graduate courses is required by the University. In addition, a B average is required in specific groups of courses, as indicated below.

#### **1. Core Courses**

Three courses from the following:

EL 630	<i>Probability</i>
EL 625	<i>Linear Systems</i>
EL 611	<i>Signals, Systems and Transforms</i>
EL 671	<i>Fields and Waves</i>
EL 644	<i>VLSI System &amp; Architecture Design I</i>
EL 735	<i>Communication Networks I</i>

9 Units

**2. Two one-year sequences which may include courses in group (1). Both sequences must be in EL or CS courses and at least one must be an EL sequence.**

6-12 Units

**3. Approved electives, which may include a thesis (9 units) and one reading course (3 units maximum).**

21-15 Units

Total: 36 Units

At least 24 of the 36 units offered for the MS degree in electrical engineering must be in EL prefixed courses.

An overall B average is required in the combination of the five to seven courses offered to satisfy categories (1) and (2) in the above table.

## DEPARTMENT OF ELECTRICAL ENGINEERING

The core courses cover fundamental material and should be taken as early as possible.

A complete program of study, including the choice of one-year sequences, is arranged with a departmental adviser. The *EE Department Graduate Student Manual* should first be consulted for detailed rules and procedures, such as student status, recommended one-year sequences, recommended electives, current areas of research, repetition of courses and disqualification for low grades. The manual also contains announcements of changes in degree requirements, if any, adopted by the faculty after the publication of this catalog.

**Out-of-department courses** (i.e., courses not carrying the departmental prefix EL): A maximum of 12 units of approved courses may be taken as electives.

**Thesis:** An exceptional student may elect to write a master's thesis for which 9 units toward the degree may be earned. Such a student should find an appropriate adviser who has agreed to monitor the thesis research. The research should adequately demonstrate the student's proficiency in the subject material. Oral defense of the master's thesis with at least three professors in attendance is required.

**Transfer credits:** The 9 units of transfer credits which may be allowed in accordance with Polytechnic regulations can be applied only toward the electives. Transfer credits may not be used to satisfy the core or sequence course requirements.

**Validation credit:** Validation credits may be allowed in accord with Polytechnic regulations. In order to obtain credit, permission to take the validation examination must first be obtained by application to the EE Graduate Committee.

**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 be allowed for degree credit if it was taken in violation of this rule.

### **MS IN COMPUTER ENGINEERING\***

The MS program in computer engineering targets two important needs. For students intending to round out their education and seek employment, the MS in computer engineering can be a terminal degree. On the other hand, for

students planning a PhD, the master's degree provides them with the tools and background necessary to carry out such self-directed research.

**Admission** — Admission to the MS in computer engineering requires a bachelor's degree in computer engineering, electrical engineering or computer science from an accredited institution. Students not meeting these requirements will be considered for admission on an individual basis, and may be admitted subject to the completion of appropriate courses to remove any deficiencies in preparation. Topics in which deficiencies must be removed include logic circuits design, state analysis and synthesis techniques, computer architecture, data structures and algorithms, and C or C++ programming.

**Degree Requirements** — A student must complete 36 credits as described below to satisfy the requirements for the MS in computer engineering degree. **Of these at least 21 credits should be electrical engineering credits and 9 credits should be computer science credits.**

#### GROUP 1: Core courses (9 credits)

- EL 590 *Advanced Hardware Design (VHDL)*
- EL 536 *Principles of Communication Networks*
- CS 613 *Computer Architecture I*

#### GROUP 2: Two one-year sequences

GROUP 3: Approved electives are chosen with adviser approval from graduate offerings in EE, EL, CS and, occasionally, pertinent courses from other departments. With adviser approval, other groups or individual courses may be selected, provided they relate to the various facets of computer engineering.

GROUP 4: Project: Students are required to take a project that is related to the computer engineering discipline and is approved by advisers. [3 credits]

Thesis option: A 9-unit thesis may be selected and used to replace (EL 995 or CS 996) (a) either a one-year sequence from GROUP 2 or two electives from GROUP 3 and (b) 3-credit project from Group 4.

An average of B is required in all graduate courses taken at Polytechnic, except those used for the undergraduate degree. No more than 9 of 36 credits may be taken outside Polytechnic University.

Also, such credits are not used while computing the GPA. An average of B is also required in the courses taken to satisfy GROUPS 1 and 2 above. These courses must all be taken at Polytechnic University. If some of these courses are excused because they were taken as part of an undergraduate program or were awarded transfer credits, substitute courses approved by the adviser will be used in calculating this average. In any case, a total of 36 credits are required for the degree.

*\* Pending approval by the New York State Department of Education.*

### **REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY**

**General** — Graduate students who have exhibited a high degree of scholastic proficiency and have given evidence of ability for conducting independent research may consider extending their goals towards the doctorate. The PhD is awarded to a student who completes the program of studies and research described below, and prepares and defends a dissertation representing an original and significant contribution for publication in a recognized scientific or engineering journal. For a more complete description of the topics summarized here, please refer to the latest *EE Graduate Student Manual*.

**Admission to Programs** — Entrance into the doctoral program of study and research is contingent on the candidate's passing the departmental qualifying examination and forming a guidance committee (both described below). A student entering with a bachelor's degree will normally take the qualifying examinations after one year of study. Entering students holding master's degrees may take these examinations as soon as they are prepared, but full-time students are expected to submit to examinations within the calendar year.

Students entering the doctoral program at the baccalaureate level must meet the entrance requirement listed above for the master's program. Students entering at the master's level for the PhD program in electrical engineering are normally expected to have a master's in electrical engineering. Students holding a master's degree from Polytechnic in systems engineering, electrophysics or telecommunications networks can also enter the program.

**Qualifying Examinations** — The PhD qualifying examinations are offered once each year. These examinations are divided into two sections: (a) a written examination requiring preparation through the first-year graduate level in several areas related to the student's principal area of interest; and (b) an oral examination concentrating mainly on this principal area. Principal areas of concentration are communications, signal processing, systems and control, electro-optics, electromagnetics, networks, computer and network architecture, and power.

Details regarding allowed subject areas, recommended background courses, sample examination questions and the precise format for the coming year are available in the latest *Graduate Student Manual*.

**Guidance Committee** — Upon passing the qualifying examination, the graduate student must find a faculty member in the student's area of major interest who will become the thesis adviser. In consultation with the thesis adviser, the student suggests an adviser for a minor outside of electrical engineering and a guidance committee of three or four faculty members, with the thesis adviser usually acting as chairman. At least one other guidance committee member must be in the student's area of major research interest; this member may be from outside of Polytechnic. The minor adviser may be a member of the guidance committee. The student must submit the names of these guidance committee members to the Office of Graduate Programs for approval.

The thesis adviser approves the program of study 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, the student should have the appropriate adviser certify this in writing to the Office of Graduate Affairs, with copies to the EE Graduate Office.

The guidance committee conducts the area examination and thesis defense, and approves the final thesis.

**Course Requirements** — Polytechnic requires that each candidate for the doctorate complete a minimum of 90 units of academic work beyond the bachelor's degree, including a minimum of 24 units of dissertation research. Candidates in EE must take a minimum of 51 units in formal courses (as distinct

from independent study units such as reading, project or thesis) as part of the general requirement of 90 units. PhD students are required to take a minimum of 12 units 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 area of study. Approval of the minor program is described in the preceding paragraph. The major program of study is developed by the student in consultation with the thesis adviser. The major program should constitute a coherent, in-depth study of the most advanced knowledge in the student's area of concentration. Attendance at graduate seminars is expected when they are offered in the student's principal area of interest.

**Area Examination** — The area examination consists of a presentation or review of the general background in the problem area of the student's dissertation. The purpose of the examination is to demonstrate that the student understands the fundamental prior research in the field of the thesis work. The examination should be taken early in the PhD program, after no more than 12 units of dissertation have been taken, and should not be a review of partial thesis results. The examination may be in the form of an open seminar attended by other interested faculty and students. The guidance committee evaluates the student's performance and determines whether the depth of knowledge and understanding necessary to carry out research in the chosen area has been demonstrated.

Postponement of the area examination beyond registration for 12 units of thesis requires the approval of the EE Graduate Committee.

**Submission of the Thesis and Final Examination** — On completion of the doctoral dissertation, the candidate will submit to an oral defense of the thesis. The examination is conducted by the guidance committee, but is open to all members of the faculty and to such other persons as may be invited. Copies of the dissertation will be made available to prospective examiners a reasonable time in advance. The guidance committee chairman will notify the Office of Graduate Programs of the candidate's readiness so that the examination date may be scheduled. The student is advised to consult the Office of

Graduate Programs regarding submission of the final manuscript, reproduction and binding.

## UNDERGRADUATE COURSES

Students are requested to consult departmental handouts and the *Schedule of Classes* for changes in required courses, course content and prerequisites in effect after the publication of this catalog.

General prerequisites: Students may not register for any junior- or senior-level courses until all freshman and most sophomore requirements are completed. Knowledge of computer programming at the level of CS 200 is assumed in all EE courses. In the listing of course credits and hours, the symbol "c" indicates significant computer usage, and "d" signifies design.

### BASIC COURSES

#### EE 101 Electric Circuits I 3:0:1:3

Kirchhoff and power laws. Passive and active d-c circuit elements. Node and loop analysis, voltage and current division, linearity and superposition, voltage and current division, Thevenin's and Norton's theorems. Source-free and forced responses of RL, RC and RLC circuits; state variables. *Prerequisites:* MA 107 and PH 107. *Co-requisites:* MA 108, PH 108 and PH 118. C- or better is required in EE 101 before proceeding to courses for which it is prerequisite.

#### EE 102 Electric Circuits II 3:0:1:3

Continuation of EE 101. Sinusoidal steady-state response. Complex voltage and current. Average power, maximum power transfer, root-mean-square values. Complex frequency, poles and zeros. Resonance. Bode plots. Real Fourier series. Mutual inductance. Three-phase systems. *Prerequisites:* EE 101 (C- or better required), MA 108, PH 108 and PH 118; experience in using a computer. *Co-requisites:* Highly recommended are EE 192, PH 109 and PH 119. C- or better is required in EE 102 before proceeding to courses for which it is prerequisite.

**EE 105 Signals, Systems & Transforms** 3:0:1:3

Complex Fourier series. Fourier Transforms: linearity, scaling, time and frequency shift, differentiation. Convolution. Band-limited signals and the sampling theorem. Linearity, time-invariance, impulse response, causality. Frequency and time response of LTI systems. Transfer functions and low-, high- and all-pass filters. Laplace transforms, inverses, and theorems; applications to time-invariant systems with initial conditions and suddenly turned-on sources. Sampled band limited signals. Z-transforms, inverses, convergence and theorems. Discrete convolution. Stability tests for rational analog and discrete systems. Concept of FIR and IIR filters. Digital simulators for analog systems. *Prerequisites: Either EE 101 (C- or better required) and EE 102 (C- or better required); or EE 370 (C or better required). MA 108 and MA 109.*

**CONTROL AND INSTRUMENTATION****EE 106 Feedback System Principles** 3:0:0:3cd

Introduction to 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, with the aid of MATLAB. *Prerequisite: EE 105, PH 107 and PH 108.*

**EE 107 Control System Design** 3:0:0:3

Topics on the 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. (See departmental bulletin board for detailed descriptions of each offering and of any additional prerequisites.) *Prerequisite: EE 106.*

**ELECTRONIC CIRCUIT ANALYSIS AND DESIGN****EE 111 Electronics I** 3:0:1:3

Circuit models and frequency response of amplifiers. Op-amps, difference amplifier, voltage-to-current converter, slew rate, full-power bandwidth, common-mode rejection. Diodes, limiters, clamps, semiconductor physics. Bipolar junction transistors, small-signal models, cut-off, saturation, amplifiers. Field-effect transistors (MOSFET and JFET), biasing, small-signal models, common-source and common-gate amplifiers, integrated-circuit MOS amplifiers. *Prerequisite: EE 102 (C- or better required) and PH 108 (recommended). Co-requisite: PH 109 and PH 234.*

**EE 112 Electronics II** 4:0:0:4cd

Differential and multistage amplifiers, current mirrors, current sources, active loads. Frequency response of MOSFET, FET and BJT amplifiers; Bode plots. Feedback amplifiers, gain-bandwidth rule, effect of feedback on frequency response. Class A, AB and B output stages. Op-amp analog integrated circuits. Piecewise-linear transient response; determination of state. Mono-, a- and bi-stable circuits. MOS and bipolar digital design: noise margin, fan-out, propagation delay; CMOS, TTL, ECL. *Prerequisite: EE 111 and PH 234 (recommended). Co-requisite: EE 195.*

**EE 115 Advanced Digital Electronics** 3:0:0:3d

Flip-flops, shift registers, counters, arithmetic operations, semiconductor memories, switches, A/D converters D/A converters and selected applications of digital circuits. *Prerequisite: EE 112, EE 195 and EE 188.*

**EE 116 Communication Electronics** 3:0:0:3d

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. *Prerequisites: EE 112 and EE 195.*

**EE 119 Semiconductor Technology** 3:0:0:3

Principal techniques involved in processing and fabrication of semiconductor devices and integrated circuits including material preparation, junction forming, circuit integration and packaging. *Prerequisites: EE 112, EE 188 and EE 195.*

**EL 545-546 Microwave Integrated and Semiconductor Circuits I, II** each 2½:0:0:3

See graduate course listings.

**COMMUNICATIONS AND INFORMATION TRANSMISSION****EE 140 Principles of Analog and Digital Communications** 3:0:0:3

Principles and techniques for modern communications systems. Analog and digital signals, sampling, quantization, signal representation. Analog and digital modulation, pulse-code modulation, time and frequency multiplexing. Noise in communication systems. *Prerequisites: EE 105 and EE 111. Co-requisite: MA 223.*

**EE 141 Signal Processing** 3:0:0:3cd

Spectral representations of discrete-time signals and the fast Fourier transform. Random discrete-time signals and spectral analysis. Detection and estimation of signals in noise. Adaptive filtering and linear mean square estimation. Computer projects involving applications of signal processing. *Prerequisites: MA 223, EE 105 and EE 140.*

**EL 512 Image Processing I** 2½:0:0:3  
See graduate course listings.**EL 514 Multimedia Information Processing and Communications Lab** (formerly EL 593) 2:3:0:3cd  
See graduate course listings.**EL 536 Principles of Communication Networks I: Systems and Protocols I** (formerly EL 635) 2½:0:0:3  
See graduate course listings.

**EL 537 Introduction to Local Area Networks** 2:3:0:3

See graduate course listings.

**EL 930 Wireless Information Systems Laboratory** (formerly EL 932) 2:3:0:3cd

See graduate course listings.

**ELECTROMAGNETIC FIELDS AND ELECTRONIC MATERIALS****EE 160 Electromagnetic Lines and Waves** 3:0:0:3

Electromagnetic wave propagation in free space and in dielectrics, starting from a consideration of distributed inductance and capacitance on transmission lines, of waves. Reflection and transmission of waves at discontinuities is discussed for pulsed sources; and impedance transformation and matching are presented for sinusoidal sources. Snell's Law and the reflection and transmission coefficients at dielectric interfaces are derived for obliquely propagated plane waves. Guiding of waves by dielectrics and metal waveguides. *Prerequisite: EE 102 (C- or better required), PH 108, MA 108, PH 109 and MA 109.*

**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 160.*

**EE 167 Quantum and Solid State Electronics** 3:0:0:3

Review of experimental necessity for introduction of quantum states and wave-particle dualism; elements of wave mechanics and quantum statistics. Application to electronic structure of atoms and the periodic table; properties of electrons in metals, semiconductors and insulators; laser systems. *Prerequisite: PH 234, EE 111 and EE 160.*

**EL 551-552 Electro-Optics I, II** Each 2%:0:0:3

See graduate course listings.

**EL 557 Introduction to Electric and Magnetic Properties of Solids** 2%:0:0:3

See graduate course listings.

**EL 571-572 Engineering Electromagnetics I, II**

See graduate course listings.

**EL 573 Introduction to Microwave Engineering** 2%:0:0:3

See graduate course listings.

**EL 581 Introduction to Plasma Engineering** 2%:0:0:3

See graduate course listings.

**ELECTRIC POWER****EE 180 Electrical Machinery I** 3:0:0:3

Description, theory and analysis of steady-state performance for the four types of electrical machines: transformer, induction motor, synchronous machine and d-c machine. Equivalent circuits and vector diagrams derived and used as the primary tools for analysis. Power majors should take EE 180 in junior spring, EE 204 in senior fall, and EE 205 in senior spring. *Prerequisites: EE 160 and EE 102 (C- or better required).*

**EE 181 Electrical Machinery II** 3:0:0:3

Two alternative unifying viewpoints of electrical machines are presented. One is based on physical considerations and leads to design guidelines. The second is based on Kron's theory and provides means for system analysis. *Prerequisites: EE 180 and EE 160. Co-requisite: preferably EE 204.*

**EE 183 Electric Power Systems** 3:0:0:3c

Principles of operating electric power systems. Transmission lines: inductance and capacitance parameters and current-voltage relations. Power system representation. Introduction to network calculations, symmetrical phase compo-

nents and economic dispatch. Computer exercises on power-load flows. *Prerequisites: EE 102 (C- or better required). Co-requisite: EE 204 is suggested.*

**EL 564 Electromechanical Power Conversion** 2%:0:0:3

See graduate course listings.

**EL 568-569 Electric Drives I, II** each 2%:0:0:3

See graduate course listings.

**ELECTRICAL AND COMPUTER ENGINEERING LABORATORIES**

Transfer students who enroll in junior- and senior-level laboratory courses may be required to purchase components of preceding courses for which they have transfer credits.

**EE 188 Junior Computing Engineering (Hardware) Laboratory** 2:3:0:3cd

Lectures and required experiments provide an introduction to digital and analog circuit techniques (gates, programmable arrays, sequential circuits, decodes, memories, operational amplifier circuits, active filters, D/A, A/D, etc.); computer hardware; and microcomputer organization and an introduction to sampled data systems. *Prerequisites: CS 336 (C- or better required); EE 102 (C- or better required) or EE 370 (C or better required); EE 192, EE 374 or EE lab experience as approved by the instructor. Co-requisites: CS 337 and TC 110. Offered fall semester.*

**EE 189 Senior Computer Engineering (Interfacing & Firmware) Laboratory** 1:6:0:3cd

Lectures and required experiments provide an introduction to interfacing small computer hardware to physical devices. Emphasis is on the use of small computers as system components. Topics include interrupt-programming concepts; sensors and transducers, signal conditioning; sampled-data systems techniques; and real-time, closed-loop systems. Independent learning and hands-on experience are provided by projects involving such subjects as computer graphics, light intensity control and

motor speed control, voice digitizing, etc. *Prerequisites:* CS 337, CS 205 (C- or better required) and EE 188 (C- or better required). *Co-requisite:* EE 112. Offered spring semester.

**EE 192 Sophomore EE Laboratory**  
1/2:1/2:0:1c

Experiments in instrumentation and electric circuits. Use of SPICE. *Prerequisites:* EE 101 (C- or better required), PH 108, PH 118 and preferably TC 110 or HU 110. *Co-requisite:* EE 102. Meets alternate weeks.

**EE 195 Junior Electrical Engineering Laboratory**  
1:3:0:2

Circuits and electronics laboratory. *Prerequisites:* EE 192, EE 111, PH 118 and HU 200. *Co-requisite:* EE 112 and TC 110 or HU 110.

**SENIOR LABORATORY AND SENIOR DESIGN PROJECTS**

All electrical engineering and computer engineering majors develop their professional competence by taking a senior laboratory (3 credits); and a senior design project (3 credits). EE majors accompany the course selected as their design project with a concurrent course EE 260, Project Planning and Presentation (1 credit, 1 semester), which, depending on the topic, may be split into EE 261 in the preceding semester and EE 262 in the concurrent semester to allow time for project planning. For CompE's, the appropriate course number is EE 270 (or 271 and 272).

You carefully plan for a senior lab and senior design project by completing any required prerequisites (one of the labs may often be a prerequisite for the design project), and by taking co-requisites.

In particular, the course designated as your senior design project presents a special challenge in planning, designing and testing/checking, including both technical and socioethical considerations. To be sure that your design project is professional, you may receive an incomplete (I) grade extending no more than 4 weeks beyond the last day of final exams, provided the instructor deems that the work achieved by the semester's end represents good progress and diligence. The final oral presentation must be done at the regularly scheduled time.

All senior labs and projects are part of Writing and Speech across the Curriculum, and technically competent, clear written and oral reports are essential.

Seniors are invited and urged to take additional senior lab/projects or design projects as senior electives to develop practical and professional understanding. If you select a second design project course, you will prepare reports, but are excused from EE 260/270 and the full professional report.

Please consult the EE advising bulletin board for further information on the campus, year and semester for all courses. Offering of laboratories and projects is contingent on student and staff interest.

Each design project includes planning, design, evaluation, social responsibility, quality and marketability. Projects that run in any particular semester will depend on student and staff interest. Students may propose projects at least one semester before they are to be offered.

Senior design projects may often be offered to a large group of students (8 to 25) to give experience in group planning and dynamics. The instructor will be a staff member experienced in the area of the project. Students will concentrate on a common theme. As specified by the instructor, students may work individually or in small groups on the same design project, and then compare their different results at the end of the semester. Alternatively, the whole class may work on a single large project, where the class is divided into subgroups, each responsible for a different part of the large project. Seminars and lectures on the chosen theme will be given. Other students may work individually or in small groups.

*Prerequisites:* Completion of the junior year; an appropriate senior lab/project; TC 110 or HU 110; HU 118. Additional appropriate co-requisites will be specified semester by semester for each project. If used as a senior project, professional formal and informal written and oral reports are required as part of Writing and Speech across the Curriculum; in this case, EE majors co-register for EE 260 (or, if required, pre-register for EE 261 and co-register for EE 262), and CompE majors co-register for EE 270 (or, if required, pre-register for EE 271 and co-register for EE 272).

**SENIOR LABORATORIES AND PROJECTS**

**EE 200 General Senior EE Laboratory** 1/2:4/2:0:3cd

Experiments in electronics, control and electromagnetic waves. Miniproject. Course is part of Writing and Speech across the Curriculum. *Prerequisites:* EE 112, EE 106, EE 160 and EE 195; TC 110 or HU 110; HU 118; and preferably EE 188. *Co-requisite:* EE 113. Offered fall and spring.

**EE 202 Senior Electronics Laboratory** 3cd

Experiments in analog, digital, and communications electronics, including a two-stage amplifier design with SPICE simulation, FM modulators, multivibrator and timing circuits, active filters, large-signal tuned amplifiers, sine-wave oscillators and phase-locked loops. Miniproject. *Prerequisites:* Senior Status; EE 112, EE 195 and EE 188; TC 110 or HU 110; HU 118. Offered fall, contingent on sufficient demand.

**EE 203 Senior Design Project in Electronics** 3cd

*Prerequisites:* Senior status; TC 110 or HU 110; HU 118; EE 112; EE 200 or 202. Other pre-/co-requisites: As specified by adviser.

**EE 204 Senior Machinery Laboratory** 3d

Experiments on basic power devices, including the transformer, the d-c machine, the induction motor and the synchronous machine. Miniproject. *Prerequisites:* Senior status; EE 160; EE 180 (preferably taken in junior II by power majors); EE195; TC 110 or HU 110; HU 118; preferably EE 188. Offered fall and spring.

**EE 205 Senior Design Project in Power** 3d

*Prerequisites:* Senior Status; TC 110 or HU 110; HU 118; EE 180; EE 204. Other pre-/co-requisites: As specified by adviser.

**EE 206 Senior Semiconductor and Materials Laboratory** 3d

Experiments and projects on the fabrication of PMOS transistors, starting with a blank silicon wafer, mask generation, lithography, oxidation, diffusion, metalization and encapsulation. Test and analysis of completed packages. If possible, meets once weekly in Farmingdale, so that Brooklyn students may attend. *Prerequisites:* Senior status; EE 112; EE 160; EE 195; TC 110 or HU 110; HU 118; EE 188. *Pre-/Co-requisites:* EE 167 or similar. *Other pre-/co-requisites:* As specified by adviser.

**EE 207 Senior Design Project in Semiconductors and Materials** 3d

*Prerequisites:* Senior status; TC 110 or HU 110; HU 118; EE 112; EE 195; EE 160. *Other pre-/co-requisites:* As specified by adviser.

**EE 208 Senior Special Topics Laboratory** 3d

Studies and experiments related to current research or other laboratory facilities. Miniproject. *Prerequisites:* Completion of the technical courses and laboratories of the junior year; TC 110 or HU 110; HU 118. *Other pre-/co-requisites:* As specified by adviser.

**EE 209 Senior Design Project in Special Topics** 3d

*Prerequisites:* Senior Status; TC 110 or HU 110; HU 118. *Other pre/corequisites:* As specified by adviser.

**EE 210 Summer Honors Research Laboratory** 3cd

An individual or small-group intensive 11-week research-oriented project, often related to current research. Offered in the summer following the junior year, under the supervision of a staff member. Students using this course as their senior design project register for EE 260 (EE majors) or EE 270 (CompE majors) in the following fall to complete professional written and oral reports as well as further research; the work is to be completed by October 15. *Prerequisite:* Completion of all technical courses and laboratories of the junior year with 3.3 or greater GPA; competitive selection by the Steering Committee and Staff

*Sponsor:* TC 110 or HU 110; HU 118. Students submit an application form in the preceding spring. Offered summer.

**EE 213 Senior Design Project in VLSI (Very Large-Scale Integrated Circuits)** 3cd

*Prerequisite:* TC 110 or HU 110; HU 118; EE 112; EL 547 or EL 590; with permission of project adviser, EE 547 may be co-requisite and EE 189 may be prerequisite.

**EE 214 Senior Robotics/Control Laboratory** 3cd

Theoretical principles germane to feedback control and robotics. Small-scale analog and/or digital control applications. Data acquisition and control through a computer. Experiments such as:

- Stabilization of an inverted pendulum (non-linear) on a cart, by accelerating the cart back and forth using various feedback-control algorithms.
- Control of a two-degree-of-freedom non-linear robot manipulator, using various algorithms.
- Pulse-width modulation technique for the control of d-c motors.
- Adaptive control algorithms and their application to a specific second-order system.

*Prerequisites:* EE 106; EE 112 (or EE 370 for B students); EE 195; EE 188; ability to program in C language; TC 110 or HU 110, HU 118. *Pre-/Co-requisite:* preferably EE 180. B-or-better students from other departments should discuss prerequisites with senior EE adviser or instructor. If possible, will meet once weekly in Brooklyn, so that Farmingdale students may attend. Offered fall.

**EE 215 Senior Design Project in Control and Robotics** 3cd

*Prerequisites:* TC 110 or HU 110; HU 118, EE 106 and EE 214. *Other pre-/co-requisites:* As specified by adviser.

**EE 217 Senior Design Project in Imaging** 3cd

*Prerequisite:* TC 110 or HU 110; HU 118 and EL 512. *Other pre-/co-requisites:* As specified by adviser.

**EE 218 Senior Microwave Laboratory** 3d

See EL 970 for typical topics and additional co-requisites. Miniproject. If possible, will meet once weekly in Farmingdale, so that Brooklyn students may attend. *Prerequisites:* EE 105 and EE 112; EE 160 with B- or better grade; EE 195; TC 110 or HU 110; HU 118; preferably EE 188. *Other pre-/co-requisites:* As specified by adviser.

**EE 219 Senior Design Project in Electromagnetics and Waves** 3d

*Prerequisites:* TC 110 or HU 110; HU 118, EE 160 and EE 200. *Other pre-/co-requisites:* As specified by adviser.

**EE 220 Senior Electrical Engineering Laboratory** 3d

Individual or small-group laboratory/project under staff guidance for EE majors. Offered only in special cases with permission of senior EE adviser. *Prerequisites:* Completion of all technical courses and laboratories of the junior year; TC 110 or HU 110; HU 118. *Other pre-/Co-requisites:* As specified by adviser.

**EE 221 Senior Design Project in Electrical Engineering** 3d

*Prerequisites:* Senior status; TC 110 or HU 110; HU 118. *Other pre-/co-requisites:* As specified by adviser.

**EE 222 Senior Computer Engineering Laboratory** 3d

Individual or small-group laboratory/project under staff guidance for CompE majors. Offered only in special cases with permission of senior CompE/EE adviser. *Prerequisites:* Completion of all technical courses and laboratories of the junior year; TC 110 or HU 110; HU 118. *Other pre-/co-requisites:* As specified by adviser.

## DEPARTMENT OF ELECTRICAL ENGINEERING

### EE 223 Senior Design Project in Computer Engineering 3

*Prerequisites:* Senior status; TC 110 or HU 110; HU 118, EE 189 and EL 590. Other pre-/co-requisites: As specified by adviser.

### EE 225 Senior Design Project, Polytechnic Multisemester Plan 3

*Prerequisites:* Senior status; TC 110 or HU 110; HU 118. Other pre-/co-requisites: As specified by adviser. Register in final semester.

### EE 227 Senior Design Project in Telecommunications 3

*Prerequisites:* Senior status; TC 110 or HU 110; HU 118. Other pre-/co-requisites: As specified by adviser.

### EE 229 Senior Design Project in Digital Signal Processing 3

*Prerequisites:* Senior status; TC 110 or HU 110; HU 118, EE 105 and EE 140, EE 188. Other pre-/co-requisites: As specified by adviser.

### EE 260 Senior Electrical Engineering Project Planning and Presentation 1:0:0:1

*Prerequisites:* TC 110 or HU 110; HU 118. Other pre-/co-requisites: As specified.

For EE majors only. If the design project should require advanced planning or purchases, this course may be split into:

### EE 261 Senior EE Project Planning and Presentation I %:0:0:%

Offered in the semester prior to the design project offering.

### EE 262 Senior EE Project Planning and Presentation II %:0:0:%

Offered in the same semester as the design project.

### EE 270 Senior Computer Engineering Project Planning and Presentation 1:0:0:1

*Prerequisites:* TC 110 or HU 110; HU 118. Other pre-/co-requisites: As specified.

For CompE majors only. If the design project should require advanced plan-

ning and purchases, this course should be split into:

### EE 271 Senior CompE Project Planning and Presentation I %:0:0:%

Offered in the semester prior to the design project offering.

### EE 272 Senior CompE Project Planning and Presentation II %:0:0:%

Offered in the same semester as the project offering.

### EE 298 Senior Design Project in Computer Systems 3cd

*Prerequisites:* EE 189 and EE 590. Other pre-/co-requisites: As specified by adviser.

### EE 371-6 Guided Studies in EE 1,2,3,4,5,6 credits respectively.

### EE 381-6 Guided Studies in CompE 1,2,3,4,5,6 credits respectively.

### EE 397 Bachelor's Thesis in Electrical Engineering or Computer Engineering 3d

Solution of an electrical engineering problem involving adequate statements of problem, choice of methods of attack, solution of problem and test of the design. Presentation of results in oral reports and a formal bound report. An extensive design achievement is required. For students using this course as their senior project (along with EE 260 or EE 270), a professional written final report corresponding to standards published by the department must be filed in the department office for a passing grade. Formal oral presentation before a group of students and staff required. Brooklyn and Farmingdale; fall and spring, infrequently summer; *Prerequisite:* Completion of the technical courses and laboratories of the junior year; TC 110 and approval of senior faculty department adviser.

## INTERDEPARTMENTAL COURSES

### EE 370 Principles of Electrical Engineering 3:0:0:3

Electrical signals and circuit elements. Network analysis. Transient and sinusoidal steady-state analysis of first and second order circuits. Operational ampli-

fiers. Diode and transistor circuits. Digital and logic circuits. (Cannot be used to satisfy any electrical engineering degree requirements.) *Prerequisite:* MA 107 and PH 108. Co-/Prerequisite: MA 108.

### EE 377 Instrumentation Laboratory 0:3:0:1

Experiments designed to supplement EE 370. Familiarization with electrical measurements, equipment and modern electronic components. (Cannot be used to satisfy any electrical engineering degree requirements.) *Prerequisite:* PH 118. Co-requisite: EE 370.

## GRADUATE COURSES

Graduate courses in electrical engineering are offered on each campus either on a regular basis, annually or in two-year or three-year cycles. Consult the *Graduate Student Manual* for these scheduling cycles as well as for information about day offerings, the summer program and curriculum revisions. Some graduate courses are offered online over the Internet. The list of Internet-based courses is expanding. Students are urged to check with the EE office for the latest information on course offerings and revisions, including special topics courses.

Course number system: the courses below are grouped in terms of the middle digit, which defines the academic area. The first digit represents the level:

- 5 - senior/graduate level
- 6 - first-year graduate level
- 7, 8 - advanced courses
- 9 - miscellaneous courses

Courses in selected topics bearing the same numbers may be repeated for credit if the topics are different, subject to adviser's approval.



## TABLE OF GRADUATE COURSE OFFERINGS

### Linear Systems and Networks

- EL 613 *Applied Matrix Theory*  
EL 617 *System Reliability*

### Signal Processing

- EL 512 *Image Processing I*  
EL 514 *Multimedia Information Processing  
and Communications Lab*  
EL 611 *Signals, Systems and Transforms*  
EL 612 *Image Processing II*  
EL 711 *Advanced Signals and Systems*  
EL 713 *Digital Signal Processing I*  
EL 714 *Digital Signal Processing II*  
EL 715 *Array Signal Processing*  
EL 716 *Multiresolution Signal Decomposition  
Transforms, Subbands and Wavelets*  
EL 911 to  
EL 919 *Selected Topics in Systems*

### Control Systems

- EL 522 *Sensor-Based Robotics*  
EL 621 *System Theory and Feedback Control I*  
EL 622 *Nonlinear and Sampled-Data Control  
Systems*  
EL 625 *Linear Systems*  
EL 721 *System Theory and Feedback II*  
EL 723 *System Optimization Method*  
EL 724 *∞ Frequency Domain Methods in  
Control*  
EL 725 *State Space Design for Linear Control  
Systems*  
EL 821 *Analysis of Stochastic Systems*  
EL 822 *Application of Nonlinear Control to  
Robotics*  
EL 823 *Optimal Control Theory*  
EL 825 *Large-Scale Systems and Decentralized  
Control*  
EL 826 *Adaptive Control*  
EL 827 *Stochastic Control*  
EL 921 to  
EL 929 *Selected Topics in Control Engineering*

### Telecommunications and Networking

- EL 535 *Elements of Communication Networks*  
EL 536 *Principles of Communication Networks I*  
EL 537 *Protocols for Local Area Networks*  
EL 630 *Probability*  
EL 631 *Engineering Applications of Stochastic  
Processes*  
EL 632 *Principles of Analog Communications*  
EL 633 *Detection and Estimation Theory*  
EL 636 *Introduction to Communication  
Networks: Protocols*  
EL 637 *Local and Metropolitan Area Networks*  
EL 638 *SONET/ATM Based Broadband Networks*  
EL 639 *Wireless Communication Systems  
Fundamentals*  
EL 733 *Digital and Data Communications*  
EL 735 *Communication Networks I: Analysis,  
Modeling and Performance*  
EL 736 *Communication Networks II: Design and  
Algorithms*  
EL 737 *Broadband Packet Switching Systems*  
EL 738 *Algebraic Codes*  
EL 739 *Information Theory*  
EL 930 *Wireless Information System Lab*  
EL 931 to  
EL 939 *Selected Topics in Information Science*

### Electronic Devices, Circuits and Systems

- EL 545 *Microwave Integrated and  
Semiconductor Circuits I*  
EL 546 *Microwave Integrated and  
Semiconductor Circuits II*  
EL 547 *Introduction to VLSI Design*  
EL 590 *Advanced Hardware Design*  
EL 641 *Advanced Electronic Circuitry I*  
EL 642 *Advanced Electronic Circuitry II*  
EL 643 *Advanced Electronic Circuitry III*  
EL 644 *VLSI Systems and Architecture Design*  
EL 646 *Integrated Circuit (VLSI) Fabrication  
Techniques*  
EL 647 *Power Electronics*  
EL 941 to  
EL 949 *Selected Topics in Electronics*

### Electro-Optics, Quantum Electronics and Material Science

- EL 551-552 *Electro-Optics I, II*  
EL 651 *Statistical Mechanics I*  
EL 652 *Statistical Mechanics II*  
EL 653-654 *Quantum Electronics I, II*  
EL 654-656 *Quantum Mechanics I, II*  
EL 658 *Fiber Optic Communication*  
EL 950 *Laboratory in Electronics Materials and  
Electro-Optics*  
EL 951 to  
EL 959 *Selected Topics in Quantum Electronics,  
Material Science and Electro-Optics*

### Power Engineering

- EL 564 *Electromechanical Power Conversion*  
EL 568 *Electric Drives I: Characteristic and  
Controls*  
EL 569 *Electric Drives II: Design*  
EL 647 *Power Electronics*  
EL 661 *Introduction to Power Systems  
Engineering*  
EL 662 *Power System Economics and Planning*  
EL 663 *Transients, Surges and Faults in Power  
Systems*  
EL 664 *Relay Fault Protection*  
EL 665 *Power System Stability I*  
EL 666 *Power System Stability II*  
EL 961 to  
EL 969 *Selected Topics in Power*

### Electrodynamic and Wave Phenomena

- EL 571-572 *Engineering Electromagnetics I, II*  
EL 573 *Introduction to Microwave Engineering*  
EL 581 *Introduction to Plasma Engineering*  
EL 671 *Fields and Waves*  
EL 672 *Electrodynamics: Wave Propagation and  
Guidance*  
EL 673 *Electrodynamics: Fields and Materials*  
EL 675 *UHF Propagation for Wireless Systems*  
EL 676 *Fundamentals of Radar*  
EL 771-772 *Radiation and Diffraction I, II*  
EL 773-774 *Guided Waves and Beams I, II*  
EL 775 *Antenna Theory*  
EL 871 *Advanced Ray Methods in Wave  
Propagation*  
EL 970 *Microwave Engineering  
Laboratory/Project*  
EL 971-979 *Selected Topics in Electromagnetic  
Theory*  
EL 981-989 *Selected Topics in Plasmas*

### Department Projects, Readings, Theses, and Seminars

- EL 590 *Advanced Computer Hardware Design*  
EL 591 to  
EL 599 *Selected Topics in Electrical Engineering*  
EL 990-991 *Laboratory Internships I, II*  
EL 997 *Thesis for Degree of MS in EE*  
EL 999 *Dissertation for Degree of Doctor of  
Philosophy in EE*

### LINEAR SYSTEMS AND NETWORKS

#### EL 613 Applied Matrix Theory

2%/0:0:3

In-depth introduction to theory and application of linear operators and matrices in finite-dimensional vector space. Invariant subspaces, elementary divisors, canonic forms and minimax theorems for eigenvalues of hermitian pencils. *Prerequisites: graduate status, MA 108 and MA 109. Also listed under MA 601.*

#### EL 617 System Reliability 2%/0:0:3

Structural reliability, redundancy, bounds on reliability of complex systems. Repairable systems: Markov models, maintainability and availability. Optimization of spare parts inventories, inspection intervals and replacement times. Failure models: accumulated shocks and stress-strength-time. Marginal failures and dependent failures. *Prerequisite: graduate status; EL 630 or MA 561 or equivalent.*

### SIGNAL PROCESSING

#### EL 512 Image Processing I 2%/0:0:3

Introduction of basic concepts and techniques in digital image processing: image acquisition and display using digital devices, properties of human visual perception, sampling and quantization, sampling rate conversion, two-dimensional transforms, linear and nonlinear filtering, morphological operations, contrast enhancement, noise removal, image deblurring, image registration and geometric transformation, and edge detection. Students will learn to perform some basic image processing operations using computers equipped with special imaging hardware such as video cameras and frame grabbers. *Prerequisites: EE 105 and MA 223; MA 153 or knowledge of basic matrix algebra; C-programming skill; senior or graduate status. Instruction approval required for senior students.*

**EL 514 Multimedia Information  
Processing and Communications Lab**  
2%:0:3cd

Multimedia communications refers to integrated processing and communication of video, image, audio and computer-generated graphics and data. This course will provide students with hands-on experience in the acquisition, processing and communication of voice, image and video, as well as multimedia document creation and use of real-time multimedia interactive communications over a variety of channels. Scanning, digitization, image contrast enhancement, color palettes, frame rate conversion, Ethernet LANs and multipoint video conference. Includes weekly experiments and two-week miniproject. This course is subject to final faculty review. *Prerequisites: graduate status or EE 105 (prerequisite) and EE 140 (co-requisite) or instructor's permission.*

**EL 611 Signals, Systems and  
Transforms** 2%:0:0:3

Continuous and discrete linear systems, system function, Fourier transforms, periodic functions,  $Z$  transforms, discrete Fourier series, fast Fourier transforms, analog and digital filters, finite order system functions, digital processing of analog signals, sampling theorems. *Prerequisite: graduate status and EE 105.*

**EL 612 Image Processing II** 2%:0:0:3

Advanced topics in digital image processing, such as image compression, image recovery, medical imaging, advanced television systems, etc. (See department mailings for detailed description of each particular offering.) Both basic principles and recent research developments will be introduced. In addition to the lecture material, each student is required to finish a term project implementing in software or hardware an existing or new image processing algorithm. *Prerequisites: EL 512, EL 630, EL 625; C-programming skill; Graduate status.*

**EL 711 Advanced Signals and  
Systems** 2%:0:0:3

Approximation methods in digital simulation of analog signals. Sampling theo-

rems. Maximum system response under constraints. Analytic properties of Laplace transforms, complex inversion factorization, windows, extrapolation, maximum entropy. Two-dimensional and Hankel transforms. Diffraction. Fourier optics. Ambiguity functions and pulse compression. Spectral estimation. *Prerequisite: graduate status or EL 611.*

**EL 713 Digital Signal Processing I**  
2%:0:0:3

Time and transform domain description of discrete-time signals and filters,  $Z$ -transforms, difference equations, discrete Fourier analysis and the FFT. Properties and design of recursive and nonrecursive filters. Effects of finite precision arithmetic and round-off errors. Hardware realizations of digital filters. Introduction to spectral analysis. *Prerequisites: graduate status and EL 611.*

**EL 714 Digital Signal Processing II**  
2%:0:0:3

Two-dimensional signals and systems: Fourier representations and multidimensional sampling, 2-D discrete Fourier transform and convolution. Difference equations,  $Z$ -transforms and multidimensional stability. Design and implementation of nonrecursive and recursive digital filters. Multiparameter statistical estimation theory: the principle of maximum likelihood. Signal parameter estimation in additive noise and performance degradation due to parameter uncertainty. The Kalman filter: steady state theory and frequency domain analysis. Kalman filters for smoothing, correlated signal in noise and colored noise. *Prerequisites: graduate status, EL 631 and EL 713.*

**EL 715 Array Signal Processing**  
2%:0:0:3

General sonar and radar array processing concepts. Array performance considerations. Narrowband and broadband signal processors. Classical and high resolution techniques for 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 uncorrelat-

ed 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. *Prerequisite: graduate status, EL 611 and EL 631.*

**EL 716 Multiresolution Signal  
Decomposition: Transforms,  
Subbands and Wavelets** 2%:0:0:3

A unified treatments of signal decomposition methods for coding, compression and feature extraction. Orthonormal block transforms: sinusoidal and polynomial based transforms; decorrelation and compaction properties; and optimal quantizers. Subband filter banks: multi-rate sampling; decimation, interpolation, polyphase expansions; Mband filter banks for multichannel and multiresolution expansions; and alias-free and perfect reconstruction designs. Wavelets: time frequency localization, the short time Fourier and Gabor transforms; the orthonormal wavelet family; "Zoom-in" property; link to dyadic filter banks; and continuous and discrete wavelet transforms. *Prerequisite: graduate status and EL 713.*

**EL 911-919 Selected Topics in  
Systems** each 2%:0:0:3

Selected topics of current interest in systems and networks. (See departmental mailing for detailed description of each particular offering.) *Prerequisite: specified when offered.*

**CONTROL SYSTEMS**

**EL 522 Sensor Based Robotics**  
2%:0:0:3

Robot mechanisms, robot arm kinematics (direct and inverse kinematics), robot arm dynamics (Euler-Language, Newton-Euler, and Hamiltonian Formulations), trajectory planning, sensing, end-effector mechanisms, force and moment analysis, introduction to control of robot manipulators. *Prerequisite: graduate status. Pre-/Co-requisite: EE 106. Also listed under ME 661.*

**EL 621 System Theory and Feedback Control I** 2%:0:0:3

Design of single-input-output systems in the frequency domain. Stability of interconnected systems from component transfer functions. Parameterization of stabilizing controllers. Introduction to optimization (Wiener-Hopf design). *Prerequisite: graduate status and EE 106.*

**EL 622 Nonlinear and Sampled-Data Control Systems** 2%:0:0:3

Introduction to nonlinear systems. Phase plane analysis, nonlinearities, linearization, limit cycles and averaging. Stability techniques: describing function, Lyapunov functions, Popov locus and circle criterion. Analysis and design of sampled-data systems by Z-transforms and state variable methods. *Prerequisites: graduate status, EL 625 and EE 106 or equivalent.*

**EL 625 Linear Systems (formerly EL 610)** 2%:0:0:3

Basic system concepts. Equations describing continuous and discrete-time linear systems. Time domain analysis, state variables, transition matrix and impulse response. Transform methods. Time-variable systems. Controllability, observability and stability. *Prerequisite: graduate status and EE 105. Also listed under ME 670.*

**EL 721 System Theory and Feedback II** 2%:0:0:3

A continuation of EL 621 for multi-input-output systems. Matrix fractions, optimal and suboptimal design considerations for two-degree-of-freedom systems. *Prerequisites: graduate status, EL 621 and EL 613.*

**EL 723 System Optimization Method** 2%:0:0:3

Formulation 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. *Prerequisite: graduate status, EL 625 or EL 613.*

**EL 724  $H^\infty$  Frequency Domain Methods in Control** 2%:0:0:3

Systems and operators, stabilizability, parameterization of stabilizing controllers,  $H^\infty$  weighted sensitivity minimization for rational plants,  $H_2$  controller and  $H^\infty$  controller design. *Prerequisites: graduate status, EL 621 and EL 725. Also listed under ME 870.*

**EL 725 State Space Design for Linear Control Systems** 2%:0:0:3

Topics to be covered include canonical forms; control system design objectives; feedback system design by pole placement; linear observers; the separation principle; linear quadratic optimum control; random processes; Kalman filters as optimum observers; the separation theorem; robust control; and the servo compensator problem. *Prerequisite: graduate status, EL 625. Also listed under ME 671.*

**EL 821 Analysis of Stochastic Systems** 2%:0:0:3

Stochastic difference and differential equations. Wiener process and Markov systems. Kolmogorov's equations for Markov systems. Stability of stochastic systems: stochastic Lyapunov functions, moment equations. *Prerequisite: graduate status and EL 631.*

**EL 822 Application of Nonlinear Control to Robotics** 2%:0:0:3

Differential geometric approaches for control of nonlinear systems and applications to robot manipulators. Introduction to Lie algebra and Lie bracket. Multivariable inverses for nonlinear systems, external feedback linearization and zero dynamics. Application of nonlinear control to robotics: inverse dynamics, feedforward control, PD and PID controllers, variable-structure control, adaptive control techniques (STR and MRAC) and force control. *Prerequisite: graduate status and EL 725 (EL 522 is recommended but not essential). Also listed under ME 860.*

**EL 823 Optimal Control Theory** 2%:0:0:3

Optimal control problem for deterministic systems with various constraints. Solution for both continuous and

discrete-time systems using the maximum principle and dynamic programming. Hamilton-Jacobi theory as applied to the synthesis problem. *Prerequisite: graduate status, EL 723 and EL 625. Also listed under ME 771.*

**EL 825 Large-Scale Systems and Decentralized Control** 2%:0:0:3

Introduction to analysis and synthesis of large-scale systems. System order reduction algorithms, interconnected system stability, series expansion and singular perturbation. Decentralized control: decentralized fixed modes, LQR, frequency-shaped cost functionals and overlapping decompositions. *Prerequisites: graduate status and EL 725 or instructor's permission. Also listed under ME 873.*

**EL 826 Adaptive Control** 2%:0:0:3

Controllable and observable system models (ARMA models), parameter estimation (least squares, projection algorithm, lattice filters), one and multi-step ahead prediction control, minimum variance, pole placement, LQG control, model reference adaptive control. *Prerequisite: graduate status and EL 725 or equivalent. Also listed under ME 871.*

**EL 827 Stochastic Control** 2%:0:0:3

Introduction to stochastic control, stochastic processes, covariance and spectral density, stochastic state models, spectral factorization of continuous or discrete time processes and parametric optimization. Introduction to prediction and filtering theory: Wiener and Kalman filters. *Prerequisite: graduate status, EL 625 and EL 631. Also listed under ME 872.*

**EL 921-929 Selected Topics in Control Engineering** each 2%:0:0:3

Topics of current interest to feedback and control system engineers. (See department mailing for detailed description of each particular offering.) *Prerequisite: specified when offered.*

**TELECOMMUNICATIONS  
AND NETWORKING****EL 535 Elements of Communications  
Networks** 2%:0:0:3

An introductory course in telecommunications networks. Review of calculus and probability theory in the context of telecommunications. Modulation of sinusoidal waves. Amplification and regeneration. Characterization of telecommunications traffic in terms of spectrum, capacity, response and duty cycle. Voice communications systems, switches, PBXs and transmission options. Circuit switching. Facsimile, image and video communications. ISDN and other integrated services approaches. *Prerequisite: graduate status.* This course cannot be applied towards degrees offered by the EE Dept.

**EL 536 Principles of Communication  
Networks (formerly EL 635)** 2%:0:0:3

An introductory course in data communications, computer communications and networking. Examples of networks. Data communications principles: transmission, digital and analog data and signalling and encoding. Data communication techniques: asynchronous and synchronous transmission, error detection, data link control and multiplexing. Circuit switching and packet switching, local metropolitan area networks. ISDN and Broadband ISDN, frame relay and other high speed networks. Introduction to protocols, architecture, and Internetworking. *Prerequisite: Seniors may take course; juniors must have a GPA of >3.0, and preferably EE 105. Co-requisite: MA 222 or MA 223 or instructor's permission.*

**EL 537 Protocols for Local Area  
Networks** 2:3:0:3

This course introduces the student to some basic local area networking technologies and protocols in a set of lectures and laboratory experiments. 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: graduate status and EL 536 (formerly EL 635).*

**EL 630 Probability (formerly EL 531)**  
2%:0:0:3

Events, probability, repeated trials. Random variables distributions moments, characteristic functions. Functions of random variables. Sequences of random variables. Limit theorems, Engineering applications of statistics. *Prerequisite: graduate status and MA 223.*

**EL 631 Engineering Applications of  
Stochastic Processes** 2%:0:0:3

Correlation, power spectrum, coherence, with applications in linear systems. Nonstationary signals, normal processes, mean square estimation, spectral analysis. Topics in Markov processes. *Prerequisite: graduate status and EL 630.*

**EL 632 Principles of Analog  
Communications** 2%:0:0:3

Performance analysis of AM and FM systems, FM bandwidth, Hilbert transform and its applications and noise models. Threshold effect in FM receivers and the application of phase locked loops to threshold extension. Sampling theorem, pulse modulation, A/D conversion pulse code modulation (PCM) and delta modulation, and pulse design. *Prerequisite: graduate status, EE 140 or equivalent and MA 223 or equivalent.*

**EL 633 Detection and Estimation  
Theory** 2%:0:0:3

Detection of signals in noise, matched filters, M-ary digital communications. Signal detection and feature extraction in noisy environment based on likelihood ratio tests. Game-theoretic formulation of classification problems. Bayesian and point estimators: near-optimum detectors. Combined estimation and detection. Wiener theory and Kalman-Bucy filters. *Co-requisite: graduate status and EL 631.*

**EL 636 Introduction to Communica-  
tions Networks: Protocols** 2%:0:0:3

A continuation of EL 536 (formerly EL 635) with emphasis on higher layer protocols. Overview of the seven layer OSI model. Review of data link and networking layer protocols. Introduction to routing and internetworking. Transport layer

considerations. Connection management. Analysis of major session, presentation and application layer protocols. Emphasis on issues involved in interactive, file transfer and mail transport. Discussion of syntax and Abstract Notation One (ASN.1). Introduction to directory services, remote procedure calls and client-server computing. *Prerequisite: graduate status and EL 536 (formerly EL 635).*

**EL 637 Local and Metropolitan Area  
Networks** 2%:0:0:3

Introduction. Local Area Networks: CSMA/CD, Token Ring, Token Bus: IEEE Standards, protocols and performance analysis. LAN interconnection: Bridges, Routers, Gateways. Metropolitan Area Networks: FDDI, DQDB: Standards and performance analysis. Higher Level Protocols used in LAN/MANs; LAN/MAN management, LAN/MAN interconnection: Frame Relay, ISDN, emerging standards and protocols. Other current topics. *Prerequisites: graduate status. EL 536 (formerly EL 635) or EE 392.*

**EL 638 SONET-/ATM-Based  
Broadband Networks** 2%:0:0:3

Future broadband networks will be based on SONET (Synchronous Optical Network) standards and ATM (Asynchronous Transfer Mode) techniques. This course covers three layers of broadband network transfer protocols, namely, SONET, ATM, and ATM adaptation layer (AAL), as well as design implementation issues of transporting connectionless data packets (IP datagram and SMDS packets) over ATM networks, signaling/routing, LAN emulation and congestion flow control. *Prerequisites: graduate status and EL 536 (formerly EL 635).*

**EL 639 Wireless Communications  
Systems Fundamentals** 2%:0:0:3

Overview of evolving radio communications technology and wireless information networks. Frequency planning and standards activities. Resource sharing and reuse: trunking efficiency, cellular approach, sectorization, smart antennas. Basic features of radio propagation: loss, fading delay spread, Doppler shift. Characterization of radio channels: deterministic models, empirical loss predic-

tion, narrowband statistical models (log-normal, Rayleigh), wideband statistical models. Fading, noise and interface counteractions: diversity combining, coding, equalization, power control. Modems: QPSK, DQPSK, MSK, GMSK. Codecs: vocoder, linear predictive coding, vector quantization. Spread spectrum: direct sequence, frequency hopping. Medium access protocols. Multi-access methods: FDMA, TDMA, CDMA. Traffic engineering: blocking probability, Erlang-B model, channel allocation methods, hand-off, performance enhancement. *Prerequisites: graduate status and EL 536 (formerly EL 635).*

**EL 733 Digital and Data Communications** 2%:0:0:3

Detection of signals in noise. Signaling through bandlimited channels: intersymbol interference, equalizers. Principles of M-ary communication: signal space methods, optimum detection. Bandwidth efficiency of modulation schemes, combined coding and modulation. Spread spectrum systems: bandwidth expansion schemes performance in jamming and multiuser environments. *Prerequisites: graduate status, EE 140 and EL 630.*

**EL 735 Communication Networks I: Analysis, Modeling and Performance** 2%:0:0:3

Analysis, modeling and performance of centralized and distributed data communication networks. Modeling of user traffic, communications link and processors. Queueing analysis. Packet-switched networks. Time delay analysis of networks. Capacity assignment. Concentration, multiplexing, polling and buffer analysis. Multiple access for broadcast networks-satellites, ALOHA, ground radio, local area networks. *Prerequisites: graduate status, EL 630 and EL 536 (formerly EL 635).*

**EL 736 Communications Networks II: Design and Algorithms** 2%:0:0:3

Principles of network design, network design algorithms, centralized network design, static and dynamic routing algorithms, concentrator and switching node location, network reliability analysis, application of minimum spanning tree and shortest path algorithms to problems in network design, distributed network

design, case studies. *Prerequisite: graduate status and EL 536 (formerly EL 635) and knowledge of data structures.*

**EL 737 Broadband Packet Switching Systems** 2%:0:0:3

Broadband integrated service digital networks (B-ISDNs) provide end-to-end transport for a wide range of services, such as voice, data, image and video signals. Broadband packet switches are essential components in B-ISDN and many architectures have been proposed. In this course, we will discuss these switches and compare their performance and implementation complexity. Course topics include Introduction of B-ISDN and Asynchronous Transfer Mode (ATM) Technology, ATM switch design criteria and performance requirement, survey of existing ATM switch architecture, shared-medium switch, shared-batcher-banyan switch, large-scale ATM switch, multicast ATM switch, optical ATM switch and VLSI chips for ATM switches. *Prerequisites: graduate status and EL 536 (formerly EL635).*

**EL 738 Algebraic Codes** 2%:0:0:3

General theory of linear codes. Groups, rings, fields, matrices and vector spaces. Coding and error correction methods. Encoding and decoding cyclic codes. Convolutional codes and other encoding schemes. Capabilities and limitations of error-correcting code. Emphasizes codes used in computers. *Prerequisite: graduate status and a basic knowledge of probability and linear algebra.*

**EL 739 Information Theory** 2%:0:0:3

Concepts of entropy and mutual information as mathematical measures for discrete information sources and discrete communications channels. Source encoding theorems and source coding techniques. Extension to sources with memory, channel capacity and noisy channel coding theory. Extensions to continuous waveforms. *Prerequisite: graduate status and EL 630.*

**EL 930 Wireless Information Systems Lab (formerly EL 932)** 2%:0:0:3

This course will include hands-on experience including a combination of laboratory experiments, lectures and projects

relating to spread spectrum code division multiple access (CDMA) wireless communication systems. Among the specific topics addressed include pseudo-noise codes, 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: EE 140 or equivalent.*

**EL 931-939 Selected Topics in Information Science** each 2%:0:0:3

Selected topics of current interest in information science. (See departmental mailing for detailed description of each particular offering.) *Prerequisite: specified when offered.*

**ELECTRONIC DEVICES, CIRCUITS AND SYSTEMS**

**EL 545 Microwave Integrated and Semiconductor Circuits I** 2%:0:0:3

Transmission line review: co-axial, two-wire, parallel plate transmission lines. Printed transmission lines: microstrip line, stripline and other printed lines; quasistatic analysis, introduction to spectral-domain analysis, Green's functions; characteristic impedance; attenuation, perturbation method. Coupled transmission lines, directional coupler, coupled line filters. Transmission line transitions: bends, junctions, cross-overs, qualitative equivalent models. *Prerequisite: graduate status and EE 160 (or 163).*

**EL 546 Microwave Integrated and Semiconductor Circuits II** 2%:0:0:3

Review of semiconductor physics, introduction to microwave integrated circuits (MICs) S-parameter analysis, flow graphs, stability criteria of amplifiers. Oscillators and amplifiers, noise figure, noise measurement. PN junction diodes, varactors, Schottley-barrier, PIN, IMPATT and Gunn diodes; bipolar and field-effect transistors; device physics and applications to VCO, frequency multipliers, detectors, mixers, attenuators, phase shifters, switches. *Prerequisite: graduate status, EL 545, EE 112.*

## DEPARTMENT OF ELECTRICAL ENGINEERING

### **EL 547 Introduction to VLSI Design System Design** 2%:0:0:3

This course will cover the following subjects: MOS transistor theory; CMOS-BiCMOS logic; CMOS processing technology; latchup; circuit characterization and performance estimation; static/dynamic circuit and logic design techniques; mixed (analog/digital) design, standard cells and gate arrays; clocking strategies; input/output structures; datapath, memory and control logic design. Advanced VLSI CAD tools will be used for layout, timing, functional and mixed mode simulations. *Prerequisites: senior or graduate status, CS 336 and EE 111.*

### **EL 641 Advanced Electronic Circuitry I** 2%:0:0:3

Basic semiconductor physics. Small-signal, low-frequency models for bipolar junction transistors and biasing. Physics, models and biasing for field-effect transistors. General treatment of nonlinear controlled sources. High-frequency models. Single- and multistage broadband small-signal amplifiers, operational amplifiers, discrete and analog integrated circuits. *Prerequisite: graduate status, EE 111 and EE 112.*

### **EL 642 Advanced Electronic Circuitry II** 2%:0:0:3

Tuned circuits and impedance transformers, narrow-band non-linear amplifiers. Tuned-circuit sine-wave oscillators, mixers, AM modulators and demodulators, and FM modulators and demodulators. *Prerequisite: graduate status, EL 641.*

### **EL 643 Advanced Electronic Circuitry III** 2%:0:0:3

Junction and field-effect transistors as switches. Basic digital logic gates and switching circuits. Integrated circuit logic schemes and "building blocks". Sweep circuits and switching circuits. *Prerequisite: graduate status, EL 641.*

### **EL 644 VLSI System and Architecture Design** 2:2:0:3

This course is a continuation of EL 547, and covers top-down design using VHDL: structural design, modeling, algorithmic and register level design,

synthesis; FPGAs; case studies; design for testing. This course provides students with a solid background and hands-on experiences on full-custom VLSI chip design using CMOS technologies. Several design examples of prototyped VLSI chips in high-speed networking are described in the class. Each student or each group (with two students per group) needs to submit a project proposal at the beginning of the semester that outlines the project objective, system and chip architectures, specification of the chip, and approaches and schedule to complete the project. The project includes the design and simulation of a VLSI lab: partitioning, placement and routing, automated synthesis and standard cells. Chips that are designed completely will be sent to foundry for fabrication. Students are supposed to finish and present the project at the end of the semester. The grade will depend on the completion and the presentation of the project. *Prerequisites: EL 547 or instructor's permission.*

### **EL 646 Integrated Circuit (VLSI) Fabrication Techniques** 2%:0:0:3

Study of process technology used to produce integrated circuits with emphasis on silicon technology: bipolar, MOS, and VLSI processes. Definition of process requirements in terms of the circuit structure, i.e., concentration profiles and topographical layout as defined by previously determined mask set. Analysis of the steps from crystal growth through diffusion, ion implantation, oxidation, photolithography, metalization, interconnection and packaging to final tests. Study of impact and process on design rules. *Prerequisites: graduate status and EE 112. Also listed under MT 709.*

### **EL 647 Power Electronics**

See course listings under Power Engineering.

### **EL 941-949 Selected Topics in Electronics** each 2%:0:0:3

Special topics of current interest to staff in the field of electronic devices, circuits and systems. (See departmental mailing for detailed description of each particular offering.) *Prerequisite: specified when offered.*

## **ELECTRO-OPTICS, QUANTUM ELECTRONICS AND MATERIALS SCIENCE**

### **EL 551-552 Electro-Optics, I, II** each 2 1/2:0:0:3

Maxwell equations. Propagation of plane waves: polarization, reflection, refraction, interfaces and multilayers; diffraction; Fourier optics; Gaussian beams; laser resonators; optical fibers and guiding layers; optical waveguide couplers, propagation in anisotropic media; modulators and optical detection. *EL 551 prerequisite: graduate status and EE 164 or equivalent. EL 552 prerequisite: graduate status and EL 551.*

### **EL 651 Statistical Mechanics I** 2%:0:0:3

Equilibrium distributions. Relationships to laws of thermodynamics. Quantum effects. Maxwell-Boltzmann, Fermi-Dirac, Bose-Einstein distributions. Applications to bulk properties of matter and to thermal radiation. Kinetic theory. Nonequilibrium phenomena using Boltzmann transport equation. *Prerequisite: graduate status. Also listed under PH 663.*

### **EL 652 Statistical Mechanics II** 2%: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: graduate status and EL 651 or PH 663. Also listed under PH 664.*

### **EL 653-654 Quantum Electronics I, II** each 2%:0:0:3

Interaction of electromagnetic radiation with quantized matter systems: spontaneous emission, absorption and induced emission; two-level systems; relaxation processes; homogeneous and inhomogeneous lines. Laser devices: Gaseous, solid state and diode lasers. Laser dynamics: Q-switch, mode locked and ultrashort pulse generation. Non-linear optics: Harmonic generation, parametric interactions Raman and Brillouin nonlinearities. Fundamental noise properties of laser

oscillators. *EL 653 prerequisite: graduate status. EL 654 prerequisite: EL 653.*

**EL 655-656 Quantum Mechanics I, II**  
each 2½:0:0:3

Quantum mechanics with applications to atomic systems. The use of Schrodinger's equations. Angular momentum and spin. Problems and approximation methods. Semiclassical theory of field-matter interaction. *EL 655 prerequisite: graduate status. EL 656 prerequisite: EL 655. Also listed under PH 667-668.*

**EL 658 Fiber Optic Communications** 2½:0:0:3

Preview of fiber optic communications, optical fibers, light sources, detectors and modulation techniques. Transmitter, receiver and repeater technology. System applications. Integrated optics. *Prerequisite: graduate status.*

**EL 950 Laboratory in Electronic Materials and Electro-Optics** 0:5:0:3

Selected experiments in electrical properties of materials. Physical properties of semiconductors, Hall effect measurements, photoelectricity, superconductivity, magnetoresistance, masers and lasers, harmonic generation, frequency mixing and modulation in optics and quasi-optic region. Experiments of project type designed to prepare students for independent research in above areas. Lab fee required. *Prerequisite: graduate status.*

**EL 951-959 Selected Topics in Quantum Electronics, Material Science and Electro-Optics**  
each 2½:0:0:3

Topics of current interest dealing with interaction of matter with electromagnetic fields. (See department mailing for detailed description of each particular offering.) *Prerequisite: specified when offered.*

**POWER ENGINEERING**

**EL 564 Electromechanical Power Conversion** 2½:0:0:3

Motion of elementary charged particles in electromagnetic fields. Transformation laws for the electromagnetic field intensities. Magnetoplasma-dynamical

equations. Electrical and mechanical power densities, power density relations, and the design of the armature conductors in terms of power densities. Representation of fields in terms of traveling waves; synchronous and asynchronous interaction. Steady-state performance of synchronous converters. MHD power generation. *Prerequisite: graduate status and EE 160 or EE 163.*

**EL 568 Electric Drives I: Characteristics and Controls** 2½:0:0:3

Transient conditions in electric drives. Load torques, moments of inertia, masses and forces translated to a rotating shaft. Acceleration and deceleration time. Consideration in selecting motor power rating. Motor heating (cooling) under different kinds of duty. Load diagram construction. Speed control of electric drives. Four quadrant operation of dc and ac drives with static converter supply. Worked examples effectively illustrate the application of the mathematical derivations. *Prerequisite: graduate status and EE 180.*

**EL 569 Electric Drive II: Design** 2½:0:0:3

Torque-speed envelopes, electrical and mechanical ports. Modeling of the motor and speed control. Outline of direct approach to design. Mechanical and thermal stress limitations. Magnetic and electrical loading. Relations between flux and current densities. Determination of losses. Scaling laws. Flux plotting techniques. Procedures, computer programs and applications. *Prerequisite: graduate status and EL 568.*

**EL 647 Power Electronics** 2½:0:0:3

Principles of thyristor devices, GTOs, MOSFETs, dynamic characteristics of DC choppers, dependence of turnoff circuits on load characteristics and switched-mode power supplies. Phase control, full wave circuits with inductive load and commutation. Power inverters. *Prerequisite: graduate status, EE 105 and EE 112.*

**EL 661 Introduction to Power System Engineering** 2½:0:0:3

Power system engineering analysis: three-phase circuit calculations, network representations and load flow calcula-

tions. Reliability analysis: generation reliability. Generation costing and economic dispatch. *Prerequisite: graduate status and EE 183 or equivalent.*

**EL 662 Power Systems Economics and Planning** 2½:0:0:3

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. *Prerequisite: graduate status and EL 661.*

**EL 663 Transients, Surges and Faults in Power Systems** 2½:0:0:3

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. *Prerequisite: graduate status and EE 183 or equivalent.*

**EL 664 Relay Fault Protection** 2½:0:0:3

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. *Prerequisite: graduate status and EL 663.*

**EL 665 Power System Stability I** 2½:0:0:3

Introduction to the study of power system dynamics: mathematical modeling of prime movers, power plants, synchronous machines, field exciters transmission lines, relay loads and stabilizers. *Prerequisites: graduate status, EE 106 and EE 183.*

**EL 666 Power System Stability II**  
2%:0:0:3

Study of electrical machine and system dynamics, system governing and generation control prime mover, energy supply, system dynamics and control. *Prerequisite: graduate status and EL 665.*

**EL 961-969 Selected Topics in Power**  
each 2%:0:0:3

Topics of current interest in electric power engineering. (See departmental mailing for detailed description of each particular offering.) *Prerequisite: To be specified when offered.*

**ELECTRODYNAMIC AND WAVE PHENOMENA**

**EL 571-572 Engineering Electromagnetics I, II** each 2%:0:0:3

Engineering applications of electromagnetics. A device-hardware oriented course for graduate and advanced undergraduate students. Topics include hollow conducting waveguides, dielectric guides; two-wire, coaxial and strip transmission lines; linear antennas, arrays, horn and dish antennas. Waveguide components: attenuators, phase shifters; waveguide-coaxial transitions, etc. Electromechanical transducers: loud speakers, microphones, relays. *EL 571 prerequisite: graduate status and EE 160 or EE 163. EL 572 prerequisite: graduate status and EL 571.*

**EL 573 Introduction to Microwave Engineering** 2%:0:0:3

Review of EM theory, transmission lines, S, Z, Y, ABCD parameters, network theory, network analyzer, signal flow graphs, CAD methods. Impedance matching, multisection and tapered impedance transformer, Bode-Fano criteria. Power divider, directional coupler, hybrid circuits. Microwave resonators: series, parallel resonant circuits, stubs, and cavities. Filter theory and design: microstrip and stripline designs, coupled line filters, Kuroda identities, Chebychev and maximally flat filters. *Prerequisite: graduate status and EE 160 or EE 163.*

**EL 581 Introduction to Plasma Engineering** 2%:0:0:3

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. *Prerequisite: graduate status and EE 160 or EE 163.*

**EL 671 Fields and Waves** 2%:0:0:3

The course lays the groundwork to the theory and understanding of electromagnetic fields, their sources and their propagation in the form of waves. The treatment starts from basic physical concepts and develops the description of electromagnetic fields in terms of Maxwell's equations by using vector analysis and related techniques. *Prerequisites: graduate status and EE 160 or EE 163.*

**EL 672 Electrodynamics: Wave Propagation and Guidance** 2%:0:0:3

The electrodynamics of waves guided by metallic and dielectric structures, resonators, radiation and other relevant theoretical aspects of modern electromagnetic engineering are covered. The emphasis is on understanding wave phenomena and on studying the basic concepts and techniques that are useful when treating relevant problems over the entire electromagnetic spectrum. *Prerequisite: graduate status and EL 671.*

**EL 673 Electrodynamics: Fields and Materials** 2%:0:0:3

Interaction of electromagnetic fields with material media from classical viewpoint. Macroscopic description of dielectric, magnetic and conducting materials, energy relations, dispersion and attenuation in dielectrics and ionized media. Wave propagation in anisotropic crystals and ferrites, and waves in inhomogeneous media. *Prerequisite: graduate status and EL 671. Also listed under PH 625.*

**EL 675 UHF Propagation for Wireless Systems** 2%:0:0:3

UHF radio applications for cellular mobile radio telephones, wireless local area networks and personal communications networks. Propagation characteristics of UHF radio signals over a flat earth, buildings in cities and within buildings; basic physical principles underlying propagation and diffraction; signal behavior; theoretical models for predicting propagation characteristics: Huygens' principle; Fresnel zone and diffraction theory; and mathematical models of propagation. *Prerequisites: graduate status and undergraduate electromagnetics course.*

**EL 676 Fundamentals of Radar** 2%:0:0:3

Principles of range and direction find by means of radio echoes. Requirements and limitations of radar, the radar equation and statistical nature of reception. Establishment of design criteria for radar receivers, indicators, modulators and microwave components. Presentation of systems and techniques including MTI, Doppler radars and pulse compression. *Prerequisite: graduate status and EL 611.*

**EL 771-772 Radiation and Diffraction I, II** each 2%:0:0:3

First semester: An introductory level with asymptotic methods for radiation and diffraction. Saddle point approximations of radiation and diffraction integrals for harmonic and transient fields, wave packets; ray description of reflection and refraction, diffracted rays (geometrical theory of diffraction). Second semester: rigorous methods. Eigen-function expansions; discrete and continuous spectra. Green's functions; alternative representations, asymptotic reduction of rigorous integral representations. *EL 771 prerequisite: graduate status and EL 672. EL 772 prerequisite: graduate status and EL 771.*

**EL 773-774 Guided Waves and Beams I, II** each 2%:0:0:3

Theory and application of guided waves and beams in areas of electromagnetics (radar), microwave acoustics and integrated optics. Propagation characteristics of surface and leaky waves; effects of loss;



mode coupling; characterization of discontinuities. Propagation in periodic structures. Beam fields; properties of laser beams; divergence, Fresnel and Fraunhofer approximations; scattering and guiding of beams by planar structures; beam displacement and distortion; coupling to surface waves. *EL 773 prerequisite: graduate status and EL 672. EL 774 prerequisite: graduate status and EL 773.*

**EL 775 Antenna Theory** 2½:0:0:3

Concepts of antenna radiation patterns, radiation resistance equivalent network; gain; effective area; reciprocity. Electromagnetic fields due to prescribed sources. Huygens' principle. Fresnel and Fraunhofer regions. Finite and infinite arrays. Mutual coupling. Aperture antennas. Traveling-wave antennas. Frequency independent antennas. *Prerequisite: graduate status and EL 671.*

**EL 871 Advanced Ray Methods in Wave Propagation** 2½:0:0:3

Asymptotic theory of radiation and diffraction, with emphasis on inhomogeneous and dispersive media. WKB approximations and comparison methods, advanced saddle-point techniques and relation to ray optics. Space-time rays in inhomogeneous dispersive media, diffraction and transition phenomena for transients. *Prerequisite: graduate status and EL 772.*

**EL 970 Microwave Engineering Laboratory/Project** 1:4:0:3

Design, fabrication, testing of passive circuits (couplers and filters), active circuits (amplifier and oscillator) and antennas using printed circuits. Design and simulation using microwave CAD tools (Supercompact, Touchtone, Puff, PCAAMT), HP-8510 automated network analyzer measurement, frequency and time-domain measurements, antenna pattern measurement, printed circuit layout and photoetching. *Prerequisite: EE160; Co-requisite: EL 545 or EL 571.*

**EL 971-979 Selected Topics in Electromagnetic Theory** each 2½:0:0:3

Aspects of electromagnetic and acoustic wave propagation, diffraction and radiation of current interest, including wave interactions with materials and special mathematical and numerical techniques.

(See departmental mailing for detailed description of each particular offering.) *Prerequisite: specified when offered.*

**EL 981-989 Selected Topics in Plasmas** each 2½:0:0:3

Aspects of plasmas of current interest. Subjects drawn from plasma composition dynamics and interactions with electromagnetic fields. (See departmental mailing for detailed description of each particular offering.) *Prerequisite: specified when offered.*

**DEPARTMENT PROJECTS, READINGS, THESIS AND SEMINAR**

**EL 590 Advanced Computer Hardware Design** 2:3:0:3cd

The use of hardware description language VHDL 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. We plan to use programs such as QuickVHDL, modeling and simulation tools from Mentor Graphics or similar large-scale programs. Students will use X-terminals in the UNIX Lab and workstations in the VLSI lab for approximately four hours per week. A design project is required, and students will make a written and oral presentation. *Prerequisites: CS 201, CS 337 and EE188.*

**EL 591-599† Selected Topics in Electrical Engineering** each 2½:0:0:3

Topics of current interest in electrical engineering offered for credit to both selected undergraduate and graduate students. (Call the EE department for detailed description of each particular offering.) *Prerequisite: specified when offered.*

**EL 990-991 Laboratory Internship I, II** each 0:5:0:3

Work in graduate laboratories under immediate guidance of faculty member. May be used as adjunct to or continuation of departmental graduate laboratory courses. *Prerequisite: degree status.*

**EL 993-994 Readings in Electrical Engineering I, II** each 3 units

Designed primarily for students who desire to push toward frontiers of their specialization in electrical engineering, electrophysics or system engineering and who have completed essentially all related course offerings. Readings conducted under guidance of a faculty member who is expert in the fields, generally consists of readings in advanced literature. Examination required. Not more than 3 units may be offered toward the master's degree. *Prerequisite: degree status.*

**EL 995-996 Advanced Projects I, II** each 0:5:0:3

Theoretical and experimental projects in various research areas in electrical engineering and electrophysics for the advanced graduate student. Projects assigned on basis of specialized interest and preparation of the student. A written report or oral examination is required at the discretion of the adviser. *Prerequisite: degree status.*

**EL 997 Thesis for Degree of Master of Science in Electrical Engineering** each 3 units

Independent engineering project demonstrating professional maturity, performed under guidance of adviser. Oral thesis defense and formal, bound thesis volume required. Registration of 9 units required (continuous thesis registration required). *Prerequisite: degree status.*

**EL 999 Dissertation for Degree of Doctor of Philosophy in Electrical Engineering** each 3 units

Original investigation of electrical engineering problem. Must demonstrate creativity and include features of originality and utility worthy of publication in recognized journal. Candidate must successfully defend dissertation orally. Registration of 24 units required (continuous dissertation registration required). *Prerequisite: passing qualifying examination. Registration beyond 12th unit requires passing of area examination.*

# ELECTROPHYSICS PROGRAM

Polytechnic offers a program of study leading to a Master of Science in electrophysics. The program is intended to prepare students to work at the interface between electrical engineering and physics, where new engineering applications of various physical phenomena are developed. Emphasis is placed on wave propagation, electro-optics and plasmas. Students entering the program typically have an undergraduate background in electrical engineering or in physics, a strong interest in physical phenomena and/or applied mathematics and a desire to participate in research.

The program is administered by the Department of Electrical Engineering.

The program of study consists of basic courses in wave propagation, electromagnetic theory and electro-optics offered through the Department of Electrical Engineering. Traditional areas of active research that are covered include propagation and diffraction of waves, antennas, microwave networks, plasmas and solid-state devices. Areas of modern optics that are covered include lasers and optical communications. Additional areas are nonlinear wave propagation, ultrasonic waves in solids and waves in the earth's ionosphere. The basic courses are offered yearly on both the Brooklyn and Farmingdale campuses. Specialized courses may be offered on one or the other campus, or in alternate years on the two campuses.

The electrophysics faculty at Polytechnic has made significant contributions to each of the areas cited above and maintains active theoretical and experimental programs in them. Because the electrophysics program is an outgrowth of these research activities, students in the program are exposed to the most current technical developments in each area and can be guided in research at the forefront of these areas. Experimental research is carried out in laboratories in Farmingdale and Brooklyn. At Farmingdale, experimental facilities include laboratories devoted to semiconductors, microwaves and millimeter waves, gas discharges and plasmas. The Brooklyn campus has laboratories devoted to electro-optics.

## REQUIREMENTS FOR THE MASTER'S DEGREE

The entrance requirements for the 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 the MS in electrophysics, the student must complete a total of 36 units of courses, as described below. An overall grade-point average of B in all graduate courses is required by the University. In addition, a B average is required in specific groups of courses, as indicated below.

### 1. Core Courses

Three courses from among the following:

EL 551	<i>Electro-Optics I</i>
EL 581	<i>Introduction to Plasma Engineering</i>
EL 611	<i>Signals, Systems and Transforms</i>
EL 651	<i>Statistical Mechanics I</i>
EL 653	<i>Quantum Electronics I</i>
EL 671	<i>Fields and Waves</i>

9 Units

2. Two one-year sequences, which may include the above courses. Both of these one-year sequences must be in electrical engineering or physics courses, and at least one must be an EL sequence.

6-12 Units

3. Approved electives. 21-15 Units

Total: 36 Units

A complete course of study, including the choice of the one-year sequences, should be arranged in consultation with an adviser. A master's thesis of 9 units may be included as part of the elective courses. At least 24 of the 36 units must be in courses with an EL prefix.

An overall B average is required in the combination of five to seven courses offered to satisfy categories 1 and 2 above.

The *EE Department Graduate Student Manual* should be consulted for more detailed rules and procedures, including student status, recommended electives and one-year sequences, current areas of research and disqualification for low grades.

### EP 997 Thesis for Degree of Master of Science in Electrophysics

each 3 units

Independent research project demonstrating professional maturity, performed under guidance of adviser. Oral thesis defense and formal bound thesis volume required. Registration of 9 units required (continuous thesis registration required). *Prerequisite: Degree status.*

# SYSTEMS ENGINEERING PROGRAM

Systems engineering is based on the body of theoretical knowledge that underlies the engineering of modern complex systems. Systems engineering is the application of this body of knowledge to the design of systems, usually involving the integration of several disciplines to achieve the desired design objective. The theoretical resources of these fields include selections from among the newer branches of applied mathematics, methods of modeling and simulation, methods for the analysis of signals and systems, the theories of communication and control, the techniques of optimization and of decision making and many of the facets of computer science.

Faced with a diverse and complex scientific environment, the systems engineer may receive assignments crossing traditional lines of engineering applications. Systems engineering is presently applied in areas such as transportation, urban services, bioengineering, resource management, power and energy, and environmental and pollution control.

The program in systems engineering covers, in an interdisciplinary manner, the viewpoints, tools of analysis and mathematical techniques of feedback control, instrumentation and measurement, analysis of data, optimization communication of information and simulation, stressing the use of computers. The systems engineering graduates' orientation and training enable them to participate in the analysis and solution of today's complex technological and societal problems.

The Department of Electrical Engineering administers the program leading to the degree Master of Science in systems engineering. Outstanding students should apply for financial aid in the form of research fellowships, teaching fellowships or partial tuition remission.

Students wishing to continue graduate study towards a PhD in the area of systems may do so in the Electrical Engineering Program.

## REQUIREMENTS FOR THE MASTER OF SCIENCE

The entrance requirement for the Master of Science in systems engineering is a bachelor's degree in engineering or science from an accredited institution, with a superior undergraduate record, including undergraduate courses in differential equations, probability, linear systems, feedback control and computer programming. Students with deficiencies in these areas may be admitted if they take appropriate introductory courses to remedy these deficiencies.

To satisfy the requirements for the MS in systems engineering, the student must complete a total of 36 units of courses, as described below. An overall grade average of B in all courses is required by the University. In addition, a B average is required in specific groups of courses, as indicated below.

### 1. Core Courses

Three courses from among the following:

EL 630	<i>Probability</i>	
EL 625	<i>Linear Systems</i>	
EL 611	<i>Signals, Systems and Transforms</i>	
EL 613	<i>Applied Matrix Theory</i>	
EL 621	<i>Feedback Control I</i>	
MA 683	<i>Statistical Inference I</i>	9 Units

2. Two approved one-year sequences, which may include the above courses. At least one of these sequences must be in EL or CS courses.

6-12 Units

3. Approved electives.

21-15 Units  
Total: 36 Units

A complete course of study, including the choice of the one-year sequences, should be arranged in consultation with an adviser. A master's thesis of 9 units may be included as part of the elective courses. At least 24 of the 36 units must be in courses in engineering subjects, computer science or operations research, and at least 18 units must be in EL or CS prefixed courses.

An overall B-average is required in the combination of five to seven courses offered to satisfy categories 1 and 2 above.

The *EE Department Graduate Student Manual* should be consulted for more detailed rules and procedures, including student status, recommended electives and one-year sequences, current areas of research and disqualification for low grades.

### SE 997 Thesis for Degree of Master of Science in Systems Engineering

each 3 units

Independent engineering project, demonstrating professional maturity, performed under guidance of adviser. Oral thesis defense and formal, bound thesis volume required. Registration of 9 units required (continuous thesis registration required).  
*Prerequisite: Degree status.*

# TELECOMMUNICATION NETWORKS PROGRAM

Telecommunications is a rapidly growing field. From the military communication networks of the early 1950s, telecommunications technology has evolved to find applications in almost all areas of modern society, including banking, reservation systems, office information systems, corporate networks, and the Internet and World Wide Web. Recent challenges include gigabit optical networks, multimedia communications and wireless network access.

The rapid evolution of telecommunications technology demands a broad educational background including today's technological breakthroughs. Polytechnic's master's program in telecommunication networks contains a wide variety of courses ranging from fundamental topics to recent technological advances.

## REQUIREMENTS FOR THE MASTER OF SCIENCE

Admission to the Master of Science in telecommunication networks program 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 recommended. Applicants having comparable degrees in other fields will be considered for admission on an individual basis. Generally, entering students are expected to have a basic knowledge of computer fundamentals such as programming in C++, data structures and computer architecture.

Students having superior academic credentials but lacking sufficient background are admitted in conditional status pending satisfactory completion of several individually specified preparatory courses. These preparatory courses include CS 530 (Introduction to Computer Science), CS 540 (Data Structures and Algorithms) and CS 580: (Computer Architecture and Organization), however, no credit will be allowed for any of the preparatory courses towards this degree (other courses may be required). In some cases such students will be invited to an interview to determine the necessary 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.

Admission with advanced standing is accepted in accordance with Polytechnic regulations published in this catalog. A maximum of 9 units may be applied to the MS in telecommunications networks from previous graduate work at an acceptable institution.

To satisfy the requirements for the master's degree, the student must complete a total of 36 units as described below, with an overall average of B. In addition, a B average is required in the core courses group, as indicated below. Students with an exceptionally strong telecommunications background may be allowed to replace required courses with more advanced electives. Permission of the graduate adviser is required for all courses.

### 1. Core Courses

EL 536	<i>Princ. of Commun. Networks (formerly EL 635)</i>
EL 637	<i>Local and Metrop. Area Networks</i>
CS 613	<i>Computer Architecture I, or CS 623 Operating Systems I</i>
CS 627	<i>Perform. Eval. of Computer Sysys.</i>
CS 682	<i>Network Management and Security</i>
CS 684	<i>Network Protocols I or</i>
EL 537	<i>Protocols for Local Area Networks (an other approved core elective course)</i>

21 Units

In certain rare circumstances, and with approval of the program's director, other CS and EE courses may be used to fulfill the core requirement. For students with the appropriate background, CS 627 may be replaced by EL 735 (Communications Networks I.) Students may not take both CS 684 and EL 537.

### 2. Project Requirements

#### CS 687 Project in Telecommunications Networks or EL 995 Advanced Project I

All students in the MS in Telecommunications Networks program are required to take a project course, either CS 687 or EL 995. A project adviser must be obtained and a project plan approved before registering. The project should be completed in one semester. If not, it must be completed in the next semester, and the student will have to register for 0.5 credits. After obtaining the graduate adviser's approval, a student may substitute CS 687 with a traditional EE or CS master's thesis or project, as long as it is telecommunications-related. If the thesis option is chosen, additional thesis credits will count towards the free elective courses.

3 Units

### 3. Program Elective Courses

Students are required to take two courses (not already counted towards the core requirement) from the following list of optional courses:

CS 603	<i>Design and Analysis Algorithms I</i>
CS 613	<i>Computer Architecture I</i>
CS 623	<i>Operating Systems I</i>
CS 685	<i>Network Protocols II</i>
CS 606	<i>Software Engineering I</i>
CS 608	<i>Principles of Database Systems</i>
EL 638	<i>SONET/ATM-Based Broadband Networks</i>
EL 639	<i>Wireless Communication Systems Fundamentals</i>
EL 735	<i>Communications Networks I</i>
EL 736	<i>Communications Networks II</i>
EL 737	<i>Broadband Packet Switching</i>
EL 930	<i>Wireless Information Systems Lab</i>
MG 652	<i>Telecommunications Regulation, Policy and Law</i>
MG 654	<i>Economics of Information Systems</i>

6 Units

### 4. Free Elective Courses

Any two graduate elective courses from EE or CS, approved by a program adviser.

6 Units of free electives

Total: 36 Units

# DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES

*Head:* Richard E. Wener

The Department of Humanities and Social Sciences offers a variety of degree programs, minors, concentrations and elective courses. Through these courses and programs, we hope to provide a means whereby students can expand their understanding of the society and culture in which they live and obtain skills that can lead to successful and enriching careers. In a world of narrowly focused specialists, human progress depends upon those who can synthesize knowledge and communicate it with real understanding. Such persons are not locked into rigid academic disciplines and patterns of thinking; they are as intellectually comfortable in the sciences as in the humanities and social sciences. While such persons are rare, they are in demand in virtually every profession and can expect to fill vital roles in fields which are only now being explored. It is the mission of the department to provide students with the kind of integrated education that can give them a breadth of knowledge and perspective.

The department fulfills its mission with degree programs for humanities and social science majors and plays an essential role in the education of students who are majors in other departments. Today's engineers and scientists must have a background in the humanities and social sciences in order to make well-reasoned decisions involving human values implicit in technological options, to understand the ways human beings see themselves and the natural and social worlds, and to communicate effectively.

All majors and minors are available at the Brooklyn campus. For availability at the Farmingdale campus, check with the departmental office.

## DEGREE PROGRAMS

### *Undergraduate Degrees*

The department offers the following undergraduate degrees:

- BS in Journalism and Technical Writing (Technical Communication)

BS in Social Sciences with concentrations in

- Pre-Law
- History and Philosophy of Science and Technology
- World History
- Economics
- Psychology and Behavioral Sciences (Anthropology and Sociology)

BS in Humanities with concentrations in

- Philosophy
- Literature
- Humanistic Studies (multidisciplinary)

### *Graduate Degrees*

The department offers the following graduate degrees:

- MS in Specialized Journalism (Technical and Professional Communication)
- MS in History of Science
- MS in Environment-Behavior Studies
- Certificate in Human-Computer Interaction

### *The Undergraduate Degree*

Students working toward one of the bachelor of science degrees take a core curriculum in contemporary liberal arts, together with their chosen course concentrations. The core curriculum was conceived to meet the increasing need for specialists in the social sciences, technical writing and the humanities who

are also familiar with computers, the physical sciences and engineering and mathematics. The degree is interdisciplinary, with emphasis on developing integrated historical, economic, behavioral and cultural perspectives on human society. The graduate and undergraduate programs exploit the advantages and strengths of a technological university and thus are particularly beneficial to students who combine strong interests in the social sciences, humanities, or journalism and technical writing with interests in science and technology.

### *Dual Undergraduate Degrees*

Students may pursue dual undergraduate degrees in one of the humanities or social sciences fields listed above and in engineering, science or mathematics. Besides completing all requirements for degrees in engineering, science or mathematics, students must complete an additional 33 credits of humanities and social science courses. These courses must be approved by a departmental adviser.

### *Minors*

The department offers minors in technical writing, pre-law, economics, psychology and behavioral sciences, history, and history of science and philosophy. Students take 15 credits in consultation with a departmental adviser.

### *The Writing Placement Exam*

As freshmen, all students admitted to Polytechnic University are placed at appropriate levels in the freshman English sequence. On the basis of an English composition placement test evaluated by the department, most students are placed in one of the standard freshman courses (HU 101 or HU 103); some may be exempted and placed in HU 200, the second required course of the sequence; others may first be required to take one or more semesters of an introductory course in English (HU 008 or HU 009) with a reduced course load (a maximum of 14 credits).

**Research Centers**

The department houses the Philosophy and Technology Studies Center (Rogers Hall 329 B; 718/260-3241). The center was established to encourage discussion among philosophers, engineers, computer scientists and other practitioners from the scientific and technological professions on the ethical, political and general cultural connotations of contemporary technological activity, as well as straightforward research in the traditional philosophical questions concerning technology. The Philosophy and Technology Studies Center fosters various types of interdisciplinary education.

By bringing the humanities, communications and social science disciplines closer together and reaching out to other academic departments in the University, the center helps facilitate the exploration of intellectual common ground.

**Instructional Labs**

The Writing Center (Rogers Hall 331) provides free consultation in writing and speaking for undergraduate and graduate students. The center also offers writing tutorials via e-mail and sponsors special workshops on writing and grammar throughout the semester. Tutoring is also available at the Farmingdale campus.



**PROFESSORS**

**Wolhee Choe**, Professor of English  
PhD, City University of New York  
*Nineteenth-century English literature, literary theory*

**Anne Eisenberg**, Professor of Humanities and Communications  
PhD, New York University  
*Science Writing*

**David Mermelstein**, Professor of Economics  
PhD, Columbia University  
*Political economy, macroeconomic policy, money and banking*

**ASSOCIATE PROFESSORS**

**Sheila Lehman**, Research Associate Professor of Psychology  
MA, Columbia University  
*Human-computer interaction, environmental psychology, multimedia environments*

**Sylvia Kasey Marks**, Associate Professor of English  
PhD, Princeton University  
*Shakespeare, Samuel Richardson, the eighteenth- and nineteenth-century British novel, public speaking, expository writing*

**F. David Mulcahy**, Associate Professor of Anthropology  
PhD, University of Massachusetts  
*China, Spain, language and culture*

**Lowell L. Scheiner**, Associate Professor of Humanities and Communications  
MS, Columbia University Graduate School of Journalism  
MA, Columbia University  
*Technical writing, journalism*

**Romualdas Sviedrys**, Associate Professor of History of Technology  
PhD, Johns Hopkins University  
*Technology forecasting and technology assessment, history of technology and science since 1750, technology transfer to developing countries*

**Richard E. Wener**, Associate Professor of Psychology and Department Head  
PhD, University of Illinois at Chicago  
*Environmental psychology, crowding, assessment of the built environment*

**ASSISTANT PROFESSORS**

**Alexi Assmus**, Assistant Professor of History of Science and Technology  
PhD, Harvard University  
*U.S. science and technology, history of modern physics, technology policy and assessment*

**Jonathan Bain**, Assistant Professor of Philosophy of Science  
PhD, University of Pittsburgh  
*Quantum theory, philosophy of space and time*

**Teresa Feroli**, Assistant Professor of English  
PhD, Cornell University  
*Renaissance literature, Shakespeare, women's studies*

**Jean Gallagher**, Assistant Professor of English  
PhD, City University of New York Graduate Center  
*Feminist theory, nineteenth- and twentieth-century American literature, composition and rhetoric*

**Victor Hugo Lane IV**, Assistant Professor of History  
PhD, University of Michigan  
*Eastern European history*

**Jonathan Soffer**, Assistant Professor of History  
PhD, Columbia University  
*American history, pre-law adviser*

**INDUSTRY FACULTY**

**Noel N. Kriftcher**, Industry Professor and Director of David Packard Center for Technology and Educational Alliances  
EdD, Hofstra University

**Harold Sjurson**, Industry Professor of Philosophy and Director, Philosophy and Technology Studies Center  
PhD, New School for Social Research  
*History of philosophy, ethics, philosophy of science and technology*

**INSTRUCTORS**

**Elizabeth Chesla**, Instructor of English and Coordinator, Technical and Professional Communication Program  
MA, Columbia University

**Lauren Kozol**, Instructor of English  
MA, City University of New York

**Donald Phillips**, Instructor of Psychology  
BS, Polytechnic Institute of New York  
*Experimental and physiological psychology, physical anthropology, paleontology*

**Bethany Saltman**, Instructor of English  
MFA, Brooklyn College

**ADJUNCT FACULTY**

**Asya Blue**, Adjunct Instructor of  
Technical and Professional  
Communication  
BFA, Parsons School of Design

**Lucielle Borelli**, Adjunct Instructor of  
Technical and Professional  
Communication  
MA, Fairleigh Dickinson University

**Diana Bryant-Friedman**, Adjunct  
Instructor of English  
MA, New York University

**James Roderick Burns**, Adjunct  
Instructor of English  
MA, State University of New York at  
Stonybrook

**Noel Caban**, Adjunct Instructor of  
Technical and Professional  
Communication  
BFA, State University of New York at  
Buffalo

**Deborah Cassetta**, Adjunct Instructor  
of History  
MPhil, New York University

**Allen Cobrin**, Adjunct Instructor of  
English  
MA, Columbia University

**Reva Ehrlich**, Adjunct Assistant  
Professor of Speech  
Doctor of Arts, St. John's University

**Susan Fowler**, Adjunct Instructor of  
Technical and Professional  
Communication  
BA, University of Hartford

**Susan Fox**, Adjunct Instructor of  
Technical and Professional  
Communication  
MA, George Mason University

**Frances Gambino**, Adjunct Instructor  
of Technical and Professional  
Communication  
MS, Rensselaer Polytechnic Institute  
MBA, New York University

**Julia Keefer**, Adjunct Instructor of  
Technical and Professional  
Communication  
PhD, New York University

**Dianne Kohl**, Adjunct Instructor of  
English  
MA, State University of New York at  
Stonybrook

**I. Leonard Leeb**, Adjunct Associate  
Professor of History  
PhD, Columbia University

**Barbara Lynch**, Adjunct Instructor of  
Speech  
MA, Teachers College, Columbia  
University

**Valerie Mantz**, Adjunct Instructor of  
MA, Hunter College

**Louis Menashe**, Adjunct Professor of  
History  
PhD, New York University

**Olga Nachimovsky**, Adjunct Instructor  
of Technical and Professional  
Communication  
BA, Yeshiva University

**Alan M. Nadler**, Adjunct Instructor of  
English  
MFA, Columbia University

**Julie Price**, Adjunct Instructor of  
English  
BA, St. John's University

**Jilliau Quinn**, Adjunct Instructor of  
English  
MA, State University of New York at  
Stonybrook

**Colleen M. Sandford**, Adjunct  
Assistant Professor of English  
PhD, University of Illinois

**Scott Wilson**, Adjunct Instructor of  
Technical and Professional  
Communication  
BA, California State University at  
Northridge

**EMERITUS FACULTY**

**Lester Bumas**  
**John G. Cavanna**  
**Duane DeVries**  
**Marvin Gettleman**  
**Helmut Gruber**  
**Frederick C. Kreiling**  
**Clifford Osborne**  
**Bernard Rechtschaffen**  
**Thomas B. Settle**

# ENVIRONMENT-BEHAVIOR STUDIES PROGRAM

*Director:* Richard Wener

The Department of Humanities and Social Sciences offers a Master of Science program in environment-behavior studies. This field applies the methods and knowledge of the behavioral sciences to understand the relationship between people and the built or natural environment. This program is aimed at training students to be capable of addressing 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.

This program offers a Master of Science degree (36 credits), Certificate in Environment-Behavior Studies (15 credits) and a Certificate in Human-Computer Interaction (15 credits).

## DEGREE REQUIREMENTS FOR MS IN ENVIRONMENT-BEHAVIOR STUDIES

### Core Courses (15 units)

SS 908	<i>Experimental Psychology I</i>
SS 909	<i>Experimental Psychology II</i>
SS 920	<i>Seminar in Psychology</i>
SS 926	<i>Environmental Psychology</i>
MA 552	<i>Applied Statistics I</i>

### Thesis (up to 6 units):

SS 997	<i>Master's Thesis</i> (can be repeated once)
--------	--

### Electives (15 Credits):

Students may take up to three graduate psychology elective courses and two from any department, chosen in consultation with their adviser.

## CERTIFICATE PROGRAM IN ENVIRONMENT-BEHAVIOR STUDIES

Students may take a five-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.

## CERTIFICATE PROGRAM IN HUMAN-COMPUTER INTERACTION

The Certificate in Human-Computer Interaction (HCI) is offered jointly by the Department of Humanities and Social Sciences and by the Department of Computer and Information Sciences. Computer industry leaders have identified HCI—the interdisciplinary field concerned with the design, development, implementation and evaluation of the user interfaces of computer-based systems, and the study of a broad range of related phenomena—as a primary challenge for the late 90s and beyond. Currently HCI is one of the most rapidly developing areas in feeder disciplines, such as applied behavioral science, computer science and industrial, graphic and information design. Thus, graduates of an HCI certificate program will have a highly marketable skill for which demand outpaces supply. This certificate program provides five-course sequences that enable students to take rigorous graduate level courses, some of which could be used in partial fulfillment of the requirements for a master's degree in either computer science or environment and behavior, if the student chooses to take further courses beyond the certificate program.

### Admission Criteria

Students are required to have a bachelor's degree from an accredited institution. An introductory course in computer science or equivalent demonstrated knowledge is also a prerequisite for admission to the program. Preference will be given to those with a minimum of three years of experience in a professional or managerial position related to software development, or with a background in industry-based behavioral research.

All students will be required to submit a formal application for admission to the program, along with two letters of recommendation, one from a current or recent employer, and one from a person acquainted with the student's performance in an academic setting, along with

an official transcript of undergraduate work and any graduate work. Admission to the HCI certificate program does not constitute admission to any master's degree program.

### Curriculum

The HCI certificate program is a 15-credit-hour program designed to provide both knowledge about the cutting edge issues in HCI research and practice, and experience with state-of-the-art technologies for advanced user interface development and evaluation. Students will be required to take two core courses, including a highly structured capstone HCI Practicum, and three elective courses, which can be chosen from among the eight to be offered, for a total of five 3-credit courses.

All entering students must have taken the prerequisite course CS 200/530, Introduction to Computer Science (or equivalent).

### HCI Core Courses

**All students must take two core courses:**

SS/CS 9097	<i>Human-Computer Interaction</i>
SS/CS 990	<i>HCI Practicum</i>

### Elective Courses

**Students can choose three electives from the following list:**

SS 906	<i>Human Cognition and Information Processing</i>
SS 909	<i>Research Methods in the Social Sciences</i>
CS 540	<i>Data Structures</i>
CS 606	<i>Software Engineering (Prerequisite: CS 540 or equivalent)</i>
CS 914	<i>Usability Engineering</i>
CS 653	<i>Interactive Computer Graphics (Prerequisite: CS 540 or equivalent)</i>
JW 504	<i>Fundamentals of Design for Interactive Communication</i>
JW 646	<i>End-User Training</i>



<p><b>COURSE DESCRIPTIONS</b></p>
---------------------------------------

**SS 905 Psychology: Applied** 2%:0:0:3

This course will show how various problems, particularly in work, can be solved through the judicious use of psychological principles. Phenomena addressed will 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 will learn to employ the method of behavioral analysis in gaining an understanding of various problems. They will select a problem, do a behavioral analysis and, finally, modify it as a class project. *Prerequisite: SS 189.*

**SS 906 Human Cognition and Information Processing** 2%:0:0:3

Human cognitive capabilities including natural language and information processing. 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. *Prerequisite: SS 189.*

**SS 907 Human-Computer Interaction** 2%:3:0:3

This course will introduce students to human behavioral issues in the design and use of interfaces for information systems. Basic issues of behavioral research and evaluation methods will be discussed. Sensory systems and memory and learning theory relevant to human factors systems will be reviewed and related to specific interface issues, such as interaction devices, dialogue design and reference material. The focus will be on understanding the issues involved in creating systems amenable to human use. *Prerequisite: SS 189 or equivalent.*

**SS 908 Experimental Psychology I** 2%:3:0:3

Theory and methods of measurement of sensory functions in human and animal subjects. Examination of the concept of the threshold and problems of its measurement. Investigation of learning, both motor and verbal, and both simple and complex, including problem solving and creative thinking. Students will perform a series of experiments with human and animal subjects. *Prerequisite: SS 189.*

**SS 909 Experimental Psychology II** 2%:3:0:3

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 naturalistic settings. The course focuses upon 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: SS 189.*

**SS 910 Theories of Learning** 2%:0:0:3

Programmed learning, behavior therapy, attitude function and social interaction. All students are required to perform one experiment on learning under guidance of instructor. Available to undergraduate majors in social science. *Prerequisite: SS 189 or equivalent.*

**SS 911 Psychology of Language and Communication** 2%:0:0:3

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. Available to undergraduate majors in social science. *Prerequisite: SS 189 or equivalent.*

**SS 912 Sensation and Perception**  
2%:0:0:3

Review of different sensory systems: vision, audition, taste, smell, touch, temperature sensitivity, vestibular and kinesthetic senses and their relations to non-sensory controlling stimuli such as states of the organism, learning and social psychological variables. 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. *Prerequisite: SS 189 or equivalent or instructor's permission.*  
**Also listed under BE 675.**

**SS 913 Physiological Psychology**  
2%:0:0:3

Physiological and anatomical bases of behavior. Memory, motivation, emotion, sleep reward mechanisms, psychosurgery and higher cortical functions. *Prerequisite: SS 189.*  
**Also listed under BE 695.**

**SS 915 Behavioral and Societal Aspects of Transportation** 2%:0:0:3

Behavioral analyses of transportation decision-making and travel characteristics. User needs in design of transportation systems: crowding, social isolation, crime, comfort and convenience. Social impacts of transport systems on communities. *Prerequisite: undergraduate introductory psychology or MG 601 or equivalent.*  
**Also listed under MG 856 and TR 756.**

**SS 920 Proseminar in Psychology**  
2%:0:0:3

Major areas of psychology required of all master's candidates. History and systems, sensation and perception, learning, developmental and abnormal.

**SS 925 Social Impact Assessment**  
2%:0:0:3

How physical changes in urban or rural settings affect social systems and group and individual behavior. Measuring quality of life and social responses to technology; uses of alternative futures paradigms. Students do an analysis of a problem in social impact and report finding to class.

**SS 926 Environmental Psychology**  
2%:0:0:3

Critical issues in person-environment relations, including privacy, crowding and environmental design. Work includes a term paper and a major research project, emphasizing applications of psychological research methods to practical design problems or specific environmental issues.

**SS 928 Advanced Topics in Environmental Psychology**  
2%:0:0:3

This course varies from year to year depending on the needs and interests of students and instructors. Potential subjects include social impacts of transportation systems; stress and the environment; adverse 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.

**SS 997 Thesis for Degree of Master of Science**  
*each 3 units*

Independent research project demonstrating scientific competence performed under guidance of advisers.



*(see departmental sections of the catalog for additional information about each professor)*

**Sheila Lehman  
Donald Phillips  
Richard Wener**

# HISTORY OF SCIENCE PROGRAM

*Director:* Alexi Assmus

The master's program in the History of Science 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. In considering ideas, time, process, transfer and social changes in the history of science, students are able to explore the elusive connections that exist between science and engineering and the social sciences and humanities. Prospective teachers of science and engineering subjects are able to increase their effectiveness through knowledge of the history of their own and related disciplines. Polytechnic's libraries contain many important and rare works on the history of science, which may be used for original research.

A total of 36 units is required for the master's degree. Normally students start by taking introductory courses SS 600 and SS 601 and then proceed to more advanced courses and seminars. In all cases, programs are constructed in consultation with advisors, taking into consideration individual backgrounds and interests. The student will be encouraged to take 9 units of work in related fields outside the program, for example, in philosophy, mathematical logic, Renaissance history or one of the sciences or engineering.

To qualify for degrees, students may elect to write either a comprehensive examination or a thesis embodying appropriate and substantive research. If students choose the former, examinations may be taken in the term in which courses are completed. A student choosing the thesis may apply up to 12 units of thesis course work toward requirements for the degree. Acceptance of a thesis involves an oral presentation and defense. In addition to these requirements, students must

demonstrate reading knowledge of one foreign language, whether French, German, Russian or Spanish.

## GRADUATE COURSES

### HISTORY OF SCIENCE

**SS 600 History of Science:  
Antiquity to the Scientific Revolution**  
2½:0:0:3

Biological and physical sciences from antiquity to the Renaissance. Issues, aims and tools of historians of science working in these periods.

**SS 601 History of Science:  
Scientific Revolution to Darwin**  
2½:0:0:3

Biological and physical sciences from the scientific revolution to Darwin. Issues, aims and tools of historians of science working in these periods.

**SS 602 Seminar in History of Science**  
2½:0:0:3

Advanced problems in history of science: development of quantification, historiography of science, history of ecology, science and social thought. Main topic chosen by students and instructor. Training in methods of archival research. Required regular reports leading to a major paper. Course may be taken twice for credit with different topical emphasis and instructor's consent.

**SS 616 Guided Reading in History of Science**  
2½:0:0:3

Independent studies of leading interpretive works and sources in history of science. Regular tutorial sessions and periodic student-teacher colloquia. Course may be taken twice for credit with different topical emphasis and instructor's consent. Comprehensive written examination.

**SS 625 History of Technology:  
Antiquity through Early Industrial  
Revolution**  
2½:0:0:3

**SS 626 History of Technology:  
Industrial Revolution to the Present**  
2½:0:0:3

These two courses involve the evolutions of techniques and tools used in man's attempts to master the environment. Reciprocal relationships between technology and other facets of society's economic and social structures, political policies; general cultural manifestations. Technological bases of historical changes and interactions of science and technology. *SS 625 prerequisite: SS 600 or equivalent. SS 626 prerequisite: SS 601 or equivalent.*

**SS 635 History of Psychology**  
2½:0:0:3

Survey of psychology against a background of periods in which principal modern schools and issues emerged. Early psychology as speculative discipline, essentially part of philosophy. Differentiation of psychology into various fields. *Prerequisite: SS 189-190 or equivalent or SS 135-136 or equivalent.*

**SS 640-641 Environmental Studies  
Seminar**  
3:0:0:3

This seminar provides an opportunity to investigate environmental issues by focusing on a specific topic each year. The aim is to cultivate a more holistic understanding of human societies in their ecological settings. Attention is given to such factors as weather, technology, population, social organization and political structure. All students are responsible for a seminar paper. Guest participants on special topics. *Prerequisite: SS 182 or other appropriate environmental studies course or instructor's permission.*

DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES

**SS 672 Technological Forecasting**  
2½:0:0:3

Introduction to problems associated with technology forecasting. Short-range, intermediate and long-range forecasting methodologies. Forecasting social and economic consequences of adopted innovations. Students will prepare a forecast on a topic of their choice. *Prerequisite: SS 104 and one introductory history of science/technology course (or instructor's permission).* **Also listed under MG 672.**

**SS 675 Technology Transfer among Nations**  
2½:0:0:3

Social, ecological and economic factors in the selection, transfer and use of technology. Mechanisms of technology transfer and criteria of success. Case studies of successful and unsuccessful technology transfers. *Prerequisite: SS 104 and one introductory history of science/technology course (or instructor's permission).* **Also listed under IE 757 and MG 757.**

**SS 676 Human Resource Development in Developing Countries**  
2½:0:0:3

Spectra of technology-related manpower needs in less-developed countries. Education of engineers, technicians and skilled mechanics. Uses of foreign personnel, foreign schools and "brain-drain" problems. Economic consequences. Comparisons of educational systems of Western, Eastern and developing countries. Designs of curricula to suit national needs. Roles of technical assistance programs. Forecasting of human resource needs. **Also listed under IE 758.**

# HUMANITIES PROGRAM

The Department of Humanities and Social Sciences offers a BS in humanities with concentrations in:

- Philosophy
- Literature
- Humanistic Studies

For more information, please call the Humanities Office at 718/260-3340 or send e-mail to Professor Wolhee Choe (wchoe@duke.poly.edu).

## UNDERGRADUATE PROGRAMS

### DEGREE REQUIREMENTS

All majors are required to take the Liberal Arts Core Program plus 12 credits in their areas of concentration.

### HU/SS Core Courses (Liberal Arts Core Program)

HU 101 or		
HU 103	<i>Writing and the Humanities I</i>	3
HU 105 or		
TC 110	<i>Advanced Composition/ Basic Report Writing</i>	3
HU 200	<i>Writing and the Humanities II</i>	3
HU 344	<i>Introduction to Logic</i>	3
SS 104	<i>Main Themes in Contemporary World History</i>	3
SS 138	<i>Technology, Science, Ethics and Contemporary Society</i>	3
EG 101	<i>Introduction to Engineering</i>	3
CS 200	<i>Introduction to Programming Methodology</i>	3
MA 105 or		
MA 106	<i>Calculus I</i>	4
		28 credits

Six or more credits in an engineering or science sequence (CM, PH, IS or others as approved by adviser). 6

### HU/SS Core Electives (8 classes, 24 credits)

1 SS	<i>World History (109, 120, 121, 123, 124)</i>	3
1 SS	<i>History/Philosophy of Science/Technology (135, 136)</i>	3
1 SS	<i>Psychology/Behavioral Sciences (189)</i>	3
1 SS	<i>Economics (250)</i>	3
1 HU	<i>Literature (212, 213, 222, 252, 283, 291)</i>	3
1 HU	<i>Philosophy (346, 347, 348, 349, 352, 353)</i>	3
1 HU	<i>Art (388)</i>	3
1 HU	<i>Music (371)</i>	3
		24 credits
	<i>Free Electives</i>	26
	<i>Concentration Requirements</i>	36
	<b>TOTAL</b>	<b>120</b>

### CONCENTRATION REQUIREMENTS

Majors choose 12 courses (36 credits) in one of the following concentrations:

- Philosophy
- Literature
- Humanistic Studies

### CONCENTRATION IN PHILOSOPHY

Philosophy traditionally has been a broad, interdisciplinary and inclusive study of such fundamental questions as human freedom, personal immortality, the nature of truth and the validity of scientific claims. The concentration introduces the major areas of philosophy from both analytical and historical perspectives. The student who completes the concentration will be familiar with the major traditions in philosophy and have a firm understanding of how perennial questions are addressed in the contemporary world. In particular, attention is given to the impact of science and technology upon human values.

In classes, students read and discuss classical philosophical texts. With the exception of logic, all philosophy classes require term papers. Courses in ethics give special attention to issues as they arise within the engineering professions.

Majors with a concentration in philosophy choose 12 courses from the following:

HU 213	<i>Science and Literature</i>
IU 302	<i>Special Topics in Philosophy</i>
HU 341	<i>Introduction to Philosophy</i>
HU 344	<i>Introduction to Logic</i>
HU 346	<i>Ethical Theories or LA139 Engineering Ethics</i>
HU 347	<i>Ethics and Technology or LA 143 Computers, Culture and Society</i>
HU 348	<i>Great Philosophers I</i>
HU 349	<i>Great Philosophers II</i>
HU 352	<i>Philosophy of Science</i>
IU 353	<i>Philosophy of Technology</i>
HU 354	<i>Social and Political Philosophy</i>
IU 363	<i>World Religions</i>
HU 364	<i>Philosophy of Religions</i>
HU 365	<i>Science, Technology and Religion</i>

The philosophy minor consists of five courses (15 credits) as follows:

HU 344	<i>Introduction to Logic</i>
IU 346	<i>Ethical Theories or IU 347 Ethics and Technology</i>
IU 348	<i>Great Philosophers I or HU 349 Great Philosophers II</i>
HU 352	<i>Philosophy of Science or HU 353 Philosophy of Technology</i>
HU 341	<i>Introduction to Philosophy or HU 354 Social and Political Philosophy or HU 365 Science, Technology and Religion</i>

### CONCENTRATION IN LITERATURE AND CONCENTRATION IN HUMANISTIC STUDIES

Courses in literature and humanistic studies help students explore the world through creative works. The courses are designed to cultivate a critical sense toward received ideas about physical, intellectual and moral environments. Students analyze and discuss literary and other works of art, which through their blend of representation and imagination of the particular and the general, reveal continuity of humanity amid changing cultural settings.

Students who wish to obtain certification for teaching in public schools in the New York City area should plan to take the necessary education courses at another institution. Credit will be given for these education courses as free electives in meeting degree requirements.

**Majors with a concentration in Literature or Humanistic Studies choose 12 courses from the following:**

- HU 203 *Literature of Western Civilization III*
- HU 211 *English Literature from Beowulf to 1800*
- HU 212 *English Literature from 1800 to Present*
- HU 213 *Science and Literature*
- HU 222 *Shakespeare*
- HU 251 *American Literature to 1880*
- HU 252 *American Literature from 1880 to Present*
- HU 262 *Contemporary American Novel*
- HU 264 *The Short Story*
- HU 281 *Comedy*
- HU 283 *Modern American Drama*
- HU 291 *Short Fiction*



**WRITING AND HUMANITIES**

**HU 008 Reading and Writing in English as a Second Language** 6:0:0:0

English as a second language at the high-intermediate level. Development of grammatical control in writing and improved comprehension of college-level texts. Practice in listening and speaking; intensive preparation in language skills for academic and professional purposes. Graduate students may register with permission of department. Admission by placement examination.

**HU 009 Introductory Composition** 6:0:0:0

Intensive course in reading comprehension and composition skills for native speakers of English who have not been adequately prepared for college composition. Emphasis on development of control over standard written English and fluency in writing. Admission by placement examination.

**HU 101 Writing and the Humanities I** 3:0:0:3

Introduction to the humanities and to effective techniques of college-level writing. Examination of basic concepts, forms and techniques of philosophy, art and literature, with emphases on fluency,

precision and imaginative use of source materials in writing. Admission by placement examination.

**HU 103 Writing and the Humanities I (English as a Second Language)** 6:0:0:3

Introduction to the humanities and to effective techniques of college-level writing, designed for students for whom English is a second language. Examination of basic concepts, forms and techniques of philosophy, art and literature, with emphases on fluency, grammar, syntax, precision and imaginative use of source materials in writing. Admission by placement examination.

**HU 200 Writing and the Humanities II** 3:0:0:3

Introduction to the humanities and to advanced techniques in writing. Thematic emphasis on change and continuity in the humanities and an exploration of the interrelationship of the humanistic disciplines through study of great works of art, philosophy, literature and, in some sections, music. Advanced work in stylistic options and more complex forms of writing: the longer critical study, the formal report, the research paper. In some cases, this course may be presented as an introduction to literature, covering poetry, short stories, and novels. *Prerequisite: HU 101 or 103 or advanced placement.*

**COMMUNICATION**

**HU 118 Public Speaking Seminar** 1:0:0:1

Preparation and delivery of oral presentations with emphasis on technical and industrial topics. Students will conduct personal or phone interviews with sources in the research phase of their assignments. Practice in making team presentations. Students will learn to incorporate graphics into their talks. Critiques by instructor and fellow students. *Prerequisites: HU 101 or HU 103 and HU 200.*

**HU 120 Public Speaking and Pronunciation** 2:0:0:2

Training and practice in speaking before groups, preparation of materials for oral

presentations, discussion and interviewing techniques, extemporaneous speaking, pronunciation and speaking of English. This course is only for intermediate English as a Second Language students who are required to take HU 008 as result of the English Composition Placement.

**HU 121 Public Speaking** 3:0:0:3

Training and practice in speaking before groups, preparation of materials for oral presentations, discussion and interviewing techniques, extemporaneous speaking. Not open to students who were required to take HU 008.

**LITERATURE**

*(See also Literature in Translation and Interdisciplinary Studies, below)*

**HU 201 Literature of Western Civilization I** 3:0:0:3

Sources of modern ideals and values in ancient world: Greek drama, Plato, Lucretius, the Bible and others.

**HU 202 Literature of Western Civilization II** 3:0:0:3

Sources of modern ideals and values from Middle Ages to 18th century: miracle plays, Shakespeare, Milton, Voltaire and others.

**HU 203 Literature of Western Civilization III** 3:0:0:3

Intellectual and cultural, moral and spiritual values of the modern world in novels, drama, philosophy and poetry. Literature of the Romantic revolt, Goethe, Dostoevski, Brecht, Sartre, Solzhenitsyn. American and European poetry. *Prerequisite: HU 200.*

**HU 204 Literature of Eastern Civilization** 3:0:0:3

Influential texts selected from Eastern classical and contemporary works will be studied from the perspectives of historically analyzed Western themes, literary theories and traditional East Asian poetics.

**HU 211 English Literature from Beowulf to 1800** 3:0:0:3

English literature from Beowulf through Chaucer, the Elizabethans and the Jacobean to 1800. *Prerequisite: HU 200.*

**HU 212 English Literature from 1800 to Present** 3:0:0:3

English literature from the Romantics to the present (Wordsworth, Byron, Dickens, Tennyson, Shaw, Conrad, Beckett and others). *Prerequisite: HU 200.*

**HU 213 Science and Literature** 3:0:0:3

With emphasis on the modern period, examination of the literary merits of scientific and imaginative literature devoted to and affected by science. Readings in such authors as Charles Darwin, T.H. Huxley, Bertolt Brecht, Sinclair Lewis, Arthur Koestler, Heinar Kipphart, James Watson, Kurt Vonnegut and Isaac Asimov. *Prerequisite: HU 200.*

**HU 222 Shakespeare** 3:0:0:3

Representative tragedies, comedies, histories. Cultural, social and literary influences. Textual problems, recent criticism, Elizabethan theater. *Prerequisite: HU 200.*

**HU 251 American Literature to 1880** 3:0:0:3

The puritan and neoclassic periods through the romantic movement and the rise of realism. Jonathan Edwards, Paine, Irving, Poe, Hawthorne, Emerson, Thoreau, Whitman, Twain, James and others. *Prerequisite: HU 200.*

**HU 252 American Literature from 1880 to Present** 3:0:0:3

Major American writers from 1880. Background and thought of Crane, Dreiser, Robinson, Frost, Millay, Sandburg, O'Neill, Cather, Wharton, Lewis, Hemingway, Fitzgerald, Wolfe and Faulkner. *Prerequisite: HU 200.*

**HU 262 Contemporary American Novel** 3:0:0:3

The contemporary American novel as affirmative expression of the human situation. Technical and philosophical analyses of such writers as Salinger, Updike, Roth, Vonnegut, Bellow, Morrison, Silke, Ford and others. *Prerequisite: HU 200.*

**HU 264 The Short Story** 3:0:0:3

Themes, structure, techniques of short stories by writers as diverse in style and philosophy as Chekhov, Twain, O. Henry, Mansfield, Lardner, Faulkner, Thurber and Hemingway. *Prerequisite: HU 200.*

**HU 281 Comedy** 3:0:0:3

Nature and uses of humor as viewed by playwrights, psychologists and philosophers. Theories of comedy from Aristotle to Freud. Plays from Aristophanes and Molière to Giraudoux and Shaw. Humor from Tarleton to Chaplin and Benchley. *Prerequisite: HU 200.*

**HU 283 Modern American Drama** 3:0:0:3

Technical and philosophical analyses of O'Neill, Miller, Anderson, Hellman, Williams, Inge, Albee and others. Some contemporary American films may be included. *Prerequisite: HU 200.*

**HU 291 Short Fiction** 3:0:0:3

Major writers of the novella (long short story). Study of the relationship between literature and ideas in such writers as Saul Bellow, Albert Camus, Joseph Conrad, Ernest Hemingway, Franz Kafka, Thomas Mann, Alexander Solzhenitsyn and Nathanael West. Class discussions, cinematic presentations of some works and theater visits are integral to course. *Prerequisite: HU 200.*

**PHILOSOPHY AND COMPARATIVE RELIGION****HU 341 Introduction to Philosophy** 3:0:0:3

An initial inquiry into problems, methods and terminology of Western philosophy through study and discussions of selected philosophical texts. *Prerequisite: HU 200.*

**HU 344 Introduction to Logic** 3:0:0:3

Principles and problems in syllogistic and propositional logic. Introduction to first order predicate logic. Some discussion of the history of logic, informal fallacies and relations between logic and language. *Prerequisite: HU 200.*

**HU 346 Ethical Theories** 3:0:0:3

A study of one or more major ethical theories. The nature of human action, distinctions between good and bad, virtue, sources of obligation, freedom of action, human valuation and conscience. *Prerequisite: HU 200. Students may not take both LA 139 and HU 346.*

**HU 347 Ethics and Technology** 3:0:0:3

An examination of some basic ethical theories of human action and how these relate to technological making and using. Use will be made of case studies of various ethical problems as well as some classic ethical texts. *Prerequisite: HU 200. Students may not take both LA 143 and HU 347.*

**HU 348 Great Philosophers I** 3:0:0:3

Selected works of such philosophers as Plato, Aristotle, the Stoics, neo-Platonists, St. Augustine, Maimonides and St. Thomas Aquinas. *Prerequisite: HU 200.*

## DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES

### HU 349 Great Philosophers II 3:0:0:3

Philosophy from the Renaissance to the 19th century, emphasizing the rationalist tradition (Descartes, Spinoza, Leibniz), the empiricist tradition (Bacon, Locke, Hume) and Kant. *Prerequisite: HU 200.*

### HU 352 Philosophy of Science 3:0:0:3

Central problems in theories of science and scientific methodology. Relation between science and philosophy; scope and objectives of natural sciences, role of mathematics in science; observation and experimentation; laws, theories, explanations; causality and induction. *Prerequisite: HU 200.*

### HU 353 Philosophy of Technology 3:0:0:3

The nature and meaning of human making and using activities, examined by means of a critical reading of various conceptual, anthropological, ethical-political and metaphysical-epistemological studies. *Prerequisite: HU 200.*

### HU 354 Social and Political Philosophy 3:0:0:3

Examination of philosophical and ethical foundations of divergent sociopolitical theories and systems. Analysis of such concepts as justice, the good, freedom, authority and rights in the thought of selected political philosophers. *Prerequisite: HU 200.*

### HU 365 Science, Technology and Religion 3:0:0:3

The implications of science and technology for religion, and of religion for science and technology. Does scientific cosmology support or undermine religious beliefs? Does the scientific method influence the interpretation of religious texts? What is the religious response to moral issues raised by technology? Is religion responsible for the development of Western technology? *Prerequisite: HU 200.*

## MUSIC AND FINE ARTS

### HU 371 Understanding of Music 3:0:0:3

Active, intelligent listening to masterpieces of Western music from its origins through Bach, Beethoven and Brahms. Major musical forms: concerto grosso, fugue, sonata, symphony, concerto, music drama, tone poem. Analysis of orchestra scores. Parallel trends in other arts. The changes in the social roles of music. *Prerequisite: HU 200.*

### HU 375 Modern Music 3:0:0:3

Music from 1850 to present: Wagner, Strauss, Mahler, Debussy, Stravinsky, Ives, Schoenberg, Berg, Weber, Varese. Revolt against romanticism; breakdown of traditional tonal-harmonic system. Polyharmony, polytonality, pantonality, melodic fragmentation, aleatory and electronic music as expressions of the 20th century. Jazz, modern popular music and music of other cultures. *Prerequisite: HU 200.*

### HU 382 Fine Arts I 3:0:0:3

Historical and analytical study of Western architecture, sculpture, painting. Egyptian, Greek, Roman architecture and sculpture. Gothic and Renaissance art. Parallel trends in other arts. *Prerequisite: HU 200.*

### HU 383 Fine Arts II 3:0:0:3

Historical and analytical study of Western architecture, sculpture, painting from 1600 to present. Baroque, neoclassic, romantic styles. Revolt against romanticism and quest for new artistic, decorative and tectonic forms to express contemporary civilization. *Prerequisite: HU 200.*

## SPECIAL TOPICS

The following special topics courses are offered from time to time by the staff of the department or by visiting scholars. Specific titles and prerequisites are announced before registration. May be repeated for credit.

### HU 300 Special Topics in Humanities 3:0:0:3

*Prerequisite: HU 200.*

### HU 301 Special Topics in Literature 3:0:0:3

*Prerequisite: HU 200.*

### HU 302 Special Topics in Philosophy 3:0:0:3

*Prerequisite: HU 200.*

### HU 303 Special Topics in Music and Fine Arts 3:0:0:3

*Prerequisite: HU 200.*

## The Following Humanities Courses are Offered Irregularly in Response to Student Demand:

### Literature

- HU 250 *American Thought*
- HU 272 *Contemporary American Poetry*
- HU 295 *Literary Interpretation and Criticism*
- HU 297 *English Language*

### Philosophy and Comparative Religion

- HU 345 *Advanced Logic*
- HU 363 *World Religions*
- HU 364 *Philosophy of Religion*

### Music and Fine Arts

- HU 389 *Art of Asia*

### Linguistics

- ML 381 *Language and Society*
- ML 382 *Introduction to the Study of Language*
- ML 383 *Advanced Topics in Study of Language*

### English and Humanistic Studies

- HU 521 *Seminar in Oral English*
- HU 522 *Seminar in Written English*

### Liberal Arts:

- LA 110 *Technology and Society in Historical Perspective*
- LA 120 or
- LA 121 *Principles of Mathematics I and II*
- LA 125 *Introduction to Computers*
- LA 130 *Introduction to Physical Science*
- LA 131 *Introduction to Biological Science*
- LA 132 *Introduction to Behavioral Science*
- LA 140 *Ethics and Technology*
- LA 141 *Materials and Social Issues*
- LA 142 *The Cultures of Machines*
- LA 144 *Energy Technology and Social Issues*
- LA 150 *The Making of Connections*
- LA 160 *Senior Thesis*



# TECHNICAL AND PROFESSIONAL COMMUNICATION PROGRAM

*Director:* Elizabeth Chesla

The Department of Humanities and Social Sciences offers the following programs of study through its Technical and Professional Communication Program:

- Bachelor of Science in Journalism and Technical Writing
- BS/MS Accelerated Degree
- Master of Science in Specialized Journalism\*
- Graduate Certificate in Technical Communication

\* Pending state approval, the name of the Master of Science degree will be changed to Master of Science in journalism and technical communication.

The Technical and Professional Communication Program is designed to train students to synthesize or "translate" technical or specialized information so that it can be easily understood and used in business, academic and private settings. Students develop their research, writing, editing and design skills as well as their interpersonal, organizational and management abilities. Students should have a strong foundation in communication skills as well as an interest in, or aptitude for, business, science or technology.

While the curriculum explores the theoretical foundations of contemporary communications, the program's emphasis is on the practice of effective communication. Through course projects and internships, students develop a solid portfolio that demonstrates a wide range of writing, editing and design skills as well as in-depth knowledge within a particular area of specialization.

To address the diversity of writing, editing and design tasks available to today's technical and professional communicators, the program offers three areas of specialization:

- Writing about Medicine, Science and Technology
- Writing for Business: *Advertising, Public Relations, Corporate Communications and the Trade Press*
- Documentation, Training and New Media

Students work closely with an adviser to determine which courses are most suitable for their intended area of specialization.

## AREAS OF SPECIALIZATION

### Writing about Medicine, Science and Technology

As our scientific knowledge continues to expand, it is more important than ever that information about medicine, science and technology be conveyed clearly and succinctly to both technical and lay audiences. Medical, science and technology writers and editors work on publications that serve physicians, nurses, computer scientists and other technical and scientific personnel; on the news staffs of print and broadcast media; on the public relations staffs of pharmaceutical houses and hospitals, medical schools and scientific research centers; in the writing departments of pharmaceutical and technology corporations; in museums and nonprofit institutions; for publishers of children's literature; and in the editing departments of textbook publishers. They write scientific biographies, science essays, newsletters and books on technology, as well as articles and freelance pieces, often in addition to full-time work in the field.

### Writing for Business: *Advertising, Public Relations, Corporate Communications and the Trade Press*

Advertising and public relations work is concerned with the promotion of corporate products and services to industrial clients and to the general public. Our program focuses on advertising and public relations for medical, health care,

technological and industrial products and services. Advertising involves copywriting, graphic design, media selection, campaign organization and market research; students may find careers as copywriters, account executives, advertising managers and media directors. Public relations professionals generate publicity for new products and services through press releases, technical articles and press conferences. They also write speeches, handle press inquiries and write case histories.

Writers in corporate communications manage the form and flow of information both within a corporation and to customers, potential clients and the general public. This information takes a variety of forms, such as proposals, newsletters, brochures, progress reports, manuals, memoranda, analyses, meeting minutes and annual reports. These writers may also be called upon to write speeches and trade magazine articles. Corporate communicators, therefore, are often responsible for how employees, customers and clients perceive an organization.

The trade press offers a variety of research, writing and editing opportunities. Hundreds of industry-specific magazines need technical journalists to report on industry trends and developments, to review new products and procedures, and to analyze industry issues. Trade journalists develop industry expertise through their research and may work closely with public relations professionals.

### Documentation, Training and New Media

**Documentation.** Large numbers of technical communicators are needed to plan, write and evaluate effective hardware, software and systems documentation. Documenters create user manuals, online tutorials and hypertext user guides and often work closely with software developers, trainers and information managers to meet the needs of the end user. Along with a basic knowledge of programming, computer documenters must understand

## DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES

the basic principles of human-computer interaction and be able to manage a documentation project from the critical stage of needs analysis to usability testing and benchmarking.

**Training.** End users often need skilled professionals to teach them how to use the latest software, hardware and systems technology. Trainers and instructional designers use a variety of training methods, including demonstrations, computer-based tutorials, online help, documentation and interactive exercises. Trainers and instructional designers have backgrounds in human learning systems, human-computer interaction, business process analysis, user interface, design and effective teaching practices.

**New Media.** Today's documenters, trainers and other professional communicators can use a variety of media to convey their message. Ideas and information can be communicated through words and pictures: in text, sound and video; on paper, computer, slides and film. New media specialists understand these technologies, their applications and their effectiveness both individually and in combination with other media. They are valuable marketers and presentation developers who know which types of media to select for each project and how to design, sequence, script and link a presentation. Interactive multimedia is a particularly powerful new technology used by new media specialists who also study the social, political, economic and cultural effects of multimedia communications.

### UNDERGRADUATE PROGRAM

#### BS IN JOURNALISM AND TECHNICAL WRITING

Majors require 120 credits for the Bachelor of Science. We recommend that at least 12 of those credits be courses within one area of specialization.

All majors are required to take the following humanities and social sciences (HU/SS) core courses and should follow the recommended TC (Technical and Professional Communication) core curriculum below:

#### TC Core Courses

HU 100	<i>Critical Thinking</i>	3
TC 110	<i>Professional Report Writing for Engineering and the Sciences</i>	3
or		
TC 111	<i>Introduction to Technical Communication</i>	3
TC 112	<i>Workshop in Copyediting &amp; Style</i>	3
TC 160	<i>Internship</i>	3-12
TC 170	<i>Senior Project and Portfolio Review</i>	3
		<hr/> 15-24

#### HU/SS Core Courses (Liberal Arts Core Program)

HU 101/103	<i>Writing and the Humanities I</i>	3
HU 200	<i>Writing and the Humanities II</i>	3
HU 344	<i>Introduction to Logic</i>	3
SS 104	<i>Main Themes in Contemporary World History</i>	3
SS 138	<i>Technology, Science, Ethics and Contemporary Society</i>	3
EG 101	<i>Introduction to Engineering</i>	3
CS 200	<i>Introduction to Programming Methodology</i>	3
MA 106	<i>Calculus I</i>	4
		<hr/> 25

Majors should also choose six courses from the following TC Core Electives, eight courses from the following HU/SS Core Electives, and 6 or more credits in an engineering or lab science sequence (CM, PH, LS or others as approved by adviser). Courses should be chosen based on students' intended concentration.

#### TC Core Electives (6 classes, 18 credits)

TC 104	<i>Principles of Design</i>	3
TC 106	<i>Writing for Publication: the Magazine Article</i>	3
TC 113	<i>Writing for Advertising and Public Relations</i>	3
TC 115	<i>Writing and Editing in Medicine, Science and Technology</i>	3
TC 116	<i>Computer Documentation I</i>	3
TC 119	<i>Computer-Assisted Instruction</i>	3
TC 135	<i>Corporate Communications</i>	3
TC 141	<i>Graphic Design and Technical Illustration</i>	3
TC 144	<i>Desktop Publishing and Design</i>	3
TC 145	<i>Multimedia Technologies and Applications</i>	3
6 courses		<hr/> 18 credits

#### HU/SS Core Electives (8 classes, 24 credits)

1	SS	<i>World History (109, 120, 121, 123, 124)</i>	3
1	SS	<i>History/Philosophy of Science/Technology (135, 136)</i>	3
1	SS	<i>Psychology/Behavioral Sciences (189)</i>	3
1	SS	<i>Economics (250)</i>	3
1	HU	<i>Literature</i>	

1	HU	<i>(212, 213, 222, 262, 264, 283, 291) 3</i>	
		<i>Philosophy (346, 347, 348, 349, 352, 353)</i>	3
1	HU	<i>Art (382, 383)</i>	3
1	HU	<i>Music (371, 375)</i>	3
			<hr/> 24

CM/PH/LS 2 courses 6 credits

#### Majors then have the following areas of elective courses:

4-7 TC Electives\* (3 credits each) 12-21 credits

4 Elective courses (3 credits each) 12 credits

\*The number of TC electives depends on the number of internship credits earned. If a student receives only 3 credits for a part-time internship experience, then the student must earn an additional 9 credits from TC electives. TC electives include any TC courses or courses related to the student's area of concentration (e.g., SS 365, MG 301, CS 201). Courses offered by other departments must be approved by the student's adviser.

**TOTAL CREDITS: 121**

### RECOMMENDED COURSES FOR CONCENTRATIONS

#### Writing about Medicine, Science and Technology

TC 106	<i>Writing for Publication: The Magazine Article</i>
TC 108	<i>News Writing</i>
TC 109	<i>Feature Writing</i>
HU 114	<i>Libel Law and Ethical Issues in Journalism</i>
TC 115	<i>Writing and Editing in Medicine, Science and Technology</i>
TC 125	<i>Reporting and Writing for the Wire Services</i>
TC 144	<i>Desktop Publishing and Design</i>

History/Philosophy of Science/Technology  
Lab Science  
Computer Science

#### Writing for Business: Advertising, Public Relations, Corporate Communications and the Trade Press

TC 104	<i>Principles of Design</i>
TC 113	<i>Writing and Advertising for Public Relations</i>
HU 114	<i>Libel Law and Ethical Issues in Journalism</i>
TC 135	<i>Corporate Communications</i>
TC 140	<i>Proposal Writing</i>
TC 141	<i>Graphic Design and Technical Illustration</i>
TC 144	<i>Desktop Publishing and Design</i>
TC 145	<i>Multimedia Technologies and Applications</i>
TC 147	<i>Technical Writing and the Internet: Hypertext and the World Wide Web</i>

Economics  
Management  
Psychology/Behavioral Sciences

## Sample Schedule for Journalism and Technical Writing Majors

### FRESHMAN YEAR

#### Fall Semester

Course No.	Subject	Cr.
HU 101/103	Writing and the Humanities I	3
HU 100	Critical Thinking	3
EG 101	Introduction to Engineering	3
MA 106	Calculus I	4
TC 104	Principles of Design	3
		16

#### Spring Semester

Course No.	Subject	Cr.
HU 200	Writing and the Humanities I	3
TC 114	Introduction to Technical Communications	3
CS 200	Introduction to Programming Methodology	3
SS 104	Main Themes in Contemporary World History	3
LS/PH/CM	Elective	3
		15

### SOPHOMORE YEAR

#### Fall Semester

TC 112	Workshop in Copyediting and Style	3
SS 138	Tech., Science, Ethics and Contemp. Society	3
HU/SS	Core Elective	3
HU/SS	Core Elective	3
LS/PH/CM	Elective	3
		15

#### Spring Semester

TC	Core Elective	3
TC	Core Elective	3
HU/SS	Core Elective	3
HU/SS	Core Elective	3
TC	Elective	3
		15

### JUNIOR YEAR

#### Fall Semester

TC	Core Elective	3
TC	Core Elective	3
HU/SS	Core Elective	3
HU 344	Introduction to Logic	3
	Elective	3
		15

#### Spring Semester

TC	Elective	3
TC	Core Elective	3
HU	Core Elective	3
HU	Core Elective	3
	Elective	3
		15

### SENIOR YEAR

#### Fall Semester

TC 160	Internship	12
HU/SS	Core Elective	3
		15

#### Spring Semester

TC 170	Senior Project and Portfolio Review	3
TC	Elective	3
TC	Elective	3
	Elective	3
	Elective	3
		15

**Total credits required for graduation: 120**

**Documentation, Training and New Media**

- TC 104 *Principles of Design*
- TC 116 *Computer Documentation I*
- TC 117 *Computer Documentation II*
- TC 119 *Computer-Assisted Instruction*
- TC 141 *Graphic Design and Technical Illustration*
- TC 142 *Manual and Procedure Writing*
- TC 144 *Desktop Publishing and Design*
- TC 145 *Multimedia Technologies and Applications*
- TC 147 *Technical Writing and the Internet: Hypertext and the World Wide Web*

*Computer Science Management Psychology/Behavioral Sciences*

**THE BS/MS ACCELERATED HONORS PROGRAM**

The Technical and Professional Communication Program offers a BS/MS honors program for exceptional first-year students and advanced undergraduates. Through this unique program, students can earn both a Bachelor of Science degree in journalism and technical writing and a Master of Science degree in specialized journalism\* in just four to five years.

The accelerated program allows students to take up to 9 credits that fulfill both undergraduate and graduate degree requirements. In addition, credit may be granted for high school Advanced Placement courses where a student earns a 4 or 5 on the AP test. Students accepted into the program may also earn up to 18 credits through one or more undergraduate and graduate internship opportunities.

To be eligible for this program, high school students must meet the following criteria:

- a minimum 3.33 (B+) GPA and
- a minimum 600 verbal SAT score (1200+ overall score preferred).

Polytechnic freshmen, sophomores and juniors must meet the following requirements:

- a minimum 3.33 (B+) GPA and
- two letters of recommendation from Polytechnic faculty.

All candidates for the program must pass an entrance examination administered by the department and be interviewed by a program adviser. Once enrolled in the program, students are expected to maintain a 3.0 GPA.

\*Pending state approval, the name of the MS degree will be changed to Master of Science in journalism and technical communication.



**MS IN SPECIALIZED JOURNALISM\* (TECHNICAL AND PROFESSIONAL COMMUNICATION)**

The Master of Science in specialized journalism, offered by the Department of Humanities and Social Sciences, is awarded to students who complete a minimum of 36 credits. Students enrolled in the master of science program are required to complete the following core courses:

- JW 600 *Introduction to Technical and Professional Communication\*\** 3 cr
- JW 601 *Style for the Professional Writer* 3 cr
- JW 602 *Copyediting for Technical, Scientific and Business Publications* 3 cr
- JW 704 *Master's Project* 3 cr

At least 12 of the remaining credits required for graduation should be in courses within the student's chosen specialization. Students may also take a limited number of related courses in other departments, such as Programming Language (CS 637) or Organizational Behavior (MG 601) with the approval of their adviser.

\*Pending state approval, the name of the MS degree will be changed to Master of Science in journalism and technical communication.

\*\*Upon adviser approval, students with prior experience in technical or professional communication may waive JW 600 and replace it with an elective course.

**CERTIFICATE IN TECHNICAL COMMUNICATION**

The Graduate Certificate in Technical Communication trains students in the fundamentals of technical and professional communication through a combination of core courses and electives. To earn a certificate, students must complete 15 credits (five courses). All credits earned in the certificate program are transferable to the Master of Science degree.

In general, all certificate students should take the following core courses:

- JW 600 *Introduction to Technical and Professional Communication* 3 cr
- JW 601 *Style for the Professional Writer* 3 cr
- or
- JW 602 *Copyediting for Technical, Scientific and Business Publications* 3 cr

Upon adviser approval, students with prior experience in technical or professional communication may waive JW 600 and replace it with an elective course.

We recommend that the remaining 9-12 credits be earned in courses within a particular area of specialization. Students will work with an adviser to choose the elective courses most appropriate for their academic and professional goals.

## RECOMMENDED COURSES FOR SPECIALIZATIONS

### Writing about Medicine, Science and Technology

- JW 603 *Reporting on Medicine, Science and Technology*  
 JW 605 *Libel Law and Press Ethics*  
 JW 606 *Technical Presentations*  
 JW 607 *Writing News for Radio and Television*  
 JW 621 *Reporting and Editing for the Trade Press*  
 JW 625 *Corporate Communications in Medicine, Science and Technology*  
 JW 627 *Writing Copy on Pharmaceuticals and Biotechnology*  
 JW 635 *Online Journalism*  
 JW 636 *The Feature Article*  
 JW 637 *Computer-Assisted Reporting*

### Writing for Business: Advertising, Public Relations, Corporate Communications and the Trade Press

- JW 604 *Graphic Design and Technical Illustration*  
 JW 606 *Technical Presentations*  
 JW 618 *Web Page Authorship and Design*  
 JW 621 *Reporting and Editing for the Trade Press*  
 JW 623 *Project Management*  
 JW 624 *Writing Product Information Copy*  
 JW 626 *Public Relations for Medicine, Science and Technology*  
 JW 627 *Writing Copy on Pharmaceuticals and Biotechnology*  
 JW 628 *Business-to-Business Advertising*  
 JW 631 *Proposal Writing*  
 JW 632 *Writing Technical Manuals and Procedures*  
 JW 641 *Desktop Production Workshop*

### Documentation, Training, and New Media

- JW 604 *Graphic Design and Technical Illustration*  
 JW 608 *Computer Documentation I*  
 JW 609 *Computer Documentation II*  
 JW 611 *Technical Translation and Localization Practices*  
 JW 613 *Human Factors and Product Design*  
 JW 615 *Multimedia Technologies*  
 JW 618 *Web Page Authorship and Design*  
 JW 623 *Project Management*  
 JW 632 *Writing Technical Manuals and Procedures*  
 JW 641 *Desktop Production Workshop*  
 JW 645 *Instructional Design and Development*  
 JW 646 *End-User Training*  
 JW 647 *Computer-Based End-User Training*

## UNDERGRADUATE COURSES

### HU 100 Critical Thinking 3:0:0:3

Introduction to critical thinking across the disciplines. Understanding, evaluating and analyzing arguments; fact versus opinion; types of reasoning; reasoning and semantics; and common errors in reasoning. Readings and projects in both the humanities and the sciences. *Co-requisite: HU 200*

### TC 104 Principles of Design 3:0:0:3

Introduction to the elements of design. Students study perception and the human visual system; the psychological, sociological and educational impact of design; and the fundamentals of creating effective two-dimensional designs.

### TC 106 Writing for Publication: the Magazine Article 3:0:0:3

Theory and practice of writing short to moderate-length magazine articles on general subjects. Guidance in selecting interesting topics, researching, interviewing, audience analysis, slanting, dramatizing, outlining and writing a minimum of three articles. Students also conduct basic market research and learn the art of writing effective query letters. *Prerequisite: HU 101 or HU 103.*

### TC 108 News Writing 3:0:0:3

Workshop in basic news writing techniques. Students learn methods of information gathering and interviewing for different types of news articles, including current events, meetings, speeches, human interest and news analyses. Style and structure of news stories, writing of leads. *Prerequisite: HU 101 or HU 103.*

### TC 109 Feature Writing 3:0:0:3

Development of students' interviewing and writing skills to produce in-depth feature articles. Students develop story ideas on technical or nontechnical subjects, conduct the necessary research and personal interviews, and write medium to long pieces for specific publications. Students analyze audience and editorial practices of various popular, business and technical magazines and conduct market studies and query campaigns. Students are encouraged to publish their work, although this is not a specific course requirement. Minimum of three articles. *Prerequisite: TC 106 or TC 108.*

### TC 110 Professional Report Writing for Engineering and the Sciences 3:0:0:3

Fundamentals of report writing applied to short, informal papers written by scientists and engineers in actual business situations: technical correspondence, memorandums, trip reports, periodic reports and new product information sheets; summaries, process and technical descriptions, instructions and analyses. Effective style, organization of material and mechanics. Students learn to coordinate tables, graphs and other illustrative matter with text. *Co-/Prerequisite: HU 200.*

### TC 111 Introduction to Technical Communications 3:0:0:3

For technical communications majors. Introduction to basic technical writing techniques and practices. Survey of the technical writing field and basic concepts and practices of the following areas of specialization: specialized journalism, documentation, advertising and public relations, corporate communications, training and instructional design, and multimedia. Emphasis on clarity and control in writing and audience analysis. Frequent writing practice and several short projects. *Co-/Prerequisite: HU 200.*

## DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES

### **TC 112 Workshop in Copyediting and Style** 3:0:0:3

Workshop in copyediting techniques and elements of style. Intensive review of grammar and usage and stylistic formulas in various technical writing fields. Editing, revising and rewriting copy intended for a variety of audiences. Writing headlines, leads, decks and subheads for general, technical and industrial publications. Newspaper and magazine page layout and makeup. Peer and self-editing projects and assignments. *Co-Prerequisite: TC 110 or 111. May be repeated for credit.*

### **TC 113 Writing for Advertising and Public Relations** 3:0:0:3

Writing effective advertising copy and publicity releases with emphasis on medical, technological and industrial firms and their products. Consumer psychology; how to influence public opinion; relationship of corporations and institutions to media and the public; defining PR and ad objectives and target audience; planning and implementing ad and PR campaigns. Students write product ads, brochure copy, product data sheets, news releases, newsletters, copy for house organs and speeches. Layout of ad and PR copy and accompanying color, design, typographic and illustrative features. *Prerequisite: HU 101 or HU 103; TC 110 or TC 111.*

### **HU 114 Libel Law and Ethical Issues in Journalism** 3:0:0:3

What libel is and how writers can avoid its many pitfalls. Complete and partial defenses raised during libel suits and the possible damages awarded, the principles of "fair comment and criticism," criminal and civil libel, and one's right to privacy vs. the public's "need to know." The ethical issues facing journalists and other writers today concerning writing about new products and technology believed to be defective or hazardous, pornography and the courts, shield laws, gag orders and copyrights.

### **TC 115 Writing and Editing in Medicine, Science and Technology** 3:0:0:3

Writing about medical, technical and scientific subjects for the lay audience. Students research and write both news and feature stories targeted for specific publications. Students also learn how to work as writers and editors for scientists in research, business and industry as proofreaders, content editors, project editors and technical translators. *Prerequisite: HU 101 or HU 103; TC 110 or TC 111.*

### **TC 116 Computer Documentation I** 3:0:0:3

Introduction to computer systems and software documentation. Procedures and techniques for writing effective computer and software documentation; introduction to various computer documentation tools; basics of project planning, management and assessment (usability testing). Documentation project required. *Prerequisite: TC 110 or TC 111; CS 200.* This course cannot be used to satisfy the HU/SS elective requirements.

### **TC 117 Computer Documentation II** 3:0:0:3

Advanced course in computer documentation. Students learn online documentation techniques and procedures and produce a substantial paper and online documentation project. Indexing, revising and project management; needs analysis and usability testing. *Prerequisite: TC 116.*

### **TC 119 Computer-Assisted Instruction** 3:0:0:3

Introduction to developing computer-assisted instructional programs. Topics include learning modalities, elements of effective instruction, human-computer interaction, how to use computer-assisted instructional design tools, needs analysis, project planning and management, and project assessment (usability testing). *Prerequisite: TC 110 or TC 111.*

### **TC 125 Reporting and Writing for Online and Wire Services** 3:0:0:3

Reporting, writing and editing the news under the pressure of tight deadlines (often the same day). Many assignments require field research as this course attempts to simulate an online or wire-service reporter's daily experiences. Trips to news media headquarters. Reporting accuracy, thoroughness and good journalistic style stressed. History of wire service, future of online news services, and editorial practices. *Prerequisite: TC 108.*

### **TC 135 Corporate Communications** 3:0:0:3

Intensive study, through a review of case histories and writing assignments requiring field research, of all aspects of writing and editing in the communications department of a medium-size or large corporation. Students research, write and edit meeting minutes, job descriptions, press releases, newsletters, proposals, house organs, community-relations campaigns, brochures and annual reports. *Prerequisite: TC 110 or TC 111.*

### **TC 140 Proposal Writing** 3:0:0:3

Workshop in researching and writing solicited and unsolicited proposals in government and private sectors. Analysis of specific proposals and their components, including statement of the problem, significance of problem, procedure, time line, delegation of duties, budget and key personnel. Students prepare an outline and write a proposal on a specific topic as the major course assignment. *Prerequisite: TC 110 or TC 111.*

### **TC 141 Graphic Design and Technical Illustration** 3:0:0:3

Workshop in developing and producing graphics and illustrations for technical writing projects. Applications of computer-assisted graphic design; integration of text and graphics; concept development; and layout for technical reports, manuals and proposals. *Prerequisite: TC 110 or TC 111; TC 104.*

**TC 142 Manual and Procedure Writing** 3:0:0:3

Planning, researching, writing and designing industrial, technical, administrative and instructional manuals and procedures. Focus on readability and meeting job specifications and standards. Incorporation of graphics, tables and lists; organizing, indexing and project assessment. Individual and group projects. *Prerequisite: TC 110 or TC 111.*

**TC 144 Desktop Publishing and Design** 3:0:0:3

Laboratory workshop in which students learn the basics of desktop publishing and its applications in business and technical communications. Students learn how to plan, design and produce effective business and technical documents using such desktop publishing software as QuarkXpress and PageMaker. As a final project, students work in groups to plan, write and design a newsletter or brochure for a mock organization. *Prerequisite: TC 110 or TC 111; TC 104.*

**TC 145 Multimedia Technologies and Applications** 3:0:0:3

Introduction to multimedia technologies and applications for technical writers and editors. Students learn tools and techniques for producing presentations in a variety of media. Audience analysis and objectives, media selection and production, design coordination, and sequencing. Multimedia project. *Prerequisites: TC 110 or TC 111; TC 104.*

**TC 147 Technical Writing and the Internet: Hypertext and the World Wide Web** 3:0:0:3

Planning, writing, and designing an effective World Wide Web page on the Internet. Students learn HTML and software applications for Webpage development; integration of graphics and text; effective use of hypertext linking and structures. Students examine the Internet phenomenon and the effect hypertext has on reading, writing and information processing. Webpage project including substantial development of original text required. *Prerequisites: TC 110 or TC 111; TC 104.*

**TC 150-151 Special Projects in Technical and Professional Communication** 3:0:0:3

Independent or small group work in an area of technical and professional communication selected by student in consultation with instructor. For majors only. *Prerequisite: TC 111 and completion of technical writing core courses.*

**TC 155 Special Topics in Technical and Professional Communication** 3:0:0:3

Courses on special topics in technical and professional communication are offered from time to time by department staff or by visiting scholars. Specific titles and prerequisites are announced prior to registration. May be repeated for credit. *Prerequisite: TC 110 or TC 111 and permission of instructor.*

**TC 160 Internship** 0:0:0:3-12

Full- or part-time placement as a technical writing intern. Intense, practical work experience focusing on student's area of specialization. The internship will be built around a major project that will incorporate skills learned in earlier courses and that will result in a professional technical communication product. Students will be responsible for all aspects of project implementation. Students work with a professional advisor within the sponsoring organization and a faculty advisor within the department. Weekly progress reports and a final report required. For journalism and technical writing majors and minors only. *Prerequisites: Second-semester junior or first-semester senior standing; appropriate courses for internship project; approval of the sponsoring organization and the department.*

**TC 170 Senior Project and Portfolio Review** 3:0:0:3

In this capstone course, students work in teams to develop and design a collaborative writing project that integrates the knowledge and skills they have acquired through the program. Students manage the project from start to finish under the guidance of the instructor. In addition, students revise selected projects from previous classes to develop a professional portfolio of writing samples. For jour-

nalism and technical writing majors only. *Prerequisite: Second semester senior standing.*

**GRADUATE COURSES**

**JW 600 Introduction to Technical and Professional Communication** 2:0:0:3

An overview of the research, writing, editing and design principles of technical and professional communication. Students learn how to gather, organize and present information effectively, according to audience and purpose. Writing projects range from procedures and explanations to articles and advertisements.

**JW 601 Style for the Professional Writer** 2:0:0:3

Writing and editing workshop designed to strengthen students' command of usage, style, grammar, punctuation, precision, logical structure and color through intensive writing and copyediting practice.

**JW 602 Copyediting for Technical, Scientific and Business Publications** 2:0:0:3

Copyeditors are at the center of any print-media organization. This course addresses skills copyeditors must have to produce clean copy: correct grammar and punctuation; a precise and consistent style; fact checking, including the use of both standard references and electronic databases; editing leads; making news judgments when editing stories; legal concerns affecting writers and editors, including libel, invasion of privacy and copyright infringement; writing headlines; handling photographs and informational graphics; and designing and laying out pages.

**JW 603 Reporting on Medicine, Science and Technology** 2%:0:0:3

Researching and reporting on medicine, science and technology. Students will interview recognized medical, scientific and technology authorities in a given discipline to write and edit news and feature articles for a general reading audience. Course will consider how science writers develop feature articles, how they translate technical information effectively and engagingly to the lay audience and how they follow articles through to publication. Students will analyze several scientific, medical and technical magazines for content, style and editorial practices. Students will be encouraged to submit the work they do in the course for publication. *Prerequisite: JW 600 or instructor's permission.*

**JW 604 Graphic Design and Technical Illustration** 2%:0:0:3

Workshop in developing and producing graphics and illustrations for technical communications. Topics covered include concept development, computer-assisted graphic design, integrating text and graphics, and layout for technical reports, manuals and proposals.

**JW 605 Libel Law and Press Ethics** 2%:0:0:3

Based on a study of some classic cases, this course will familiarize the student with the essentials of libel law. Journalistic ethics; writer's responsibilities to sources and readers; avoiding libel pitfalls.

**JW 606 Technical Presentations** 2%:0:0:3

Principles of effective scientific and technical presentations. Topics include channeling content to audience, organization of material, appropriate media, design and production of visual aids and audience text, effective delivery and non-verbal communication. Students will prepare for and participate in speech-making situations and in panel discussions covering a wide variety of technical subjects. *Prerequisite: JW 600 or instructor's permission.*

**JW 607 Writing News for Radio and Television** 2%:0:0:3

Writing news for the electronic media. Focus on science and business news stories. Intensive practice in writing for radio and television; accepted format and style of media news writing; and requirements and limitations of the media and how these must be taken into account in news writing. Students will use video and audio technology in this course. *Prerequisite: JW 600 or instructor's permission.*

**JW 608 Computer Documentation I** 2%:0:0:3

Introduction to the field of computer documentation. Systems and software documentation procedures and techniques; computer documentation tools; and fundamentals of project management, from needs analysis to usability testing. History and future of documentation. *Prerequisite: JW 600 or instructor's permission.*

**JW 609 Computer Documentation II** 2%:0:0:3

Advanced computer documentation course in which students learn how to produce effective online documentation, effectively index documentation projects, and revise and update documentation manuals and programs. Intensive practice in project management. *Prerequisite: JW 608 or instructor's permission.*

**JW 610 Information Design** 2%:0:0:3

A workshop providing extensive practice in strategies for information design. Students learn how to categorize or chunk information into small, digestible components that can be easily absorbed and recalled by a user or reader. The course explores the history of information design and links between information design and other writing strategies. Students will apply information design to various types of documents, including news articles, business reports, documentation (both print and online) and scripts for multimedia and radio. *Prerequisite: JW600 or instructor's permission.*

**JW 611 Technical Translation and Localization Practices** 2%:0:0:3

Students learn and practice concepts of writing and revising technical communications for effective translation. Explores the elements of translatability, especially cultural concerns, syntactic structures and style. Includes case studies and a translation project. *Prerequisite: JW 600 or instructor's permission.*

**JW 613 Human Factors and Product Design** 2%:0:0:3

Examines the elements of human-computer interaction and how it affects knowledge transfer and product design. Students learn how to design user-friendly programs by studying perception, cognition and software psychology. *Prerequisite: JW 600 or instructor's permission.*

**JW 615 Multimedia Technologies** 2%:0:0:3

The various multimedia technologies and their applications in technical communications. Elements of each medium; methods of media selection; media production; design coordination and media integration. Importance of audience analysis, clear understanding of goals and objectives, and project evaluation. Includes major multimedia project. *Prerequisite: JW 600 and JW 604 or instructor's permission.*

**JW 618 Webpage Authorship and Design** 2%:0:0:3

Workshop in writing and designing a World Wide Web page. Students examine the elements of effective World Wide Web page authorship and design, including coding, linking, information hierarchy and effective integration of graphics, text and sound. Students write and produce Webpages for a mock organization. *Prerequisite: JW 600 and JW 604 or instructor's permission.*



**JW 620 Financial and Business Reporting** 2:1½:0:3

Workshop in business and financial news writing. Students write news reports and interpretive pieces for business periodicals and the financial sections of newspapers. Topics include economic trends, marketing, corporate activities, the stock market, government regulations, industrial technology, labor-management relations, energy, industry and the environment, and advertising. Students analyze corporate annual reports, investment company research reports, stock analysis reports, financial press releases and the editorial practices of several financial and business publications. *Prerequisite: JW 600 or instructor's permission.*

**JW 621 Reporting and Editing for the Trade Press** 2½:2:0:3

Survey of the diverse editorial opportunities in trade press journalism. Students learn to write, edit and interview for trade publications. Among the assignments are writing short news stories; copyediting (including the writing of heads and decks); rewriting weak copy for a magazine's departments (new products, books and literature, case histories, news, company and personality profiles, etc.); and short features describing plant layouts, machine operation, maintenance procedures and business conditions. Consideration will be given also to the longer feature article often referred to as the roundup story. Since most trade magazines serve a particular field of industry (computers, electronics, petrochemicals, pharmaceuticals, automotive, etc.), many of the articles appearing in them are contributed by industry authorities. The course will emphasize the responsibility of the editor to cultivate good working relationships with such people to induce them to write for publication in trade journals. *Prerequisite: JW 600 or instructor's permission.*

**JW 623 Project Management** 2½:0:0:3

Managing publication projects for scientific and technical organizations. All phases of publication: project conception, design, coordination, production, and costs: planning, organizing, staffing,

directing, and budgeting. *Prerequisite: JW 600 or instructor's permission.*

**JW 624 Writing Product-Information Copy** 2½:0:0:3

Consideration of the mass of sales-promotional and technical catalogues, brochures, manuals, spec sheets, flyers and news releases that promote a company's products. Emphasis will be on the approaches to writing such material. In addition to preparing copy for the shorter product-promotion bulletins, students will be responsible for providing the text for a major catalogue or brochure promoting a given product or technology and based on raw data either provided by the instructor or gathered by students. Course will stress the need for product information of varying degrees of technical complexity to suit the technical competency of the prospective customer for whom the literature is intended. *Prerequisite: JW 600 or instructor's permission.*

**JW 625 Corporate Communications in Medicine, Science and Technology** 2½:0:0:3

Considers the corporate communications writing tasks specific to a pharmaceutical, biotechnology or technology firm. Topics include in-house technical and semitechnical reports, liaisoning between researchers and management, writing and editing for scientists. *Prerequisite: JW 600 or instructor's permission.*

**JW 626 Public Relations for Medicine, Science and Technology** 2½:0:0:3

Workshop in public relations for medical, scientific and technological industries and organizations, including research facilities, hospitals, medical schools, foundations and pharmaceutical companies. Students will learn how to write effective press releases, brochures, technical articles, film scripts, case histories, speeches and various in-house publications, as well as how to prepare press kits for press briefings. *Prerequisite: JW600 or instructor's permission.*

**JW 627 Writing Copy on Pharmaceuticals and Biotechnology** 2½:0:0:3

Course is geared to preparing students for expanding opportunities in writing copy for pharmaceutical and drug companies. Intensive practice in writing new-product data sheets, bulletins and other technical literature generally used by "detail" men; research reports, progress reports and other technical papers based on information supplied by the instructor and gathered on trips to local pharmaceutical companies; technical speeches; advertising and public relations copy. A major paper will be assigned as a term project. *Prerequisite: JW 624 or JW 626, or instructor's permission.*

**JW 628 Business-to-Business Advertising** 2½:0:0:3

Covers the objectives of business-to-business advertising and how to achieve them through the three basic ingredients of the magazine ad: copy, artwork and layout. Emphasis is on the principles of writing effective copy and heads, the process of media selection for a given ad (product promotion, institutional), the preparation of an ad campaign, how to set up booths for industrial displays and exhibits, conducting the direct mail campaign, the value and preparation of sales literature and an analysis of business-publication advertising today. The roles of the company advertising manager and the agency's account executive and their interrelationship are delineated. Completion of a special project and several ad-writing assignments will be required. *Prerequisite: JW 600 or instructor's permission.*

**JW 631 Proposal Writing** 2½:0:0:3

Writing proposals in government and industry. Students analyze the components of specific in-depth proposals and then research and write their own as a major course project. Analysis of parts of text, including statement of problem, methods, key personnel and budgeting; use of graphic and tabular material; organization, clarity, layout and editing. *Prerequisite: JW 600 or instructor's permission.*

## DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES

### **JW 632 Writing Technical Manuals and Procedures** 2%:0:0:3

Intensive practice in preparing industrial, technical, administrative and instructional manuals and procedures. Training in how to write these documents according to government and client specifications. Integration of text with graphics, tables and lists; organization, indexing and parts lists. Every aspect from compiling information to evaluating final product. Major project required on subject in student's area of specialization. *Prerequisite: JW 600 or instructor's permission.*

### **JW 635 On-Line Journalism** 2%:0:0:3

Examination of the growing field of on-line journalism. Similarities to and differences from traditional print journalism; available markets in electronic journalism, such as electronic publishing, videotext publications, and electronic magazines; techniques for writing for the videotext market, including digest techniques and writing to fit the format of an electronic publication. *Prerequisite: JW 600 or instructor's permission.*

### **JW 636 The Feature Article** 2%:0:0:3

The practice and principles of good, solid feature articles about science, technology and business. Students learn how to write several specific types of feature articles through weekly writing assignments and the creation of their own magazine (print or online). Types of articles may include book reviews, product reviews, "how-to" articles and columns. Topics include effective interview techniques and online journalism applications and concerns. *Prerequisite: JW 600 or instructor's permission.*

### **JW 637 Computer-Assisted Reporting (CAR)** 2%:0:0:3

A workshop focusing on using the computer as a key newsgathering tool. Students learn the techniques involved in finding, accessing, analyzing and using databases on the World Wide Web when researching technical and non-technical news and feature stories. The course explains how reporters and editors can use CAR methods not only for essential

online research but also with spreadsheet software, CD-ROMs, mapping and electronic mail. Students will write articles that depend heavily — but not exclusively—on CAR-based research. *Prerequisite: JW600 or instructor's permission.*

### **JW 641 Desktop Production Workshop** 2%:0:0:3

Workshop in desktop publishing software and applications. Students use QuarkXpress, PageMaker and other desktop publishing tools to write, design and produce effective business and technical documents: newsletters, brochures, etc. *Prerequisite: JW 600 and JW 604 or instructor's permission.*

### **JW 645 Instructional Design and Development** 2%:0:0:3

Fundamentals of computer-assisted instructional design and curriculum development. Topics include the different learning modalities, how to organize information into lessons, how to develop effective exercises and tests, and elements of effective instruction. Students create a training curriculum as a semester project. Scope of project includes needs analysis, project planning and management, and usability testing. *Prerequisite: JW 600 or instructor's permission.*

### **JW 646 End-User Training** 2%:0:0:3

A workshop on the effective delivery of training programs. Students will go through the training development process, from program assessment and design to delivery and evaluation. The course will review the elements of effective instructional design (with an emphasis on different learning styles) and then focus on choosing the appropriate method of instruction and the elements of effective instruction. Students will conduct several training sessions throughout the semester. *Prerequisite: JW 645 or instructor's permission.*

### **JW 647 Computer-Based End-User Training** 2%:0:0:3

Workshop in using computer-based training programs to develop a tutorial training package. Students learn and practice principles of effective computer-based training, including breakdown of steps and skills; formulation of questions and answers; and use of graphics, references charts. *Prerequisite: JW 609, JW 645, JW 646 or instructor's permission.*

### **JW 650 Special Topics in Writing about Medicine, Science and Technology** 2%:0:0:3

Special topics courses are offered periodically by the department to address topics in science journalism not currently covered in the curriculum. Topics, faculty and prerequisites may vary. *Prerequisite: JW600 or instructor's permission.*

### **JW 651 Special Topics in Writing for Business** 2%:0:0:3

Special topics courses are offered periodically by the department to address topics in business writing not currently covered in the curriculum. Topics, faculty and prerequisites may vary. *Prerequisite: JW600 or instructor's permission.*

### **JW 652 Special Topics in Documentation, Training and New Media** 2%:0:0:3

Special topics courses are offered periodically by the department to address topics in documentation, training and new media not currently covered in the curriculum. Topics, faculty and prerequisites may vary. *Prerequisite: JW600 or instructor's permission.*

**JW 701 Special Project in Technical and Professional Communication**

2%:0:0:3

Students, working in conjunction with a faculty member, will pursue a course of independent study dealing with a special facet of technical and professional communication. Students will produce an original, thought-provoking interpretive project or report to be submitted to the department for faculty review and approval. *Prerequisite: Adviser's consent.*

**JW 702 Special Topics in Technical and Professional Communication**

2%:0:0:3

This special topics course will be offered from time to time by faculty members, visiting scholars and professionals. The special titles and prerequisites will be announced prior to registration. May be repeated for credit. *Prerequisite: JW 600 or instructor's permission.*

**JW 703 Internship**

0:0:3:12

Full- or part-time placement as a technical and professional communication intern. Intense, practical work experience focusing on student's area of specialization. Students work with a professional adviser within the sponsoring organization and a faculty adviser within the department. Weekly progress reports and term project required. *Prerequisites: Completion of at least four graduate courses in technical and professional communication; approval of the sponsoring organization and the department.*

**JW 704 Master's Project**

2%:0:0:3

Students work with a faculty adviser to write and produce a master's project in technical and professional communication. After project proposal is approved, students research and develop a technical communication project in their area of specialization. *Prerequisites: Completion of at least 27 credits toward MS in Specialized Journalism and instructor's permission.*

# SOCIAL SCIENCES PROGRAM

The Department of Humanities and Social Sciences offers a BS in social sciences with concentrations in:

- Pre-Law
- History
- History and Philosophy of Science and Technology
- Economics
- Psychology and Behavioral Sciences

For more information, please call the Humanities and Social Sciences Office at 718/260-3039 or send e-mail to Professor Richard Wener: [rwener@duke.poly.edu](mailto:rwener@duke.poly.edu).

## DEGREE REQUIREMENTS

All majors are required to take the Liberal Arts Core Program plus 12 courses (36 credits) in their areas of concentration.

### HU/SS Core Courses

(Liberal Arts Core Program)

HU 101/103	<i>Writing and the Humanities I</i>	3
HU 105/TC 110	<i>Advanced Composition/Basic Report Writing</i>	3
HU 200	<i>Writing and the Humanities II</i>	3
HU 344	<i>Introduction to Logic</i>	3
SS 104	<i>Main Themes in Contemporary World History</i>	3
SS 138	<i>Technology, Science, Ethics and Contemporary Society</i>	3
EG 101	<i>Introduction to Engineering</i>	3
CS 200	<i>Introduction to Programming Methodology</i>	3
MA 105 or 106	<i>Calculus I</i>	4
		<b>28 credits</b>

Six or more credits in an engineering or science sequence (CM, PH, LS or other as approved by adviser). 6 credits

### HU/SS Core Electives

1	SS	<i>World History (109, 120, 121, 123, 124)</i>	3
1	SS	<i>History/Philosophy of Science/Technology (135, 136)</i>	3
1	SS	<i>Psychology/Behavioral Sciences (189)</i>	3
1	SS	<i>Economics (250)</i>	3
1	HU	<i>Literature (212, 213, 222, 252, 283, 291)</i>	3
1	HU	<i>Philosophy (346, 347, 348, 349, 352, 353)</i>	3
1	HU	<i>Art (388)</i>	3
1	HU	<i>Music (371)</i>	3
			<b>24 credits</b>

Free Electives	26 credits
Concentration Requirements	36 credits
<b>TOTAL</b>	<b>120 credits</b>

## CONCENTRATION REQUIREMENTS

Students choose 12 courses (36 credits) from one of the following concentrations:

- Pre-Law
- History
- History and Philosophy of Science and Technology
- Economics
- Psychology and Behavioral Sciences

### CONCENTRATION IN PRE-LAW: LAW AND TECHNOLOGY

The purpose of the program is to prepare students for postgraduate professional education which can lead to careers dealing with technological aspects of the law. These include patent law, intellectual property law, and environmental law. Attorneys working in these fields typically have engineering and/or science backgrounds in addition to their legal training.

Students entering the Pre-Law Program will choose one of the Humanities or Social Sciences concentrations (history, history and philosophy of technology and science, economics, psychology, philosophy, literature or humanistic studies) and will take a series of special pre-law courses in addition to this concentration.

Students should develop strong backgrounds in technology, in addition to their other undergraduate and professional legal training. Patent law, in particular, demands technical competence, usually in the form of an undergraduate degree in science or engineering. Other areas, such as intellectual property law or environmental law, do not demand a technology degree, but require an understanding of technologies and/or scientific methods.

The rigors of law school and the legal profession demand that all students entering this field have excellent communication skills. Clear and concise writing is crucial as is the ability to critically read and edit documents. Law schools typically look for students who have a good background in the liberal arts, including topics such as philosophy, history and economics. An understanding of the historical context of technologies (history of science and technology), and the social contexts of change (environmental and social impacts) is also important. The Polytechnic pre-law concentration provides opportunities in each of these areas of training.

There are several pre-law options described below. In all options, students must take an ongoing professional practice seminar, take special courses in technology and the law and complete an internship experience, along with pre-law advising. Students in the various options will take a series of courses designed to provide a solid background in the humanities and social sciences, preparatory for legal training.

All pre-law students will regularly meet with the pre-law advisor for consultation and support toward application and admission to law schools.

Pre-law students will take courses which follow the BS in social sciences, BS in humanities or BS in specialized journalism with several additions described below. This program is intended to provide students with a solid background in the liberal arts, which includes familiarity with issues in technology and engineering design (for example, EG 101 in the core, EG 102, EG 201 as additional requirements and others (EG 202, 301, 302) as elective options).

**HUSS Core Courses**

(as described in catalog)	58 credits
EG 102 & EG 201	4 credits
2 pre-law courses	6 credits
SS 281 Technology and the Law	
SS 282 Environmental Law	
HUSS Concentration (in Economics, History, History and Philosophy of Science and Technology or Psychology and Behavioral Sciences)	36 credits
Pre-law internship (SS 298)	6-3 credits (3 credits - can be repeated once)
Free Electives (EG 202, 301 & 302 are encouraged)	12-15 credits
Pre-Law Seminar (SS 290)	0 credits (at least 4 semesters)
<b>Total</b>	<b>122 credits</b>

**CONCENTRATION IN HISTORY**

Courses in history emphasize elements of social and economic change in various geographic areas and periods since the European Renaissance. Methods and conclusions of related work in economics and the behavioral sciences are applied. Basic sequences in the history of Western civilization familiarize students with political, economic, social, cultural and intellectual developments in European history since the Middle Ages. Students are also introduced to original documents and differing scholarly interpretations, and to the study of the non-Western world.

Majors with a concentration in history choose 12 courses from the following:

SS 109	<i>Birth of Modern Europe</i>
SS 120	<i>History of Tsarist Russia to the Revolution</i>
SS 121	<i>History of the Soviet Union</i>
SS 123	<i>History of the United States: from Settlements to Reconstruction</i>
SS 124	<i>History of the United States: from Reconstruction to the Cold War</i>
SS 135*	<i>History of Science and Technology: Antiquity to Galileo</i>
SS 136*	<i>History of Science and Technology: Galileo to Darwin</i>
SS 137*	<i>History of Science and Technology: Faraday to the Present</i>
SS 151	<i>Introduction to Politics</i>
SS 161	<i>Politics &amp; Film</i> (May be repeated for credit)
SS 221	<i>The End of the U.S.S.R.: Gorbachev and After</i>
SS 226	<i>Problems of American Foreign Policy</i>
SS 229	<i>Growth of the United States Constitution</i>
SS 302	<i>Guided Readings in History</i>
SS 362	<i>Special Topics in History</i>
SS 363	<i>Special Topics in History of Science and Technology</i>

**\*STUDENT MUST CHOOSE 2 OF THESE COURSES**

**CONCENTRATION IN HISTORY AND PHILOSOPHY OF SCIENCE AND TECHNOLOGY**

Science and technology have been pivotal in modern historical development and social change, especially in our own epoch, and are emphasized in all introductory courses. Students analyze and discuss the best historical scholarship in a variety of special courses, and methods of instruction include formal lectures, discussions, colloquia, films, and tutorials leading to independent research.

Students who major in the history and philosophy of science and technology benefit from one of the most comprehensive programs available in the New York area. Career openings for such majors may be found in government, law, medicine, teaching, public relations and all fields of media and communications. Majors with a concentration in history and philosophy of science and technology choose 12 courses from the following:

SS 109*	<i>The Birth of Modern Europe</i>
SS 133	<i>Archaic- and Ethnoastronomy</i>
SS 135*	<i>History of Science and Technology: Antiquity to Galileo</i>
SS 136*	<i>History of Science and Technology: Galileo to Darwin</i>
SS 137*	<i>History of Science and Technology: Faraday to the Present</i>
SS 182	<i>Man and the Environment</i>
SS 303	<i>Guided Readings in History of Science and Technology</i>
SS 332	<i>Science and Technology in America</i>
SS 333	<i>Medieval and Renaissance Engineering</i>
SS 338	<i>Galileo Galilei: the Man, His Research, the Times</i>
HU 352*	<i>Philosophy of Science</i>
HU 353*	<i>Philosophy of Technology</i>
SS 354	<i>Technological Forecasting</i>
SS 357	<i>Technology Transfer to Developing Countries</i>
SS 363	<i>Special Topics in History of Science and Technology</i>

**\*REQUIRED**

**CONCENTRATION IN ECONOMICS**

Economics courses guide students in developing critical understanding of economic theory and its application to contemporary and historical economic and social problems. These courses pose, in their theoretical and historical contexts, important questions of domestic and international public policy, including the role of government in market economies and the interconnection of what is considered economic and what is considered political.

Candidates for the social sciences degree concentrating in economics receive thorough training in economic theory, mathematics and statistical methods, as well as extensive analysis of how economic factors play themselves out in the "real world." The concentration in economics prepares students for careers in governmental and other nonprofit service and private business, including both the financial and non-financial sectors, as well as in teaching on all levels. In addition, economic training is especially valuable for those seeking careers in law, accounting and other fields.

Majors with a concentration in economics choose 12 courses from among the following:

SS 251	<i>Microeconomics</i>
SS 252	<i>Macroeconomics</i>
SS 254	<i>Economic Issues</i>
SS 255	<i>The Contemporary American Economy: Boom and Bust</i>
SS 257	<i>History of Economic Thought</i>
SS 264	<i>Urban Economics</i>
SS 265	<i>Money &amp; Banking</i>
SS 270	<i>Management Process</i>
SS 275	<i>Foundations of Business Systems</i>
SS 304	<i>Guided Readings in Economics</i>
SS 354	<i>Technological Forecasting</i>
SS 357	<i>Technology Transfer to Developing Countries</i>
SS 363	<i>Labor Economics</i>
SS 364	<i>Special Topics in Economics</i>

**CONCENTRATION IN  
PSYCHOLOGY AND  
BEHAVIORAL SCIENCES  
(ANTHROPOLOGY AND  
SOCIOLOGY)**

Introductory courses in anthropology, sociology and psychology broaden students' understanding of social processes and human behavior and prepare them to meet professional and administrative problems with insight and sophistication.

Advanced courses examine contemporary American society and its impact on the individual, the variety of social and cultural forms that have unfolded in the course of history, and their implications for the contemporary world as new nations enter the historical mainstream. Other courses analyze language, learning and the modification of behavior, with experiments in perception, learning and communication. Students become acquainted with a range of behavioral methods of scientific study from participant observation and structured interviewing to opinion sampling, psychological testing and controlled laboratory experiments.

Psychology courses introduce students to psychology as the science of behavior, which can be empirically investigated. The department offers advanced courses in applied, social, environmental, cognitive, developmental, personality, comparative, physiological, learning and abnormal psychology. All majors take a two-semester experimental psychology sequence, which offers fundamental methods and concepts in the empirical investigation of human and animal behavior in laboratory as well as field settings. Other psychology courses allow ample opportunities for students to design and complete individual research projects under the supervision of instructors. A concentration in psychology enables students to pursue graduate training in psychology and other fields, including psychotherapy, social work, marketing research, personnel management, organizational behavior and social-impact assessment, or to enter management training programs and paraprofessional work in such settings as youth centers, clinics, schools and community programs.

An understanding of psychology is of particular use to engineers who must

design devices and controls for safe and easy application by human beings. For engineers who become managers, psychology is useful in teaching the principles of human interaction.

Majors with a concentration in psychology and behavioral sciences choose 12 courses from the following:

- SS 175\* *Introduction to Sociology*
- SS 177\* *Social Problems*
- SS 178 *Minorities in the New World*
- SS 182 *Man and the Environment*
- SS 184\* *The Sociocultural Sciences*
- SS 185 *Anthropology: Physical*
- SS 186 *Anthropology: Cultural*
- SS 203 *Learning*
- SS 204 *Physiological Psychology*
- SS 206 *Human Cognition*
- SS 208\* *Experimental Psychology I*
- SS 209\* *Experimental Psychology II*
- SS 210 *Environmental Psychology*
- SS 213 *North American Indians*
- SS 214 *Social Psychology*
- SS 215 *Abnormal Psychology*
- SS 216 *Personality Development*
- SS 217 *Psychology of Human Development*
- SS 279 *The Sociology of Human Disease*
- SS 299 *Organizational Behavior*
- SS 305 *Guided Readings in Psychology*
- SS 306 *Guided Readings in Anthropology and Sociology*
- SS 310 *Genes, Gender and Society*
- SS 365 *Special Topics in Psychology*
- SS 366 *Special Topics in Anthropology and Sociology*

**\*REQUIRED IN CONCENTRATION**

**BS/MS Accelerated Honors  
Program in Behavioral Sciences  
(BS) and Organizational  
Behavior (MS)**

The Department of Humanities and Social Sciences and the Department of Management offer an honors program for exceptional first year or advanced undergraduate students. Through this program a student can earn a Bachelor of Science degree in social sciences—with a concentration in behavioral sciences—and a Masters of Science degree in organizational behavior in four to five years.

This new accelerated program allows undergraduate social science majors concentrating in behavioral sciences to apply for admission to the graduate organizational behavior program during their junior year for entry in their senior year, and to be guaranteed admission if they have met the program's academic and grade-point requirements.

The accelerated program allows students to use up to 9 credits of organizational behavior graduate courses in fulfillment of social science degree requirements. In addition, accelerated progress may be the result of credit granted for Advanced Placement courses where a 4 or 5 was earned on the AP test, and through summer course work.

**Minimum Admissions Requirements**

For application of high school students:  
3.4 GPA  
1200 SAT

For application of advanced Polytechnic undergraduates for entry into the MS Organizational Behavior Program  
Honors status (3.4 GPA)

All students in this program would be expected to maintain a 3.4 GPA throughout their academic career. In any semester when the cumulative drops below 3.4, the student may be dropped from the program or be placed on probationary status.

**Current Degree Requirements**

Requirements for the HU/SS degree:

-HU/SS Core Courses	58 credits
-Behavioral Sciences Specialization	36 credits
-Free Electives	26 credits
<i>Total =</i>	<i>120 credits</i>

Requirements for MS in Organizational Behavior

-Core Courses	9 credits
-Area of Concentration	18 credits
-Free Electives	6 credits
-Research Project	3 credits
<i>Total =</i>	<i>36 credits</i>

The program will be offered in Brooklyn only and limited to 15 incoming students per semester.

Students who meet all of the course and grade-point requirements will be formally admitted to the MS in organizational behavior program in the Department of Management at the end of their junior year.

<b>UNDERGRADUATE COURSES</b>
----------------------------------

**SS 104 Main Themes  
in Contemporary World History** 3:0:0:3

Examination of the major ideologies, transformations and tensions marking the contemporary age, from World War I to the last decade of the 20th century. Readings, lectures, discussion, with feature and documentary films on such topics as the World Wars and Cold Wars; the rise, and now the fall, of Communism in Eastern Europe and the U.S.S.R.; the development of American globalism; the awakening of the Third World and the end of European Imperialism; the scientific-technological revolutions in war and in peace; current crises. Required of all students at Polytechnic. Should be taken in freshman or sophomore year. *Prerequisite: HU 101.*

**PRE-LAW**

**SS281 Law and Technology** 3:0:0:3

This course will introduce students to the technological revolution in legal practice, such as the computerization and networking of courts and law offices, the automation of legal research, and the legal regulation of technology, including patents, copyrights and trademarks, as well as other areas that could affect their engineering practice. The course will also cover the basic legal reasoning, processes and terminology, including legal writing. *Prerequisite: SS104.*

**SS 282 Law and Environment** 3:0:0:3

Fundamentals of U.S. and international environmental law and regulation. *Prerequisite: SS 104.*

**SS 290 Seminar on Technology and the Law** ½:0:0:0

This seminar will meet several times a semester for all pre-law students. It will present invited speakers on topics concerning technology and the law and provide a forum in which intellectual as

well as career issues can be discussed. This course will be graded on a pass/fail basis, based on attendance. *Prerequisites: Admission to pre-law major or minor or consent of pre-law adviser.*

**SS 298 Pre-Law Internship** 0:0:0:3

Students will work in law firms or corporate legal settings providing research support for issues and/or cases which deal technological aspects of the law (placement will be provided through the Department of Humanities and Social Sciences). The amount of time students will spend in the field setting will be roughly the same as the time that would be spent in the classroom for the equivalent credits. All students on internships during the same semester will meet as a group several times over the course of the semester with the pre-law adviser to discuss their experiences and will submit a term paper dealing with an aspect of the law they dealt with during the semester.

*This course can be repeated once for a maximum of 6 credit hours.*

*Prerequisites: Admission to pre-law major or minor and consent of pre-law adviser.*

**HISTORY AND  
HISTORY OF SCIENCE AND  
TECHNOLOGY**

**SS 109 The Birth of Modern Europe:  
The Early Phase, 800-1500** 3:0:0:3

From the time of the first stirring of specifically Western European Civilization, through its initial expansion and consolidation in the High Middle Ages, to the beginnings of the next great expansion marked by a peculiar dynamism probably linked to the nature of its material, human, and institutional resources. How those resources evolved over the years, and how Europeans used them to create the foundations for the institutions and patterns of functioning that still characterize the West today.

**SS 120 History of Tsarist Russia to  
the Revolution** 3:0:0:3

Russian state and society from earliest times; structure and practice of tsarism; Russia as "underdeveloped" society; special problems of modernization; Russia and West; culture and literature with special emphasis on 19th-century fiction. Political, social, economic causes of revolution in 1905.

**SS 121 History of Soviet Union** 3:0:0:3

Revolutions of 1917; Leninism in power; industrialization, collectivization, ascendancy of Stalin; Soviet Union and West—from alliance to Cold Wars; Khrushchev and de-Stalinization; Soviet impact on underdeveloped world; the Brezhnev era and the crisis of Soviet society.

**SS 123 History of the United States:  
From Settlements through  
Reconstruction** 3:0:0:3

Indigenous civilizations in North America. Culture, politics and society from European and African-American settlements through post-Civil War era. Interpretation of accessible "primary sources," which illuminate convictions, ideologies and activities of leaders as well as ordinary Americans from the 17th through the mid-19th century. *Prerequisite: SS 104.*

**SS 124 History of the United States:  
From Reconstruction through the  
Cold War** 3:0:0:3

The transformation of the post-Civil War U.S. to a nation of global authority; interweaving of domestic struggles and foreign policies from the "Gilded Age" through the Progressive Era; the World Wars of the 20th century; the New Deal period and post-New Deal domestic policy conflicts. U.S. foreign policy in a world of revolutionary upheavals. *Prerequisite: SS 104.*

**SS 133 Archaeo- and Ethnoastronomy**  
3:0:0:3

Early astronomical knowledge and its place and uses in all cultures to keep track of the motions of celestial bodies (excluding only the astronomies of Graeco-Alexandrian antiquity forward; see SS 135). The astronomical knowledge per se of several quite different cultures and the ways in which these astronomies both reflected and reinforced the economic and social organization and the cosmological and religious beliefs of the cultures in which they were embedded. Instruction in elementary, naked-eye astronomy, exercises in designing simple instruments and, weather permitting, actual observation. Student work will include a term project.

**SS 135 History of Science and Technology: Antiquity through Galileo**  
3:0:0:3

Science and technology from earliest time to Renaissance; neolithic and medieval technologies; achievements of ancient Greeks from pre-Socratics to Euclid; Copernican revolution; science and technology in expansion of Europe; influences of science on development of European thought.

**SS 136 History of Science and Technology: Galileo through Darwin**  
3:0:0:3

Science and technology from the scientific revolution through Lavoisier to the origins of the Theory of Evolution. Galileo and Newton; the beginnings of evolutionary thought; the organization of scientific inquiry; the impact of scientific thought on society in the 17th, 18th and early 19th centuries; connections between technology and science.

**SS 137 History of Science Technology: Faraday Through Present**  
3:0:0:3

Science and technology from early 19th century forward: the maturation of evolutionary thought and its consequences; the rise of the sciences of electricity and heat, relativity, quantum mechanics; the development of cell theory, genetics and biochemistry.

**SS 138 Technology, Science, Ethics and Contemporary Society** 3:0:0:3

Mutual relationships between technology, science and society; emergence of "high science," national styles in science and technology; social effects of recent technological and scientific developments; policy and ethical issues posed by restricted and unrestricted uses of technology and science. *Prerequisite: SS 104.*

**SS 151 Introduction to Politics**  
3:0:0:3

Major issues in history of political philosophy: the state; nature of political obligation; scope of dissent. Origins and functions of American political system. Clashing ideologies of democratic society. *Prerequisite: SS 104*

**SS 161 Politics and Film** 3:0:0:3

Film viewed as historical document and political instrument. Film as facet of mass culture and mass communication and means of shaping and reflecting attitudes and values. Each of the historically framed subjects constitutes a separate course for credit. Topics include Depression America; war: A cross-cultural comparison; Weimar Germany in the shadow of fascism; the fall of France, 1930-1940; Great Britain—the end of empire; Russia in revolution and civil war; the reconstruction of Europe, 1947–1962. Film screenings, readings, lectures and discussions. Other topics offered as appropriate. May be repeated for credit. *Prerequisite: SS 104.*

**SS 221 The End of the U.S.S.R.: Gorbachev and After**  
3:0:0:3

The U.S.S.R. under Gorbachev, 1985–1991, and the crisis that led to the collapse of Soviet communism. The historical background: from Khrushchev's de-Stalinization to Brezhnev's stability and stagnation. Gorbachev's "glasnost" and "perestroika" as reform strategies out of the crisis. The unforeseen consequences of the Gorbachev reforms: the end of the U.S.S.R. Culture, politics and economy to the present. Films, lectures, readings. *Prerequisite: SS 104.*

**SS 226 Problems of American Foreign Policy**  
3:0:0:3

Formulations and applications of foreign policy from 18th century through post-Cold War; continental and overseas expansions, international rivalries; impacts of domestic influences: diplomacy of infant republic; Monroe Doctrine; "Manifest Destiny"; white man's burden; open-door policy; "dollar diplomacy"; world wars and their settlements; Cold War and aftermath. *Prerequisite: SS 104.*

**SS 229 Growth of the United States Constitution**  
3:0:0:3

Growth and unfolding of American constitutional system stressing political and economic factors shaping the law. Students handle leading court decisions and related legal texts. *Prerequisite: SS 104.*

**SS 332 Science and Technology in America**  
3:0:0:3

Colonial science. Indifference to basic science during 19th century. Technology and industrialization. Recent accomplishments of American science and technology. Emergence to superpower status.

**SS 333 Medieval and Renaissance Engineering**  
3:0:0:3

Engineering and technological enterprise in the European High Middle Ages and Renaissance, roughly 1000 to 1600. The period was characterized by a growing capacity to handle complex engineering tasks such as the building of the Gothic cathedral, the mining of ores, the extraction of metals, the industrial production chemicals (e.g., gunpowder), the building of bridges and digging of canals, the construction of ships and the design of complex machinery, both light and heavy duty. Organizing a given project or task, the means of financing, the political and institutional involvement and the training of the artisan-engineer and his position in society.

*Prerequisite: SS 135 or 136 or instructor's permission.*



**SS 338 Galileo Galilei: the Man, his Research, the Times** 3:0:0:3

The life and career of one of the pivotal founders of modern science, Galileo Galilei (1564–1642). Galileo's experimental/observational research and the genesis and development of his mature conclusions in physics and cosmology. His role in establishing new attitudes towards the investigation of natural phenomena, his conflict with the Church, the work of his predecessors and contemporaries and the setting: Italy in the late 16th and early 17th centuries. Students will have the opportunity to empirically investigate some of Galileo's experiments. *Prerequisite: SS 135 or 136 or instructor's permission.*

**SS 354 Technological Forecasting** 3:0:0:3

Introduction to problems associated with technology forecasting. Short-range, intermediate, and long-range forecasting methodologies. Forecasting social and economic consequences of adopted innovations. Students will prepare a forecast on a topic of their choice.

**SS 357 Technology Transfer to Developing Countries** 3:0:0:3

Mechanisms of technology transfer. Ecological, social and economic factors in technology selection and utilization. Local efforts to adapt technology to local needs. National and international means to stimulate or block technology transfer. Technology and political influence. Case studies of technology transfer to newly industrialized countries. *Also listed under IE 357*

**PSYCHOLOGY AND BEHAVIORAL SCIENCES (ANTHROPOLOGY AND SOCIOLOGY)****SS 175 Introduction to Sociology** 3:0:0:3

Influences of culture and social structures on human behavior. Concepts of sociological analysis; types of human societies; social stratification; urban ecology; the social context of environmental crises; the human impact of technology. *Prerequisite: HU 189 or SS 184.*

**SS 177 Social Problems** 3:0:0:3

Social disorganization and deviant behavior in contemporary society; crime and juvenile delinquency; mental disorder; drug addiction; alcoholism; suicide; family disorganization; poverty; and unemployment. Comparisons with cultures of other peoples and/or simpler societies. Discussions of conflicting theories of causes for deviance and social disorganization. *Prerequisite: SS 186.*

**SS 182 Man and the Environment: Environmental Science I** 3:0:0:3

Ecological understanding of interactions of human with non-human environments through relevant topics: ecosystem, human interaction with ecosystem, human societies as self-regulating systems, attitudes toward nature, case studies in ecological history, present environmental crises and attempts at resolutions. *Prerequisite SS 189 or SS 184.*

**SS 184 The Sociocultural Sciences** 3:0:0:3

Introduction to the nature of anthropological and sociological discourse and explanation. Society and biology in human collective behavior. Demography and social behavior. The concepts of culture and society. Classical anthropological and sociological studies—Kroeber, Boas, Spencer, Durkheim, Weber and Merton. Sociological and anthropological perspectives on language. *Prerequisite: SS189 or SS 184.*

**SS 185 Anthropology: Physical** 3:0:0:3

Biosocial bases of human conduct seen in evolutionary perspectives; elementary genetic, demographic and ecological models necessary for understanding human behavior; biology as an evolutionary complex extending from prosimian revolution through neolithic revolution. *Prerequisite: SS 189 or SS 184.*

**SS 186 Anthropology: Cultural** 3:0:0:3

Social evolution from the hunting and gathering band through state society. Considerations of variation and developmental trends in several human institutions: kinship, economic organization, warfare, politics, religion, and technology. Demographic and ecological variables receive primary stress. *Prerequisite: SS 189 or SS 184.*

**SS 189 Introduction to Psychology** 3:0:0:3

Scientific study of behavior. Learning, physiological psychology, sensory systems, developmental, educational, abnormal and social psychology. Lectures, class discussion, films/videos, demonstrations of experiments. *Prerequisite: SS 189 or SS 184.*

**SS 203 Psychology of Learning** 3:0:0:3

Response acquisition and maintenance in human beings and other animals. Concepts of reinforcement, extinction, schedules of reinforcement, generalization, discrimination training. Relationship of learning to emotion and motivation, transfer of training, retention and forgetting, concept learning, acquisition of skills. Theories of learning and application of learning to other areas of psychology. *Prerequisite: SS 189 or SS 184.*

**SS 204 Physiological Psychology** 3:0:0:3

Relationships among physiology, anatomy and behavior. Physiological, anatomical, and biochemical bases for memory, learning, motivation, sleep, arousal and stress. *Prerequisite SS 189 or 184.*

**SS 205 Applied Psychology** 3:0:0:3

How various problems, particularly in work, can be solved through the judicious use of psychological principles. 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 select a problem, do a behavioral analysis and finally modify it as a class project. *Prerequisite: SS 189 or SS 184.*

**SS 206 Human Cognition and Information Processing** 3:0:0:3

Human cognitive and information processing capabilities: Structures of memory and internal representations of knowledge, concept formation and schemas, symbol manipulation, mental operations, consciousness, and problem-solving capabilities and strategies. Implications for learning, development, language acquisition and artificial intelligence. *Prerequisites: SS 189 or SS 184.*

**SS 208 Experimental Psychology I** 3:0:0:3

Theory and methods of measurement of sensory functions in human and animal subjects. Examination of the concept of the threshold and problems of its measurement. Investigation of learning, both motor and verbal, and both simple and complex, including problem solving and creative thinking. Students will perform a series of experiments with human and animal subjects. *Prerequisite: SS 189 or SS 184.*

**SS 209 Experimental Psychology II** 3:0:0:3

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 naturalistic settings. The course focuses upon 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: SS 189 or SS 184.*

**SS 210 Environmental Psychology** 3:0:0:3

Ways people use and are affected by their physical environments. Research in natural environments as well as built urban areas. Research on personal space, privacy, territoriality, crowding and design-behavior relationships. Field research to assess suitability of environments to human needs, using interview techniques, behavioral observations and unobtrusive measures. *Prerequisite: SS 189 or SS 184.*

**SS 213 North American Indians** 3:0:0:3

A survey of the cultures of selected Indian and Eskimo groups. After a general historical introduction, primary emphasis will be placed on tribal social organization, technology, art and language at the time of European contact. *Prerequisite: SS 186.*

**SS 214 Social Psychology** 3:0:0:3

Behavior as function of social stimulation. Nature of socio-psychological inquiry, with particular emphasis on experimental methods. Biological bases of social behavior, socialization processes, effects of social stimuli on perception and communication, group processes, attitude change, interpersonal bargaining. Student participation in experiments. *Prerequisite: SS 189 or SS 184.*

**SS 215 Abnormal Psychology** 3:0:0:3

Types of abnormal behavior: neurosis, psychosis, psychosomatic reactions, character disorders. Developmental and social learning theories, biological, etiological models. Relations of methods of treatment of abnormal behavior to models of etiology. *Prerequisite: SS 189 or SS 184.*

**SS 216 Personality Development** 3:0:0:3

Methods and theory relevant to the study of personality. Personality development in terms of social learning, development, and cognition. Examples of personality research include studies of authoritarianism, achievement motivation, self-esteem, sex-role acquisition and stereotyping, family and life style choices, and effects of physiological variables including maturity and aging. *Prerequisite: SS 189 or SS 184.*

**SS 217 Psychology of Human Development** 3:0:0:3

Human development from birth to old age. Effects of age on thinking, learning, social behavior. Implications for teaching and educational programs. *Prerequisite: SS 189 or SS 184.*

**SS 279 The Sociology of Human Disease** 3:0:0:3

Human disease in context of social and biological adaptation. Disease profiles of the three major levels of social evolution (hunters and gatherers, low-energy agriculturalists and states) considered from broadly conceived human ecological viewpoints. Recommended: some background in biology and anthropology. *Prerequisite: SS 189 or SS 184.*

**SS 299 Organizational Behavior** 3:0:0:3

Behavior in industrial settings. Informal and formal group dynamics: interpersonal relationships, supervision, leadership, communication theories, attitude measurement, creativity. Analyses of administration problems through case studies and simulated situations. **Also listed under MG 301.**

**SS 310 Genes, Gender and Society** 3:0:0:3

Psychology, sociology and anthropology of men and women's relationships to one another and to society. Biological, societal and psychological bases of sex-role differentiation and acquisition. Implications of historical, cultural, economic and psychological factors for contemporary women's and men's lifestyles, sexuality, roles, economic status and political power.

**ECONOMICS****SS 250 Basic Economics 3:0:0:3**

Basic micro- and macroeconomics. Supply and demand. Markets and market structure. Income distribution. Pollution and other market failures. National output. Money and banking. Unemployment and inflation. Fiscal and monetary policy. Interest rates, taxes and deficits. International economics.

**SS 251 Microeconomics 3:0:0:3**

Advanced supply and demand analyses. Allocation of resources and distribution of income. Various market structures: perfect competition, imperfect competition, oligopoly and monopoly. Externalities. Government and the market. *Prerequisite: SS 250.*

**SS 252 Macroeconomics 3:0:0:3**

Advanced national income analysis. Employment and unemployment, inflation and growth. The federal government and fiscal policy, the Federal Reserve Board and monetary policy. International trade and the balance of payments. *Prerequisite: SS 250.*

**SS 254 Economic Issues 3:0:0:3**

An intensive study of a number of the following issues (or others as circumstances change: drug legalization, racial and sexual discrimination, pollution, military spending, alternative governmental medical programs, budgetary deficits, government and individual choice, NAFTA and tariffs, alternative tax proposals, the role of the state. *Prerequisite: SS 250.*

**SS 255 The Contemporary American Economy: Boom and Bust 3:0:0:3**

Current macroeconomic problems: inflation, unemployment, growth and recession. Interest rates, money, the stock and credit markets, wages, productivity, and profit rates budget-balancing plans. Tax proposals, including the flat tax. Contemporary Federal Reserve policy. Foreign trade and the balance of payments. Proposed solutions: wage-price controls, supply-side economics, industrial policy, a new unionism. *Prerequisite: SS 250.*

**SS 257 History of Economic Thought 3:0:0:3**

Development of economic thought. Various schools of thought which anticipated and prefigured modern economic analysis. *Prerequisite: SS 250.*

**SS 264 Urban Economics 3:0:0:3**

Contemporary American cities and changing functions. Interrelation of population with housing, jobs, transportation. Problems of public finance and services, land use, urban decay and renewal. Analytic tools to examine economic aspects and evaluate policy alternatives. *Prerequisite SS 250.*

**SS 265 Money and Banking 3:0:0:3**

Nature of money, gold and paper standards; commercial banks and Federal Reserve system, financial institutions; balance of payments, exchange rates, international monetary order. Money, prices, inflation, business fluctuations. Domestic and international monetary policy. Problems and changes in the U.S. banking system. *Prerequisite: SS 250.*

**SS 270 Management Process 3:0:0:3**

Introductory management course for undergraduates. Primary focus is the management process: planning, organizing, staffing, controlling, directing and decision making. Attention is given to the roles of various disciplines within management as well as to the traditional business functions of marketing, accounting, finance, production, engineering and research development. *Prerequisite: SS 250. Also listed under MG 300.*

**SS 275 Foundations of Business Systems 3:0:0:3**

This course provides the student with a systems perspective on the specification, development, implementation and maintenance of organizational information technology. *Prerequisite: SS 250. Also listed under MG 305.*

**SPECIAL TOPICS AND GUIDED STUDIES****SS 302-306 Guided Readings in Social Sciences each 3:0:0:3**

Selected problems in history, history of science and technology, economics, anthropology, sociology, psychology, politics, interdisciplinary studies. Individual or group projects under faculty supervision involving guided reading and/or research. For mature students wishing to undertake specialized, independent study under tutorial guidance. *Prerequisite: junior status or department's permission. Agreement of instructor required before registration.*

The following special topics courses are offered from time to time by the staff of the department or visiting scholars. The specific titles and prerequisites are announced prior to registration. May be repeated for credit. *each 3:0:0:3*

- SS 361 *Special Topics in Social Sciences*
- SS 362 *Special Topics in History*
- SS 363 *Special Topics in History of Science and Technology*
- SS 364 *Special Topics in Economics*
- SS 365 *Special Topics in Psychology*
- SS 366 *Special Topics in Anthropology and Sociology*

In addition to the above regularly scheduled courses, the department offers the following from time to time (all 3 credits each):

- SS 101 *History of Western Civilization 1500-1815*
- SS 102 *History of Western Civilization 1815-1914*
- SS 110 *The Renaissance and Reformation*
- SS 116 *History of Latin America*
- SS 126 *African-American History*
- SS 128 *History of Jazz*
- SS 154 *Russia, China and the West*
- SS 262 *Collective Bargaining*
- SS 263 *Labor Economics*
- SS 267 *The Market for Engineers and Scientists*
- SS 330 *History and Environment*
- SS 345 *Colloquium in Twentieth Century Thought*
- SS 347 *Colloquium in Imperialism*
- SS 348 *Colloquium in the History of Socialism and Communism*
- SS 358 *Human Resource Development in Advanced Developing Countries*

# DEPARTMENT OF MANAGEMENT

Chair: Mel Horwitch

## Go Beyond the Generic MBA to Succeed in the Knowledge Economy

*"Mastering broadly defined technology, innovation and information management increasingly determines success or failure in business today. The Department of Management at Polytechnic University is an acknowledged pioneer and leader in the New York City/tri-state region in offering courses and programs dealing with these increasingly critical arenas, including electronic business and the Internet. The department serves a diverse and broad range of professionals, and its faculty and students comprise a vital and forward-thinking research and learning community. Firms represented in the department's programs encompass a wide range of service companies, technology-driven manufacturing firms and electronic businesses—the areas of greatest growth and opportunity in the emerging economy."*

— Professor Mel Horwitch,  
Chair, Department of Management

The overriding mission of the Department of Management is to act as a major educational gateway and premier learning, research and development hub explicitly devoted to innovation, information and technology management and electronic business. As such, all its carefully tailored learning programs and the intellectual capital it produces enable the department to provide unique and valuable opportunities for students, other professionals and scholars. The department has as its explicit policy a commitment to upgrade and revise continually its learning programs and courses to meet fast-changing demands of a dynamic, technology-driven, competitive environment.

## RESEARCH AND DEVELOPMENT

The department has achieved its pre-eminent position with a continuous stream of high-quality and relevant research, development and pacesetter learning programs. With its outstanding faculty, the department contributes to theory and practice in an increasingly knowledge-intensive age. The department's research and development work is varied, including scholarly books and articles in the most respected journals and timely case studies. Some of this material (especially cases, which are in print or Web-based digital formats) form part of the content in the department's educational programs, helping to keep its programs up to date and distinctive. The department is also committed to integrating wisely technology into all of its educational programs to enhance learning.

## GRADUATE DEGREE AND CERTIFICATE PROGRAMS

Because all managers must now understand how technology and innovation are essential for delivering value to organizations and the market, the department offers a portfolio of redesigned and modernized educational programs, all dealing in some fashion with the broad spectrum of innovation, technology and information management in the modern economy, including the Internet.

The department offers five graduate and professional degrees, two of which are earned in Executive Programs, i.e., meeting Fridays and Saturdays, or Thursdays and Saturdays on alternating weekends:

- Master of Science in financial engineering
- Master of Science in management
- Master of Science in organizational behavior

- Master of Science in management of technology (Executive Program)
- Master of Science in telecommunication and information management (Executive Program)

The Master of Science in management, the Master of Science in organizational behavior, and the Master of Science in financial engineering may be pursued either part time or full time with an evening schedule. Each has concentrations that allow students to specialize in selected areas of management, organizational behavior or financial engineering.

The department also offers certificates from the Financial Engineering, Management and Organizational Behavior Programs, which consist of sequences of selected courses leading to advanced knowledge in a desired area of specialization.

All degree and certificate programs are further described in this catalog under the appropriate entries.

## STUDENT PROFESSIONAL SOCIETIES, ASSOCIATIONS AND ORGANIZATIONS

The Management of Technology and the Telecommunications and Information Management Executive Programs Alumni Association actively seeks 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 chapter sponsors forums with experts and provides an excellent means for professional networking to further enhance the student's education and overall career.

The Financial Engineering Student Association is quite active in promoting

a distinguished speaker series and in organizing career opportunity events.

### ADMINISTRATION

The Department of Management encourages applicants and students to contact the department for information and advising. The department office is located in Room 401, Dibner Hall, on the Brooklyn campus, and may be contacted by telephone: 718/260-3760, fax 718/260-3874, or e-mail, [mgt-dept@poly.edu](mailto:mgt-dept@poly.edu).

Departmental representatives are also available for student advising at the Long Island and Westchester campuses.

Information is also available at the following website:

<http://www.ite.poly.edu/mg>.

### INSTITUTE FOR TECHNOLOGY AND ENTERPRISE (ITE)

The Department of Management's Institute for Technology and Enterprise is New York's premier research and education hub for bridging management and innovation. Through a highly interactive portfolio of programs and research activities, the Institute nurtures and builds managerial knowledge based on the lessons of high-quality scholarship and pacesetter business practices. Essentially, it functions as a high-level research and development "engine" for the entire department and for relevant firms and fields at large.

Strategically located in the heart of Manhattan's high technology and financial districts at the coveted New York Information Technology Center at 55 Broad Street, the Institute acts a "jump-gate" for companies and managers into the famed Silicon Alley. It provides a unique starting point for forward-thinking firms embarking on major managerial change or transformation required in the increasingly competitive space defined by modern, especially digital-based, innovation.

Recent initiatives by the Institute focused on such topics as electronic retailing; new media management; technology-enabled innovation in financial services; the Internet-triggered reconfiguration of the music and entertainment industry; and open source software—a possible new model for innovation, overall.

For further information or to participate in an upcoming program, please contact the institute by telephone: 212/547-7030; fax: 212/547-7029; e-mail: [ite@poly.edu](mailto:ite@poly.edu); or visit the Institute's Website at <http://www.ite.poly.edu>.

### CENTER FOR FINANCE AND TECHNOLOGY (CFT)

This center is a unique resource, addressing the evolving financial- and technology enabled- innovation needs of the financial services industry. The center is a hub for research is a laboratory for generating new ideas and tools for the industry. The center also undertakes collaborative research projects, providing ideas, methods and tools with scholarly and practical applications.

For further information, please contact, Frederick Novomestky, Executive Director CFT: 718/260-3436; e-mail: [fnovomics@poly.edu](mailto:fnovomics@poly.edu).

### MSM EXTENSION IN ISRAEL

The Department of Management of Polytechnic University is continuing to develop its Master of Science in Management (MSM) program through an extension in Rehovot, Israel, home of the world-famous Weizmann Institute of Science and many technology-based firms. The program being developed is identical to the MSM evening curriculum in New York, with selected concentrations offered specifically for professionals and managers working in Israeli business and industry. The MSM program brings cutting-edge management approaches taught by Polytechnic University professors together with highly qualified Israeli faculty to address the advanced state of technology in Israel.

For further information about the program contact the academic director, Professor Harold Kaufman by telephone: 718/260-3485 in New York and 08-939-0520 in Israel. E-mail: [hkaufman@duke.poly.edu](mailto:hkaufman@duke.poly.edu).

## FACULTY

### PROFESSORS

**Mel Horwitch**, Professor of Management and Department Chair; Director, Institute for Technology and Enterprise  
DBA, Harvard University  
*Innovation, information technology, technology management, electronic business*

**Harold G. Kaufman**, Professor of Management; Academic Director, Organizational Behavior Program; Academic Director, MSM Extension in Israel  
PhD, New York University  
*Managing professional and technical workers, career management, obsolescence of knowledge and skills, research methods*

### ASSISTANT PROFESSORS

**Barry S. Blecherman**, Assistant Professor of Management; Academic Director, MSM Program  
PhD, Wharton School, University of Pennsylvania  
*Information economics and strategy, decision theory, business negotiations*

**Mihir Parikh**, Assistant Professor of Management  
PhD, Georgia State University  
*Information and knowledge management, management of information technologies (IT) and systems, impact of IT on organizations and industries, IT-enabled innovation, applications of IT in business decision making and education, electronic business*

**Bharat Rao**, Assistant Professor of Management  
PhD, University of Georgia  
*Strategic alliances, collaborative new product development, supply chain management, strategic management, electronic commerce*

## DEPARTMENT OF MANAGEMENT

### INDUSTRY FACULTY

**Frank Leiber**, Industry Associate Professor of Management and Financial Engineering; Academic Director, MOTIFS Track, MOT Program  
PhD, HEI Geneva

*Econometrics of financial markets, financial risk management, the economics of the digital firm, quantitative analysis for managerial decisions*

**Fredrick Novomestky**, Industry Associate Professor of Management; Academic Director, Financial Engineering Program; Director, CFT  
PhD, Polytechnic University  
*Multimedia object development, technologies for interactive management education, evolutionary computational algorithms for business optimization, systems with distributed objects, quantitative investment strategy*

**Nina D. Ziv**, Industry Associate Professor of Management; Codirector, Executive Management Master's Programs  
PhD, New York University  
*Strategic relationships between the technology organization and business units, intranet and Internet strategy, global technology strategy*

### HUMANITIES AND SOCIAL SCIENCES

**Richard. C. Wener**, Associate Professor of Psychology and Department Head  
PhD, University of Illinois at Chicago  
*Environmental psychology, crowding, assessment of the built environment*

### ADJUNCT FACULTY

**Philip Angelillo**, Adjunct Assistant Professor of Management  
MS, Polytechnic Institute of New York  
*Operations management, management of technology*

**Michel Araten**, Adjunct Associate Professor of Financial Engineering  
PhD, Columbia University  
*Credit risk measurement and management, quantitative approaches to portfolio management*

**Richard T. Archambault**, Adjunct Associate Professor of Management  
MBA, Fairleigh Dickinson University  
*Strategic planning, supply chain management, project management, business process re-engineering*

**Leonard Berkowitz**, Adjunct Associate Professor of Management  
MS, Massachusetts Institute of Technology  
*Intellectual property, patents, research and development*

**Srimat T. Chakradhar**, Adjunct Associate Professor of Management  
PhD, Rutgers University  
*Design/test distributed, networked computing systems, embedded systems*

**Robert Cohen**, Adjunct Associate Professor of Management  
MBA, New York Institute of Technology  
*Management information systems, quality control and systems*

**Michael Cortegiano**, Adjunct Associate Professor of Management  
BS, Fairfield University  
*Accounting and finance*

**Anthony Davidson**, Adjunct Associate Professor of Management  
PhD, City University of London  
*Management information systems, information technology, operations management, business policy and marketing*

**Philip Dorin**, Adjunct Associate Professor of Management; Management Dept. Adviser for Farmingdale Campus  
PhD, University of Connecticut  
*Human resource management, training and development*

**Robert Ferguson**, Adjunct Associate Professor of Financial Engineering  
PhD, Cornell University  
PhD, New York University  
*Corporate finance, quantitative approaches to financial product innovation and valuation*

**Philip Ferrara**, Adjunct Associate Professor of Management  
PhD, Hofstra University  
*Organizational staffing, job design*

**Frederick Ferront**, Adjunct Associate Professor of Management  
MBA, Rutgers University  
*Management information systems, operation management, online marketing applications*

**Stephen Fineman**, Adjunct Associate Professor of Management  
MS, Princeton University  
*Information systems, marketing, human resource management*

**Martin Fischer**, Adjunct Associate Professor of Management  
MA, Columbia University, Teacher's College  
*Network management, electronic commerce, systems management*

**Roy Freedman**, Adjunct Associate Professor of Financial Engineering  
PhD, Polytechnic University  
*Evolutionary information technology, quantitative methods in finance, artificial intelligence*

**Devorah Watkins Gilbert**, Adjunct Associate Professor of Management  
MBA, Harvard University  
*Design of organization futures, strategic planning, new venture development*

**Robert R. Goodman**, Adjunct Associate Professor of Management  
MBA, Harvard University  
*Corporate and government management*

**Clyde Granger**, Adjunct Associate Professor of Management  
MBA, Dowling College  
*Total quality management*

**Sara Grant**, Adjunct Associate Professor of Management  
MA, Indiana University  
MA, Columbia University  
*Organizational theory and design, human resource management, conflict management*

**Edward Greenbaum**, Adjunct Associate Professor of Management  
MS, Cornell University  
*Industrial and labor relations*

**Alan Hogenauer**, Adjunct Associate Professor of Management  
PhD, Columbia University  
*Marketing*

**Stanley J. Jacoby**, Adjunct Associate Professor of Management  
MS, Columbia University  
*Quality management, project management,*

**Mark Kurman**, Adjunct Associate Professor of Management  
MA, Bowling Green State University  
*Human resource management, organizational development*

**Victor Makarov**, Adjunct Associate Professor of Financial Engineering  
PhD, USSR Academy of Sciences  
*Market risk measurement and management, quantitative methods in finance*

**Ingrid Marshall**, CPA, Adjunct Associate Professor of Financial Engineering  
MBA, St. John's University  
*Corporate financial accounting*

**Daniel A. Nathanson**, Adjunct Associate Professor of Management  
PhD, Wharton School University of Pennsylvania  
*Entrepreneurship, venture capital, venture creation*

**Carl Nelson**, Adjunct Associate Professor of Management  
MIE, New York University  
*Operations management*

**Laurence O'Connell**, Adjunct Associate Professor of Management  
MBA, Fordham University  
*Construction and operation management*

**Lisa Marie Plantamura**, Adjunct Assistant Professor of Management  
MBA, Fairleigh Dickinson University  
*Human resource information systems*

**John Reilly**, Adjunct Assistant Professor of Management  
MA, Columbia University  
*Human resource information systems*

**Teresa C. Rubinson**, Adjunct Associate Professor of Management  
PhD, Polytechnic University  
*Database design, data segmentation and classification techniques, neural nets, fuzzy logic, expert systems, network design, financial engineering*

**Sandor Schweiger**, Adjunct Associate Professor of Management  
JD, New York University School of Law

**Agustin Sevilla**, Adjunct Associate Professor of Financial Engineering  
PhD, University of California at Berkeley  
*Quantitative investment strategy, interest rate security valuation, interest rate derivatives*

**Ronald T. Slivka**, Adjunct Associate Professor of Financial Engineering  
PhD, University of Pennsylvania  
*Quantitative approaches to derivative securities valuation and applications, quantitative investment strategies*

**Arthur Szeglin**, Adjunct Associate Professor of Management  
MS, Polytechnic Institute of Brooklyn  
*Total quality management*

**Kenneth Walden**, Adjunct Associate Professor of Management  
MS, New York Institute of Technology  
*Human resource management*

**Richard Walton**, Adjunct Associate Professor of Management  
MBA, New York University  
*Management*

**George Williams**, Adjunct Associate Professor of Financial Engineering  
PhD, State University of New York at Albany  
*Quantitative methods applied to index construction, fixed income security valuation, and interest rate derivatives*

**Stanley Willing**, Adjunct Professor of Management  
EdD, New York University  
*Labor relations, performance appraisal, compensation management*

**Gerald Wisz**, Adjunct Associate Professor of Financial Engineering and Management  
PhD, Johns Hopkins University  
*Corporate financial strategy, quantitative methods applied to finance and operations research*

**Anthony Zinsser**, Adjunct Associate Professor of Management  
PhD, Stevens Institute of Technology  
*Organizational development*

## EMERITUS FACULTY

**Seymour Kaplan**, Associate Professor Emeritus of Management  
PhD, New York University  
*Operations research and management*

**George Schillinger**, Professor Emeritus of Management  
ScD, Columbia University  
*Management of innovation, technology management, science and technology policy*

**Anthony Wiener**, Professor Emeritus of Management  
JD, Harvard Law School  
*Management of innovation, technology strategy, corporate strategy, business and government, business law*

CORPORATE  
ADVISORY BOARD

The Department of Management maintains close and 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. This body meets regularly throughout the year to discuss and review the department's learning programs, research and plans for the future. In this manner, the department stays informed, meets the pragmatic needs and critical challenges confronting technology and innovation executives and makes certain that its courses and programs are state-of-the-art and relevant. The board's members are:

CHAIR OF CORPORATE  
ADVISORY BOARD

**George M. Lieberman**  
Wit Capital Corporation  
Senior Vice President and  
Chief Information Officer

OTHER CORPORATE ADVISORY  
BOARD MEMBERS

**Ytzik Aranov**  
Richard A. Eisner & Company  
Managing Director, Corporate Finance

**John Clippinger**  
Lexeme, Inc.  
Chief Executive Officer and President

## DEPARTMENT OF MANAGEMENT

### **Susan Dark**

Pendulum Management Partnership  
Partner

### **Scott Dinsdale**

BMG Entertainment  
Chief Information Officer

### **Elke Geising**

Pendulum Management Partnership  
Partner

### **John Gilbert**

Rudin Management, Inc  
Chief Operating Officer  
New York Information Technology  
Center  
Executive Vice President

### **Michael Hora**

A.T. Kearney  
Vice President

### **Alan Kantrow**

Monitor Company  
Chief Knowledge Officer

### **Michael Kleeman**

Boston Consulting Group  
Vice President

### **Lewis Krulwich**

PriceWaterhouseCoopers LLP  
Senior Partner  
Management Consulting Services

### **Stephen Lake**

iVillage  
Senior Vice President for Development

### **J. R. (Jay) Topper Jr.**

Production Resource Group, LLC  
Chief Information Officer  
Two Toppers Dot Com, LLC  
Executive Vice President of Electronic  
Commerce

### **Stanley M. Welland**

Citigroup  
Senior Vice President

### **Randy Wiele**

EDS  
Vice President of Electronic Commerce

## **PROGRAM ADMINISTRATION AND PROFESSIONAL STAFF**

### **Rebecca Angelbeck**

Development and Communications  
Manager  
BA, University of Toledo

### **Bohdan Hoshovsky**

Executive Assistant and Webmaster  
MS, Polytechnic University

### **Alison Lewis**

Administrative Director, Executive  
Management Program  
MBA, University of California at  
Riverside

### **Evelyn Lombardo**

Executive Assistant

### **Ziv Navoth**

Executive Director  
Institute for Technology and Enterprise

### **Cheryl Robinson**

Administrative Assistant  
BA, College of New Rochelle



# FINANCIAL ENGINEERING PROGRAM

*Academic Director:*  
Frederick Novomestky

## THE MASTER OF SCIENCE PROGRAM

Polytechnic University's Master of Science in financial engineering has been 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 capital markets or in financial technology. The program is rigorous, demanding and selective. Graduates of the Capital Markets Track are expected to seek positions in financial risk 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 Financial Technology Track are working professionals in financial services who aspire to a diverse range of information technology management careers. Such professionals need a solid knowledge of financial products and the markets in which these products are transacted, along with a sophisticated foundation in information technology, strategy, electronic business and innovation management.

This is a unique field in which the Department of Management has demonstrated competence and academic leadership.

Graduates are expected to seek positions in commercial banks, investment banks, thrifts, insurance companies, investment companies, pension funds, finance companies, consulting firms, energy marketing firms, accounting firms with consultancy practices and so forth.

Polytechnic's Master of Science in financial engineering brings together three key areas: finance and related business disciplines, quantitative analysis (mathematics and statistics) and infor-

mation technology (telecommunications and computer science). Polytechnic has long been recognized as a leader in both advanced mathematics and information technology. Now, through its FE program and associated research and curriculum development, Polytechnic has positioned itself to be a leader in the financial technology on which financial institutions increasingly depend for their revenue streams. The financial component has been further strengthened by developing a large and versatile adjunct faculty consisting of leading financial market practitioners from major Wall Street firms. These adjunct faculty work closely with Polytechnic's full-time faculty.

### ADVANCED CERTIFICATES IN FINANCIAL ENGINEERING AND RISK MANAGEMENT

The Advanced Certificate Program in financial engineering and risk management is an "add-on" to Polytechnic's existing graduate program in financial engineering. Graduating students seeking employment in the financial services industry and possessing this certificate should have a sizable advantage over job seekers lacking such a credential.

The Advanced Certificate Program prepares participants for the challenges of today's financial services industry. Completion of the certificate program offers students the means to implement dynamic strategies in the complex and developing capital markets and financial technology divisions of investment and commercial banks, corporate treasury offices, government agencies, financial advisory firms, consulting firms, energy marketing firms and other modern financial institutions.

For the most current information, please visit our Website at:  
<http://www.itc.poly.edu/fe>.

### ADMISSION

The Master of Science in financial engineering at Polytechnic University is highly selective. Except as noted below, admission to the program requires a baccalaureate from an accredited institution. Additionally, the applicant must satisfy

the admissions criteria. The admissions criteria incorporates the student's undergraduate grade-point average (GPA, measured on a scale of 0 to 4.0) and either the Graduate Management Admission Test (GMAT) or the Graduate Record Exam (GRE). For admission the student must score a minimum of 1250 points under the following formula.

$$\text{Score} = (160 \times \text{GPA}) + (9.6 \times (\text{GMAT or GRE percentile}))$$

For example, a student who scores in the 82 percentile on the GRE and has a 3.1 undergraduate GPA would have a total score of 1283 and could be admitted in the program.

$$\text{Score} = (160 \times 3.1) + (9.6 \times 82) = 1283$$

Additionally, the applicant must demonstrate a sufficient level of proficiency and aptitude in mathematics. This may be demonstrated by grades earned in relevant course work and/or standardized examinations.

Students already holding a graduate degree will be admitted under the same criteria as students holding a baccalaureate, but their graduate GPA may be substituted for the undergraduate GPA in the formula above at the applicant's choice.

Two letters of recommendation are also required for admission.

In addition to the criteria above, a foreign student must demonstrate a proficiency in the English language or successfully complete a series of ESL courses in order to commence formal study.

The Advanced Certificates in financial engineering and risk management (spring 2000) have the same application requirements and prerequisites as the Master of Science degree. Admission to the program requires a baccalaureate from an accredited institution. Candidates to the advanced certificate are not required to take the GRE/GMAT, but should have obtained a minimum GPA of 3.0.

**Conditional Admission** — An applicant who wishes to commence immediate study but who cannot complete the required graduate exams (GRE or GMAT) before the start of a semester may be admitted, at the discretion of the FE Program academic director, on a conditional basis based on GPA alone.

Additionally, the academic director, at his discretion, may admit individuals to the program who do not qualify under the regular admission criteria if the academic director concludes that the applicant has adequate preparation to perform well in the program and that the standard admission criteria does not accurately reflect the applicant's ability. Such persons enter on a conditional basis.

**MASTER OF SCIENCE IN FINANCIAL ENGINEERING CURRICULUM**

**Program Prerequisites**

Economics	(SS 251, 252)
Calculus	(MA 106, 107)
Probability	(MA 233)
Statistics	(MA 224)

Students in the Capital Markets Track have the following prerequisites

- Linear Algebra (MA 153)
- Linear and Nonlinear Programming: Numerical Analysis<sup>1</sup>
- Advanced Statistics<sup>2</sup>

*Knowledge of spread sheets expected. Some exposure to computer programming languages.*

\*Note: Students may satisfy this requirement by either

1. demonstrating completion of a formal course
2. demonstration the completion of the essential components of this course from the contents of other courses, or
3. passing a proficiency examination

**Core Classes for the Master of Science in Financial Engineering**

The Core	Credits
FE 600 <i>Financial Accounting</i>	3.0
FE 603 <i>Money, Banking and Financial Markets</i>	1.5
FE 605 <i>Microeconomic Foundations of Finance</i>	1.5
FE 611 <i>Investment Banking and Brokerage</i>	1.5
FE 620 <i>Financial Theory with Corporate Applications</i>	3.0
FE 621 <i>Financial Market Regulation</i>	1.5
FE 655 <i>Accounting for Financial Product</i>	1.5
MG 695 <i>Economics for Business Decisions</i>	1.5

**Required Classes for the Capital Markets Track**

FE 608	<i>Quantitative Methods in Finance</i>	3.0
FE 627	<i>Valuation of Equity Securities and Financial Statement Analysis</i>	1.5
FE 640	<i>Valuation of Fixed Income Securities and Basic Interest Rate Derivatives</i>	3.0
FE 650	<i>Basic Derivatives Valuation and Applications</i>	3.0
FE 670	<i>Portfolio Theory and Applications</i>	3.0
FE 671	<i>Market Risk Measurement and Management</i>	1.5

<b>Core Courses:</b>	<b>15</b>
<b>Required Courses:</b>	<b>15</b>
<b>Electives Credits:</b>	<b>6</b>
<b>Degree Total:</b>	<b>36</b>

Summer Associateship/Internship (if appropriate, no credit)  
Communicating effectively in finance (if required)

**Electives**

The program allows for 6 elective credits. For students obtaining a waiver from core or required courses, additional electives must be taken. Permission of the student's adviser is required in selecting electives. Additionally, it is the student's responsibility to be certain that he or she has satisfied all the course prerequisites when taking elective courses. With permission of the student's adviser and the appropriate department head, a student may take additional courses as electives in mathematics, computer science, electrical engineering or financial engineering.

**Required Classes for the Financial Technology Track**

FE 613	<i>Clearing and Settlement of Financial Transactions</i>	1.5
FE 615	<i>Foundations of Financial Technology</i>	1.5
FE 617	<i>Management of Financial Institutions</i>	1.5
FE 629	<i>Introduction to Futures, Options and Swaps</i>	1.5
MG 650	<i>Management of Information and Information Technology</i>	3.0
MG 655	<i>Introduction to Management of Data Communications and Networks</i>	3.0
MG 867	<i>Technology Strategy</i>	3.0

<b>Core Courses:</b>	<b>15</b>
<b>Required Courses:</b>	<b>15</b>
<b>Electives Credits:</b>	<b>6</b>
<b>Degree Total:</b>	<b>36</b>

Summer Associateship/Internship (if appropriate, no credit)  
Communicating effectively in finance (if required)

**Electives**

The program allows for 6 elective credits. For students obtaining a waiver from core or required courses, additional electives must be taken. Permission of the student's adviser is required in selecting electives. Additionally, it is the student's responsibility to be certain that he or she has satisfied all the course prerequisites when taking elective courses. With permission of the student's adviser and the appropriate department head, a student may take additional courses as electives in mathematics, computer science, electrical engineering or financial engineering.



**Advanced Certificate Program in Financial Engineering**

**Program Prerequisites**

Economics	(SS 251, 252)
Calculus	(MA 106, 107)
Statistics	(MA 224)
Linear Algebra	(MA 153)
Optimization: Linear and Nonlinear Programming	(MA 614)
Microeconomic Foundations of Finance	(FE 605)

*Knowledge of spread sheets expected. Some exposure to computer programming languages.*

**Core Classes for the Advanced Certificate in Financial Engineering**

FE 608	<i>Quantitative Methods and Finance</i>	3.0
FE 620	<i>Financial Theory with Corporate Applications</i>	3.0
FE 640	<i>Valuation of Fixed Income Securities and Basic Interest Rate Derivatives</i>	3.0
FE 650	<i>Basic Derivatives Valuation and Applications</i>	3.0
FE 670	<i>Portfolio Theory and Applications</i>	3.0

<b>Certificate Total:</b>	<b>15</b>
---------------------------	-----------

**Advanced Certificate Program in Risk Management**

**Program Prerequisites**

Economics	(SS 251, 252)
Calculus	(MA 106, 107)
Statistics	(MA 224)
Linear Algebra	(MA 153)
Optimization: Linear and Nonlinear Programming	(MA 614)
Microeconomic Foundations of Finance	(FE 605)

Knowledge of spread sheets expected.  
Some exposure to computer programming languages.

### Core Classes for the Advanced Certificate in Risk Management

FE 608	<i>Quantitative Methods and Finance</i>	3.0
FE 627	<i>Valuation of Equity Securities and Financial Statement Analysis</i>	1.5
FE 640	<i>Valuation of Fixed Income Securities and Basic Interest Rate Derivatives</i>	3.0
FE 650	<i>Basic Derivatives Valuation and Applications</i>	3.0
FE 670	<i>Portfolio Theory and Applications</i>	3.0
FE 671	<i>Market Risk Measurement and Management</i>	1.5
FE 673	<i>Credit Risk Measurement and Management</i>	1.5
FE 675	<i>Operational Risk Measurement and Management</i>	1.5

**Certificate Total: 18**

\*Note: Students may satisfy this requirement by either

- (1) demonstrating completion of a formal course,
- (2) demonstrating the completion of the essential components of this course from the contents of other courses, or
- (3) passing a proficiency examination.

## COURSE DESCRIPTIONS

Note: Courses ending in even numbers are full-semester courses. Courses ending in odd numbers are half-semester courses. Most often, the half-semester courses, when taken in the correct sequence, can substitute for full-semester requirements.

### FE 600 Financial Accounting 2½:0:0:3

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, accrued liabilities and asset valuation. Also covered are the effects of equity transactions, cash flows, and various accounting methods on financial statements. *Prerequisites: none.*

### FE 603 Money, Banking and Financial Markets 1½:0:0:1½

This course studies how the interactions between money, the financial system and the economy determine interest rates and asset returns. It utilizes a consistent approach based in economics to explain the role of the financial system in matching savers and borrowers and in providing risk-sharing, liquidity and information services in efficient financial markets. We study why and how financial markets and financial instruments evolve as a function of transactions and information costs, adverse selection and moral hazard problems, and summarize economic arguments for and against regulation. Finally, we examine the money supply process and monetary policy, in particular the link between monetary authorities and the macro-economy through a transmission mechanism involving banks and the non-financial public. *Prerequisites: none*

### FE 605 Microeconomic Foundations of Finance 1½:0:0:1½

This course summarizes key insights from financial economics as the methodological and conceptual basis of financial engineering. It draws on results from general equilibrium analysis, information economics and the theory of contracts, and concentrates on individuals; consumption and portfolio decisions under uncertainty and their implications for the returns on and the valuation of financial assets in efficient markets. *Prerequisites: MG 695 or its equivalent offered in the evening and TIM programs.*

### FE 608 Quantitative Methods in Finance 2½:0:0:3

This course develops the theory of continuous-time stochastic models as applied to the valuation of options and other derivative securities. Brownian motion and related stochastic processes, stochastic integration, Ito's formula and other aspects of stochastic calculus are treated with substantial rigor. The theory is balanced with concrete numerical applications. The course also covers multivariate statistical methods to include maximum likelihood estimation procedures. *Prerequisites: Students are expected to have knowledge in probability and statistics as covered in MA 681, and MA 652, respectively.*

### FE 611 Investment Banking and Brokerage 1½:0:0:1½

This course is designed to give an introductory overview of Wall Street, general brokerage operations, investment banking and capital markets. The subjects covered are essential to the understanding of how products, once created, are actually distributed and sold. The course will rely heavily on the *Wall Street Journal* and other important trade publications. Topics to be covered 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, pricing and sale of debt and equity securities. One of the major objectives of this course is to understand how and where opportunities for the creation of new securities arise. A second major objective is to position financial engineering in perspective with the overall Wall Street picture. *Prerequisites: none.*

### FE 613 Clearing and Settlement of Financial Transactions 1½:0:0:1½

This course focuses on issues involved in the processing of 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 one's own clearing operations or purchasing clearing services, the role played by the clearing houses, and numerous issues associated with cross border transactions. *Prerequisites: none.*

### FE 615 Foundations of Financial Technology 1½:0:0:1½

Every year, financial institutions spend billions to exploit the latest development in information technology. This course introduces a framework within which to understand and leverage on information technology. The technology components covered include telecommunications, groupware, image and document processing, artificial intelligence and object-oriented analysis and design. The course also covers the entire technological planning process specifically for financial institutions. *Prerequisites: none.*

## DEPARTMENT OF MANAGEMENT

### **FE 617 Management of Financial Institutions** 1%:0:0:1%

This course focuses on managing return and risk in modern financial institutions and describes both the theory and practice of financial institutions from a financial-management perspective. By analyzing the factors that define the dynamics of the rapidly changing financial-services industry, it explores the normative consequences on financial management decision-making to create shareholder value. *Prerequisites: none.*

### **FE 619 Advanced Topics in Financial Technology** 1%:0:0:1%

This course complements the Foundations of Financial Technology by providing in-depth treatment of specific current topics in this rapidly changing field or by providing a structured forum for dealing with relevant issues in current practice. *Prerequisites: FE 615.*

### **FE 620 Financial Theory with Corporate Applications** 2%:0:0:3

The modern corporation, as issuer of financial securities and end-user of financial risk management products, is one of the major participants in financial markets and the economic counter-party to investors and financial intermediaries. Whereas the mechanism of financial markets and the valuation of instruments are studied in further detail elsewhere, in this course the "tools of the trade" of financial economics will be applied specifically to the financial decision-making process in the firm. Upon successful completion of this course, students will know how to contribute to optimal financial decisions in a corporation: valuation, capital budgeting, risk, capital structure, dividend policy, long-term financing, risk management, mergers and acquisitions. *Prerequisites: none.*

### **FE 621 Financial Market Regulation** 2%:0:0:3

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), self-regulating

organizations (SROs) such as the National Association of Securities Dealers, and the National Futures Association are examined. Also examined are the roles of the state insurance commissions, and the Department of Labor. *Prerequisites: FE 603.*

### **FE 627 Valuation of Equity Securities and Financial Statement Analysis** 1%:0:0:1%

This course provides a detailed examination of the tools and techniques for analyzing financial statements for the purposes of evaluating credit, forecasting, identifying merger candidates, enhancing the efficiency of decision making, and diagnosing problem areas within the firm before crisis situations develop. Students will also be taught 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: FE 600, FE 620.*

### **FE 629 Introduction to Futures, Options and Swaps** 1%:0:0:1%

This is a half-semester course that covers basic derivatives including futures contracts, forward contracts, option contracts and swap contracts. The principal focus of the course is on the use of these instruments by financial institutions. Basic valuation concepts are discussed. The use of derivatives for speculative purposes, hedging purposes and arbitrage are discussed. The specifics of the contracts and the markets in which they trade are also discussed. The main focus is to give students in the Financial Technology Track a general understanding of the derivatives market and risk management. *Prerequisites: FE 600, FE 605, FE 620.*

### **FE 640 Valuation of Fixed Income Securities and Basic Interest Rate Derivatives** 2%:0:0:3

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 covered 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 also provides 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, asset-backed securities, municipal securities, floating and inverse floating rate securities. *Prerequisites: FE 605, FE 608, FE 620.*

### **FE 649 Municipal Finance** 1%:0:0:1%

This course provided an overview and analysis of the market for the debt obligations of state and local governments. The course treats the micro structure of the market, including the types of debt issued, as well as the characteristics of the buyers. Federal and state taxation of munis will be discussed, along with the regulatory structure of the industry. Bond structure, risk assessment, and risk management utilizing cash bonds, futures and options will be covered. *Prerequisites: FE 640.*

### **FE 650 Basic Derivatives Valuation and Applications** 2%:0:0:3

This is a full-semester course that covers exchange traded and over-the-counter (OTC) derivatives including futures contracts, forward contracts, option contracts, swap contracts, and structured securities having embedded derivatives. The principal focus of the course is on financial engineering applications. Basic valuation concepts are discussed, but detailed valuation methodology is not covered in this course. The use of derivatives for speculative purposes, hedging purposes and arbitrage is discussed. The specifics of the contracts and the markets in which they trade are also discussed. The main focus is on financial derivatives such as currency and equity contracts, but some brief discussion of commodity contracts and specialty contracts such as insurance derivatives and macroeconomic derivatives may also be discussed, at the instructor's discretion. *Prerequisites: FE 605, FE 608, FE 620.*

**FE 655 Accounting for Financial Products** 1%:0:0:1%

This course addresses accounting issues as they pertain 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. *Prerequisites: FE 600.*

**FE 657 Asset Backed Securities** 1%:0:0:1%

Asset-backed securities (ABSs) have become a hot topic in today's fixed income arena, with a potential for returns exceeding that of other investments. This course examines the writings of leaders in this field and provides comprehensive coverage of the major asset-backed securities, structuring issues and relative value analysis. Topics to be covered include: The expanding frontiers of asset securitization, introduction to ABS accounting; trends in the structuring of ABSs, prepayment nomenclature in the ABS market. *Prerequisites: FE 640, FE 650.*

**FE 659 Mortgage Backed Securities** 1%:0:0:1%

This course takes the student from a general introduction to mortgage-backed securities (MBS) to a detailed treatment of some of the issues that make these instruments some of the most complex and least understood of all financial products. Students will learn the fundamentals of yield curves, mortgage cash-flows and analysis. The course will cover pass-throughs, CMOs, mortgage derivatives and ARMs. Asset/Liability management of MBS will be discussed. Students will build a price-yield calculator for MBS pass-throughs (using a spreadsheet) and complete a course project. *Prerequisites: FE 657.*

**FE 662 Derivatives: Advanced Applications and Analysis** 2%:0:0:3

This course will focus on advanced financial engineering applications using derivative securities and derivative securities in combination with other financial instruments. When possible, the course will be taught by a financial engineering team from the derivatives trading desk of a major dealer. In addition to complex financial engineering structures, students will also consider reverse engineering of structures. Cases presented will be from recent deals. Examples of applications might include tax arbitrage, the construction of equity collars on restricted stock, the alteration of the investment characteristics of large portfolios, the creation of synthetic financial instruments. *Prerequisites: FE 640, FE 650.*

**FE 664 Term Structure Modeling and Advanced Interest Rate Derivatives** 2%:0:0:3

This course will cover an assortment of numerical valuation techniques in substantial detail. Possible topics include 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 will be drawn from current literature. *Prerequisites: FE 640 Students are expected to have knowledge in numerical analysis and numerical methods as covered in MA 665.*

**FE 668 International Finance: Markets and Strategies** 2%:0:0:3

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, as well as how their integration serves to price securities. While a detailed study of the institutions that frame these markets and international macro-economics is beyond the scope of this lecture series, we must nevertheless examine some of these concepts in order to understand the fundamental determi-

nants of exchange rates and links between different countries' interest rates. A number of parity conditions that prevent arbitrage as well as the role of expectations contribute to an understanding of the level and the volatility of international asset prices. Theory and institutional description are complemented by analyzing the mechanics of international financial instruments. The value-at-risk methodology will be employed to illustrate pricing and use of the financial instruments in the context of international risk measurement and management. *Prerequisites: FE 640, FE 650.*

**FE 669 Credit Derivatives Valuation and Applications** 1%:0:0:1%

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 students to 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: FE 650.*

**FE 670 Portfolio Theory and Applications** 2%:0:0:3

This course provides an in-depth examination of 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 also 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: FE 640, FE 650. Students are expected to have knowledge in mathematical programming or quantitative methods as covered in MA 614 or MG 610, respectively.*

**FE 671 Market Risk Measurement and Management** 1%:0:0:1%

This course addresses financial risk management with particular focus on Value-at-Risk (VaR), a method of assessing risk that uses standard statistical techniques routinely employed in other fields. Value-at-risk exploits the principles and methodology of modern portfolio analysis. Portfolio theory is a prerequisite for taking this course. VaR analysis has rapidly become a standard methodology that is demanded by bank and corporate managers, and by financial market regulators. *Prerequisites:* First half of FE 670.

**FE 673 Credit Risk Measurement and Management** 1%:0:0:1%

This specialty course is intended for those individuals who feel they might become involved in credit risk measurement, credit risk management and related areas in which credit issues are important. Such issues arise in credit rating activity, credit extension by banks and other financial services firms, and in derivative markets where counterparty risk is perceived to be an important management issue. *Prerequisites:* First half of FE 670.

**FE 675 Operational Risk Measurement and Management** 1%:0:0:1%

The operational difficulties faced by financial institutions have created a need for tools to measure and management 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 effect 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. *Prerequisites:* First half of FE 670.

**FE 680 Financial Engineering (research course)** 2%:0:0:3

This course is a research/case course. It can be handled a number of different ways at the discretion of the faculty supervisor. It may involve a series of cases that are dissected and analyzed, it may involve teaming of students with industry personnel for proprietary or non-proprietary research projects, or it may involve thesis-type research. Generally, the student will work under the supervision of a faculty member, but 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 will vary depending on the student's track and the nature of the project to be undertaken.*

*Note: This is a 3-credit course the first time a student registers for it. In the event that a student does not receive a final grade from the FE adviser, the student must receive permission from the FE adviser to formally register continuously for this course for a ½ credit per semester for a maximum of two semesters. After this time period has expired, a final grade must be submitted by the course adviser, or else it will automatically turn into an F and the student will need to retake this course for 3 credits.*

**FE 682 Empirical Methods in Finance** 2%:0:0:3

The use of quantitative methods in financial engineering requires strong foundations in statistical techniques applied to problems in portfolio management, trading, derivatives pricing, etc. In this course students will learn how to estimate the parameters that are used in valuation models and other financial models. The uncertainty accompanying estimated parameters is of particular importance in financial applications, and appropriate significance tests will be reviewed. Topics to be covered include the following: a brief review of stationary time series models in the traditional ARIMA framework; the properties of stochastic time series, test for trends and unit roots; estimation and forecasting with single-equation time series models; measuring the "performance" of forecasts, which is useful in the evaluation of trading strategies; event analysis generalized to intervention analysis in the context of multi-equation time-series models; estimation of transfer functions; and the identification of impulse response functions in the implementation of Value at Risk (VaR) models. Time-varying volatility is an important empirical characteristic of economic time series, and students will learn how to estimate a variety of autoregressive conditional heteroskedastic (ARCH) models. An important area of implementing and forecasting these models is risk management. Depending on the background and the interest of students, greater emphasis is given to selected topics, while stressing software-based applications throughout the course. While understanding the underlying theory is indispensable, this course stresses application of the econometric tools to real projects. *Prerequisites:* FE640, FE650, FE671.

# MANAGEMENT PROGRAM

*Academic Director:* Barry Blecherman

## THE MASTER OF SCIENCE IN MANAGEMENT

The Department of Management at Polytechnic University is the New York City/tri-state region's premier academic hub for technology and innovation management. Because most of the department's students are working professionals, class schedules are geared to their needs and are typically offered after regular office hours. Classes are structured to enable participants to receive individual attention and to work closely with faculty. The course of study is designed for those who work in technology-intensive industries and in companies that depend on technology for products and services.

The Master of Science in Management degree (MSM) is recognized, along with the Master of Business Administration (MBA), by the Graduate Management Admission Council as a graduate professional management degree. Polytechnic's modern MSM curriculum is designed to prepare working professionals for increasing responsibility in management positions in technology-intensive settings. This updated program is aimed at developing competencies in modern decision making and in the selection, allocation and direction of human, financial, physical, technological and organizational resources in a period of rapid, technology-led change.

These management skills can be applied in a broad range of professional settings both in the private and the public sectors, in production-oriented and in service-oriented activities and in traditional as well as in high-technology environments.

Polytechnic's graduate program in management takes a pragmatic, modern results-oriented approach that emphasizes integrating technology and people for the creation of value in the marketplace and in modern organizations. Even subjects such as accounting, 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. Our courses are increasingly supported by a modern technological, Web-based infrastructure. We continually introduce state-of-the-art material—in paper and digital format.

After completing the core courses, degree candidates build further managerial skills in their choice of eight concentrations all designed for success in the modern economy.

- Entrepreneurship
- Electronic Business
- Technology Management
- Information Management
- Telecommunications Management
- Human Resource Management
- Construction Management
- Operations Management

The program concludes with a capstone project course, Project in Strategy and Innovation, which takes a high-level perspective in learning how to set goals, establish policies and implement strategies for ongoing competitive success, especially in environments where technology and innovation are critical.

Students may elect, with their advisor's approval, to conclude their studies with a Thesis instead of this project course.

Some fundamental knowledge of probability and statistics is required for this program. Students without such a background are required to take a managerial probability and statistics course such as MG 505, or its equivalent. Students with this knowledge may apply for a waiver of this requirement.

For the most current information, please visit the department's website at [www.ite.poly.edu/mg](http://www.ite.poly.edu/mg).

## 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, the ability to benefit from and contribute to professional graduate studies and a strong desire to make a difference that in some fashion is associated with innovation, technology and modern change. An applicant who does not meet all the criteria may be admitted as a nondegree student with the opportunity subsequently to become a degree candidate. Satisfactory scores on the Graduate Management Admission Test (GMAT) or an acceptable equivalent test such as the Graduate Record Examination (GRE) may be requested as support for admission.

The MSM requires completion of 12 courses, or 36 units, with a B average or better. A maximum of 9 units of transfer credits may be granted for graduate courses taken elsewhere, as evaluated by an adviser.

## CERTIFICATE PROGRAMS

The Department of Management offers several certificate programs designed for professionals with work experience. Applicants for certificate programs must hold bachelor's degrees. A certificate program requires five courses, which are selected according to individual needs. On completion of a sequence with an average grade of B or better, students are issued certificates. Those who choose to work towards the master's degree are able, upon admission, to apply all courses taken toward a certificate toward fulfillment of a degree program. Additional information may be obtained from the department.

**Management Certificates** are offered in the following fields:

- Entrepreneurship
- Electronic Business
- Construction Management
- Human Resource Management
- Information Management
- Operations Management
- Technology Management
- Telecommunications Management

## THE CURRICULUM

**1. Core Courses.** The core courses provide a modern foundation upon which students can pursue cutting-edge specializations within the degree program. These courses provide intensive exposure to the disciplines required of a professional manager. Students who have taken these courses elsewhere or previously at Polytechnic, or who have had equivalent experience, may apply to substitute elective courses for such core courses; however, all students are required to complete 36 units (12 courses).

### The Core Courses

MG 601	<i>Organizational Behavior</i>
MG 607	<i>Marketing</i>
MG 608	<i>Managerial Economics and the Economic Environment</i>
MG 609	<i>Managerial Accounting and Finance</i>
MG 650	<i>Management of Information and Information Technology</i>

Core courses should be taken as early in the program as possible.

**2. Areas of Concentration.** Students must choose an area of concentration. This may be one of those listed below or, with the adviser's approval, a set of courses designed to meet students' special needs. A minimum of four courses must be selected in any one area of concentration. Courses in all the available concentrations are shown below.

**3. Free Electives.** Two appropriate graduate courses may be chosen from any program at Polytechnic with the adviser's consent.

**4. Project in Strategy and Innovation (MG 970).** This required integrating course is recommended for students' final semester. In special cases, MG 997, Thesis for Degree of Master of Science, may be substituted for students who wish to produce a major dissertation in a specialty.

## CONCENTRATION COURSE REQUIREMENTS

Each concentration sequence consists of a minimum of four courses. Students who take more than the minimum number of required courses may count additional courses as free electives. Substitutions may be made with an adviser's approval in any concentration area.

### Entrepreneurship

The Entrepreneurship Concentration is offered for the manager, professional or specialist who is interested in entrepreneurial management, either as entrepreneur starting a new business, as an "entrepreneur" in a large, established firm or as a professional (e.g., venture capitalist) interested in playing a role in new enterprises. Modern entrepreneurial concepts and cases are studied and applied.

#### Required:

MG 770	<i>Entrepreneurship and Venture Creation</i>
MG 865	<i>Managing Technological Change and Innovation</i>
MG 867	<i>Technology Strategy</i>

#### Select one:

MG 631	<i>Organization Theory and Design</i>
MG 646	<i>Introduction to Retailing and Modern Supply Chain Management</i>
MG 654	<i>Economics and Strategy for Information Sectors</i>
MG 660	<i>Management of New and Emerging Technologies</i>
MG 750	<i>Management of Electronic Business</i>
MG 820	<i>Project Assessment and Management</i>
MG 864	<i>New Product Development</i>

### Electronic Business

The Electronic Business Concentration focuses on the new arena of electronic business and the Internet. The key aspects for managing a firm that operates increasingly in digital space and the process of digital-intensive market creation are studied. The relevant methods and concepts for effective electronic-business decision making are explored and applied.

#### Required:

MG 717	<i>Enterprise Data Systems</i>
MG 750	<i>Management of Electronic Business</i>
MG 867	<i>Technology Strategy</i>

#### Select one:

MG 631	<i>Organization Theory and Design</i>
MG 646	<i>Introduction to Retailing and Supply Chain Management</i>
MG 652	<i>Telecommunication Regulation, Policy and Law</i>
MG 654	<i>Economics and Strategy for Information Sectors</i>
MG 655	<i>Introduction to Management of Data Communications and Networks</i>
MG 660	<i>Management of New and Emerging Technologies</i>
MG 770	<i>Entrepreneurship and Venture Creation</i>
MG 864	<i>New Product Development</i>
MG 820	<i>Project Assessment and Management</i>

### Technology Management

The Technology Management Concentration is designed for managers, engineers and other professionals in technology-intensive environments or involved with technology-intensive products, processes or services. It provides the modern methods and concepts necessary for making technology investment decisions; for understanding technology and innovation strategy, product life cycles, and competitive factors; and for developing the special skills necessary for managing creative people and professionals.

#### Required:

MG 820	<i>Project Assessment and Management</i>
MG 864	<i>New Product Development</i>
MG 865	<i>Managing Technological Change and Innovation</i>

#### Select one:

MG 646	<i>Introduction to Retailing and Supply Chain Management</i>
MG 652	<i>Telecommunication Regulation, Policy and Law</i>
MG 654	<i>Economics and Strategy for Information Sectors</i>
MG 655	<i>Introduction to Management of Data Communications and Networks</i>
MG 660	<i>Management of New and Emerging Technologies</i>
MG 664	<i>Management and the Legal System</i>
MG 750	<i>Management of Electronic Business</i>
MG 770	<i>Entrepreneurship and Venture Creation</i>
MG 867	<i>Technology Strategy</i>

### Information Management

The Concentration in Information Management provides Information Technology (IT) professionals, programmers, systems experts and others with IT-related career goals and experience with the knowledge to understand how IT enhances the effectiveness of modern firms and with the ability to manage creative and professional people.

#### Required:

MG 654	<i>Economics and Strategy for Information Sectors</i>
MG 717	<i>Enterprise Data Systems</i>
MG 867	<i>Technology Strategy</i>

#### Select one:

MG 626	<i>Human Resource Information Systems</i>
MG 631	<i>Organization Theory and Design</i>
MG 652	<i>Telecommunication Regulation, Policy and Law</i>
MG 660	<i>Management of New and Emerging Technologies</i>
MG 655	<i>Introduction to Management of Data Communications and Networks</i>
MG 750	<i>Management of Electronic Business</i>
MG 820	<i>Project Assessment and Management</i>



### Telecommunications Management

The Concentration in Telecommunications Management provides managers in the telecommunications and information industries with modern methods and concepts relevant in telecommunications and information management and for integrating telecommunications and information technology into a firm's overall decision making.

#### Required:

- MG 655 *Introduction to Management of Data Communications and Networks*  
 MG 656 *Advanced Management of Data Communication and Networks*

#### Select two:

- MG 652 *Telecommunication Regulation, Policy and Law*  
 MG 654 *Economics and Strategy for Information Sectors*  
 MG 660 *Management of New and Emerging Technologies*  
 MG 717 *Enterprise Data Systems*  
 MG 750 *Management of Electronic Business*  
 MG 770 *Entrepreneurship and Venture Creation*  
 MG 820 *Project Assessment and Management*  
 MG 867 *Technology Strategy*

### Human Resource Management

The Concentration in Human Resource Management prepares professionals for today's technology-intensive environment. It 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 612 *Human Resource Management*  
 MG 633 *Research Methods*  
 MG 865 *Managing Technological Change and Innovation*

#### Select one:

- MG 611 *Career Management*  
 MG 613 *Labor Relations*  
 MG 614 *Conflict Management*  
 MG 616 *Job and Workplace Design*  
 MG 617 *Performance Measurement and Reward Systems*  
 MG 622 *Staffing Organizations*  
 MG 623 *Training in Organizations*  
 MG 624 *Organizational Development*  
 MG 625 *Seminar in Organization and Career Change*  
 MG 626 *Human Resource Information Systems*  
 MG 631 *Organization Theory and Design*  
 MG 635 *Managing for Quality*

### Construction Management

The Concentration in Construction Management provides engineers and other professionals in the construction industry with the knowledge necessary to understand relevant managerial and physical infrastructural technological developments and to be able to integrate construction and management to be effective and innovative.

#### Select four:

- MG 624 *Organization Development*  
 or  
 MG 631 *Organization Theory and Design*  
 MG 630 *Operations Management*  
 or  
 MG 635 *Managing for Quality*  
 MG 820 *Project Assessment and Management*  
 MG 825 *Construction Administration*  
 MG 826 *Construction Estimates and Costs*  
 MG 827 *Specifications and Contracts*

Selected courses in the Exec21 Program offered by the Department of Civil and Environmental Engineering can be counted as concentration electives in construction management with the approval of the Department of Management and the Exec21 Program.

### Operations Management

The Concentration in Operations Management is designed for managers involved in modern operations. It is designed to give operations managers the knowledge necessary, within the context of modern operations management and expertise, to be effective in services as well as manufacturing industries.

#### Required:

- MG 630 *Operations Management*  
 MG 635 *Managing for Quality*  
 MG 820 *Project Assessment and Management*

#### Select one:

- MG 610 *Quantitative Analysis for Managerial Decisions*  
 MG 616 *Job and Workplace Design*  
 MG 646 *Introduction to Retailing and Supply Chain Management*  
 MG 770 *Entrepreneurship and Venture Creation*  
 MG 864 *New Product Development*  
 MG 865 *Managing Technological Change and Innovation*  
 MG 867 *Technology Strategy*

## UNDERGRADUATE COURSES

### MG 300 Management Process

3:0:0:3

Introductory management course for undergraduates. Primary focus is the management process: planning, organizing, staffing, controlling, directing and decision making. Attention is given to the roles of various disciplines within management as well as to the traditional business functions of marketing, accounting, finance, production, engineering, research and development. **Also listed under SS 270.**

### MG 301 Organizational Behavior

3:0:0:3

Study of human behavior in organizational settings. Emphasis on motivation, informal and formal group dynamics, interpersonal relationships, supervision, leadership, communication theory, attitude and job satisfaction, work stress, career development, creativity. Analyses of organizational behavior problems by case studies and simulated situations. **Also listed under SS 299.**

### MG 305 Foundations of Business Systems

3:0:0:3

This course provides the student with a systems perspective on the specification, development, implementation and maintenance of organizational information technology. *Prerequisite MG 300.* **Also listed under SS 275.**

### MG 310 Project Planning and Quality Management

3:0:0:3

This course introduces engineering and computer science students to the theories and practice of project planning and quality management. Project planning topics include choosing whether or not to undertake a project, choosing between project possibilities, scheduling projects, and controlling and managing ongoing projects. Quality and concepts of quality management such as quality control, continuous improvement and customer satisfaction are explained in the second half of the course.

**MG 392: Introduction to Retailing and Supply Chain Management**

3:0:0:3

This course provides an introduction to retailing and supply chain management. Both qualitative and quantitative aspects retailing and supply chain management issues will be covered by this course. The underlying objectives are to:

- Introduce students to the standard business concepts (and associated terminology) involved in the retailing and supply chain management arena;
- Develop student skills in understanding and analyzing retailing, marketing, logistics, operations, channel management and allied issues, and the interactions between them;
- Examine and discuss the important role played by technology and integration at various points in the supply chain.

**GRADUATE COURSES**

**MG 505 Probability and Managerial Statistics**

2½:0:0:3

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 distributions, sampling, measures of central value and dispersion, hypothesis testing, statistical inference, quality control, analysis of variance, regression, correlation and nonparametrics. Emphasis is placed on application of concepts.

**MG 601 Organizational Behavior**

2½:0:0:3

Integration of behavioral science theories, concepts, research and techniques for understanding of 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; work stress; organizational change and development. Analysis of organizational

behavior problems by case studies and simulated situations.

**MG 607 Marketing**

2½:0:0:3

Marketing concepts, processes and institutions: 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 industrial, governmental and international markets.

**MG 608 Managerial Economics and the Economic Environment**

2½:0:0:3

The fundamentals of microeconomics needed by managers. 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 emphasis on managerial application.

**MG 609 Managerial Accounting and Finance**

2½:0:0:3

Elements of accounting and finance of importance to managers. 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 610 Quantitative Analysis for Managerial Decisions**

2½:0:0:3

This course teaches the student to build mathematical models of managerial problems. Types of models discussed include linear and nonlinear programming, queuing, decision analysis and decision trees, and others. The class covers the assumptions made by each

model, the model's formulation and solution, and issues that go beyond the scope of the models. This course focuses on methodologies and their applications, not on derivation of algorithms.

**MG 611 Career Management**

2½:0:0:3

An examination of careers from the perspectives of both management and individuals, including career stage models, organizational entry, career pathing, mid-career crisis, career change, continuing education and retraining, professional obsolescence, career re-entry, job loss and underemployment. Emphasis on career assessment exercises for self evaluation. *Prerequisite: MG 601 or instructor's permission.*

**MG 612 Human Resource Management**

2½:0:0:3

Personnel functions are investigated from the perspectives of individual managers and the total organization. Topics include work force characteristics, recruitment and development, performance evaluation and rewards, effects of legislation and the changing labor force. *Prerequisite: MG 601 or instructor's permission.*

**MG 613 Labor Relations**

2½:0:0:3

Policies and philosophies of management, organized labor and government with regard to solution of labor problems. Evaluation of labor relations problems, particularly those of collective bargaining, emphasizing interrelationships with social, economic and legal trends. *Co-/Prerequisite: MG 601 or instructor's permission.*

**MG 614 Conflict Management**

2½:0:0:3

This course investigates 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. Students design effective programs for class analysis. *Prerequisite: MG 601 or instructor's permission.*

**MG 616 Job and Workplace Design**  
2½:0:0:3

An examination of the interaction among individual, job design and work environment characteristics. Topics include work analysis, task and workspace design, impact on communication, job satisfaction, motivation and productivity, job and work environment redesign, sociotechnical design approaches and the emerging role of artificial intelligence. *Prerequisite: MG 601 or instructor's permission.*

**MG 617 Performance Measurement and Reward Systems**  
2½:0:0:3

An introduction to practical approaches in the establishment of a performance appraisal system that includes theoretical and applied issues. Reasons for implementing a performance appraisal system in organizations are addressed. Other topics include coaching, feedback and performance evaluations. The role of compensation benefits and other rewards in attracting, retaining and motivating employees. *Prerequisite: MG 601 or instructor's permission.*

**MG 622 Staffing Organizations**  
2½:0:0:3

This course examines the design and management of successful staffing processes used to form matches between people and jobs in order to achieve organizational effectiveness and individual job satisfaction. Emphasis will be on the psychological theories, measurement concepts and practical techniques of personnel recruitment and selection, including such topics as human resource planning, job analysis, the reliability and validity of employee assessment methods and legal issues in the employment relationship. *Co-/Prerequisite: MG 601 or instructor's permission.*

**MG 623 Training in Organizations**  
2½:0:0:3

The roles of training in organizations, focusing on department and line managers. Subjects addressed include needs analysis, preparation of employees for jobs, management development, training program design, evaluation and employee obsolescence and retraining. *Co-/Prerequisite: MG 601 or instructor's permission.*

**MG 624 Organization Development**  
2½:0:0:3

Applied theory and research related to the process of managing change in organizations. Practical application of group, intergroup and individual changes. Planned structural revisions in formal organizations. Dynamics of organizational change processes. Experimental techniques and seminar approaches emphasized. *Co-/Prerequisite: MG 601.*

**MG 625 Seminar in Organization and Career Change**  
2½:0:0:3

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 and cultural change in the work environment. Experts from the private and public sectors as well as consulting firms address these management practices. *Co-/Prerequisite: MG 601 or instructor's permission.*

**MG 626 Human Resource Information Systems**  
2½:0:0:3

Design, selection, implementation, enhancement and operation of Human Resource Information Systems (HRIS) in organizations. Organizational, legal and political issues as well as hardware, software, applications and communications in HRIS. The uses of time-sharing, personal and minicomputers and mainframes. Focus on design and use of HRIS to facilitate objectives of human resource functions as well as to support entire organizations.

**MG 630 Operations Management**  
2½:0:0:3

Analytical techniques for designing and operating production and service systems, including facility layouts and locations, capacity planning, job sequencing, inventory control and quality control. Introductory linear programming and other formal methods. Cases and PC usage.

**MG 631 Organization Theory and Design**  
2½:0:0:3

Analysis of theories of large-scale organizations focusing on their structure and design. Includes characteristics of bureaucracy, adhocracy, suboptimization, human dynamics and informal systems, influence and control systems, and planned change. Examination of both formal and informal organizations through research and case studies. *Co-/Prerequisite: MG 601 or instructor's permission.*

**MG 633 Research Methods**  
2½:0:0:3

An introduction to theories and techniques of research methods. Primary objectives are to provide understanding and appreciation of why and how organizational research is carried out. Survey of research methods. Research proposals are developed. *Prerequisite: MG 601, MG 605 or instructor's permission.*

**MG 634 Applied Research Methods**  
2½:0:0:3

Integration and application of advanced research techniques utilized in studies of organizations. Students develop and carry out individual applied research projects. *Prerequisite: MG 633 or instructor's permission.*

**MG 635 Managing for Quality**  
2½:0:0:3

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 for building quality into the management process. Total quality management (TQM) and similar approaches are covered through readings, cases and examples.

**MG 646 Introduction to Retailing and Supply Chain Management**  
2½:0:0:3

This course provides an introduction to retailing and supply chain management. Both qualitative and quantitative aspects of retailing and supply chain management will be covered by this course. The underlying objective is to:

## DEPARTMENT OF MANAGEMENT

- Introduce students to the standard business concepts (and associated terminology) involved in the retailing and supply chain management arena;
- Develop student skills in understanding and analyzing retailing, marketing, logistics, operations, channel management and allied issues, and the interactions between them;
- Examine and discuss the important role played by technology and integration at various points in the supply chain.

### **MG 650 Management of Information and Information Technology** 2%: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 re-engineering, knowledge management, and group support systems.

### **MG 652 Telecommunications Regulation, Policy and Law** 2%:0:0:3

The relationships between the development of the telecommunications industry, national growth and the development of telecommunications policy issues and policy making organizations. Analysis of the major issues which impact the telecommunications industry and commerce and society generally. The options and opportunities afforded by recent regulatory and policy issues.

### **MG 654 Economics and Strategy for Information Sectors** 2%:0:0:3

This course in applied competitive strategy draws upon recent experiences in the impact of information technology upon diverse industries. Students completing this course will have mastered a basic understanding of the economic and competitive implications of information technology. 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 will be introduced to the often poorly structured process of evaluating the economics of potential systems innovations. They will then be able to participate in strategic systems planning from a managerial point of view.

### **MG 655 Introduction to Management of Data Communications and Networks** 2%:0:0:3

This course is designed to introduce the fundamentals of modern telecommunications and networking to the current and future managers. The course covers 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 emphasis of the course is to expand technical knowledge and discuss related managerial issues.

### **MG 656 Advanced Management of Data and Communications Networks** 2%:0:0:3

This course explores advanced issues and trends in modern enterprise networking. It examines the implications of such developments in the business environment and the infrastructural needs of organizations and clusters of organizations. It reviews ramifications of the TCP/IP revolution leading to commercialization of the Internet/World Wide Web. The course discusses the network infrastructure required to implement Intranets/Extranets, electronic commerce and interorganizational business communication and collaboration generally. It evaluates emerging technologies (such as electronic payment systems, corporate digital libraries, push technology, multicasting, firewalls and digital signatures). The course also deals with the implications of internetworking, such as digital cities, smart buildings, distance learning, telecommuting and teleconferencing.  
*Prerequisite: MG 655.*

### **MG 660 Management of New and Emerging Technologies** 2%:0:0:3

This course is a survey of the exciting new and emerging technologies that are becoming available to the new business world domain of the global information marketplace. Architectures and issues for implementation for these new media are presented. The "Information Highway" is presented, and its opportunities, applications and challenges are discussed. 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.

### **MG 664 Management and the Legal System** 2%:0:0:3

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 717 Enterprise Data Systems** 2%:0:0:3

This course addresses modern issues of large-scale information and knowledge management through design, development and implementation of different kinds of database technologies. The course introduces and elaborates data modeling through entity relationship method, relational model, SQL applications, database architecture, different types of database management systems, data integrity and administration, etc. The course also introduces emerging database technologies such as distributed Internet-based databases, distributed client/server databases, multidimensional databases, groupwares, data warehousing and data mining for decision support, etc.

### **MG 750 Management of Electronic Business** 2%:0:0:3

The basic objective of this course is to investigate the management implications of electronic business. Topics include:

- accelerated new product development

- impact of technology on the value chain: the changing role of intermediaries
- electronic commerce: business models and strategies for survival general lifestyle
- implications of “being wired”
- business applications involving collaborative communication, computation and teamwork

The course material is designed to be 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 will also 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 marketplace. Classes are conducted using the case method, and a high level of class interaction is expected.

#### **MG 770 Entrepreneurship and New Venture Creation** *2%: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-technology economy. The course deals with such key issues as:

- Assessing attractiveness of opportunities
- Launching a new venture
- Nurturing and growing an entrepreneurial venture
- Obtaining the necessary financial, human and technology resources
- Managing the transition from a small entrepreneurial firm to a large, sustainable professionally managed but still entrepreneurial corporation
- Being an entrepreneur and promoting entrepreneurship in a large corporation

#### **MG 810 Project Planning and Control** *2%:0:0:3*

Network planning techniques for project management and resource allocation. Emphasis on PERT, LOB, CPM and probabilistic generalized networks. Heuristic models for multiproject scheduling and resource leveling. Network

development, computer adaptation, progress reports and project monitoring. **Also listed under IE 620 and CE 828.**

#### **MG 820 Project Assessment and Management** *2%:0:0:3*

Management of technology-based projects ranging from individual research and development to large-scale and complex technological systems. 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 820.**

#### **MG 825 Construction Administration** *2%:0:0:3*

Management techniques of construction are discussed in relation to alternate means of project execution. Organizational structures, management systems and controls are examined from the points of view of owners, constructors and professional construction managers. **Also listed under CE 825.**

#### **MG 826 Construction Estimates and Costs** *2%:0:0:3*

Techniques for estimating costs of capital projects and methods for effective cost control during project execution are taught with emphasis on principles of good management. **Also listed under CE 826.**

#### **MG 827 Specifications and Contracts** *2%:0:0:3*

Principles of contract law applied to construction; legal problems in preparing and administering construction contracts. **Also listed under CE 827.**

#### **MG 864 New Product Development** *2%:0:0:3*

The dynamics of technology and the pressures of competition are driving enterprises to make their product development and production processes strategically more effective, and economically more efficient in time and cost. This course deals with the state-of-the-art in new product activities for service and

manufacturing firms, examining in depth the marketing technology and manufacturing technology linkages.

#### **MG 865 Managing Technological Change and Innovation** *2%:0:0:3*

This course focuses on the effective management of technological change and innovation. This is accomplished by employing 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 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 provides key insights for effectively managing the process of innovation and the impact of innovation on all parts of an enterprise. Specifically, there is explicit consideration of the need within a firm to manage and inspire people so that they can effectively communicate and innovate.

#### **MG 867 Technology Strategy** *2%:0:0:3*

This course examines in depth the strategic technological decisions that a general manager faces. From entrepreneurial start-ups to established companies, in dynamic as well as mature environments, there must be a conscious process of formulating and implementing a technology strategy to serve the business interests of the firm. Such a strategy would guide investments in research and development, selection among and timing of alternate technologies, organization and communications, formation of alliances and funding of ventures.

#### **MG 968 Seminar in Management of Technology** *2%:0:0:3*

This course complements the MOT elective curriculum by providing in-depth treatment of specific current topics in this rapidly changing field or by providing a structured forum for dealing with relevant issues in current practice. Depending on the theme that is chosen for each semester that the course is given, the format may

## DEPARTMENT OF MANAGEMENT

be either readings and research or a series of discussions of contemporary issues led by expert practitioners.

### **MG 970 Project in Strategy and Innovation** 2½:0:0:3

An integrative course that brings together the concepts and theories from a number of individual courses. Considers the corporation from the viewpoint of senior corporate and divisional management. Uses case studies and projects to focus on interrelationships between strategy, technology, innovation, corporate culture, organization structure and human factors in domestic and global corporations. *Prerequisite: Advanced standing.*

### **MG 975 Selected Topics in Management** 2½:0:0:3

Current topics in various fields are analyzed and discussed. *Prerequisite: Advanced standing and instructor's permission.*

### **MG 976-977 Readings in Management** -:-:-:3

Directed individual study of supervised readings in advanced areas of management. *Prerequisite: permission of department head.*

### **MG 985 Selected Topics in Organizational Behavior** 2½:0:0:3

Discussion and analysis of current topics in organizational behavior. *Prerequisite: Advanced standing and instructor's permission.*

### **MG 986-987 Readings in Organizational Behavior** -:-:-:3

Directed individual study or supervised readings in advanced areas of organizational behavior. *Prerequisite: permission of department head.*

### **MG 997 Thesis for Degree of Master of Science** -:-:-:3

Original investigation in a topic chosen by the student. Conferences and progress reports required during work, and final written report required at completion. Oral examination may be requested by the department. *Prerequisite: degree status and approval of supervising professor, adviser and department director.*

## **INFREQUENTLY OFFERED COURSES**

### **MG 619 Employee Scheduling**

**MG 830 Formulation and Analysis of Public Works Projects**  
Also listed under CE 781.

**MG 850 Cost Systems**  
*Prerequisite: MG 609.*

**MG 860 Financial Planning, Internal Reporting and Operation Control**  
*Prerequisite: MG 609.*

**MG 863 Market Research**  
*Prerequisite: MG 607.*

**MG 871 Manufacturing Strategies**  
Also listed under MN 622.

# MANAGEMENT OF TECHNOLOGY EXECUTIVE PROGRAM

*Academic Co-Directors:* Mel Horwitch and Nina Ziv

*For forward-thinking managers, the Management of Technology (MOT) Program is the "MBA of the future."*

One of the first accredited universities to offer an advanced degree in MOT, Polytechnic University is a recognized leader in the field. Rather than grafting a few courses onto a traditional MBA program, Polytechnic's MOT Program possesses a thoroughly innovative integrated curriculum.

Key characteristics of the MOT Program:

- Focuses on strategic implications of technology and innovation
- Encompasses innovation management in all modern technology arenas
- Deals with the impact of technology and innovation throughout an enterprise
- Addresses physical and digital (including Internet-based) innovation
- Facilitates the transition from technologists to technology managers
- Assumes a global perspective.

In our new MOT curriculum, even traditional subjects such as finance, operations management and marketing, are taught with technological issues in mind. Subjects, concepts and issues directly related to technology management and accessing innovative capability that form the MOT 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
- The entrepreneurship explosion

- Venture capital and venture creation
- The Internet and the Web—innovation's new platform
- 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
- New technology choice and acquisition
- effective remote-collaboration learning and teamwork that are also enabled by technology
- learning materials which are often in digital Web-based format to take advantage of new Internet based technologies and methods
- the incorporation of technology with ease of use and access as key watch-words

The program is also well-suited for engineers and scientists with increasing managerial responsibility, as well as professionals, functional and business managers in finance, banking, telecommunications and other increasingly technological environments.

MOT is an executive program. As such, MOT has the following general features:

- close interaction and teamwork
- a professional, modern and informal learning environment
- participants viewed as real 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)
- a curriculum that is continually updated
- close collaboration with respected partners in industry and the relevant scholarly community
- full courses and new half-semester courses to make the most of the limited time available
- carefully selected elective courses to maintain flexibility in meeting diverse professional needs
- a blend of live class experience with use of modern, Web-based technology

The MOT Executive Program classes meet every other week for two full days, Friday and Saturday or Thursday and Saturday, at the New York Information Technology Center, 55 Broad Street, in 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, please visit the program's Website:  
<http://www.mot-tim.poly.edu>.

## ADMISSIONS INFORMATION

Admission to the MOT 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, an ability to benefit professionally from our rigorous two-year executive programs and significant promise of future career advancement. Because of the heavy demands of these programs, it is important that employers also explicitly support such professional education.

In general, GRE and GMAT tests are not required for applying to the MOT or MOT Programs. But the MOT Executive Master's Management Degree Programs office may ask an applicant to submit scores later in the admissions process.

## DEPARTMENT OF MANAGEMENT

### How to apply

1. Please mail your completed application and application fee to:

Administrative Director, MOT-TIM  
Polytechnic University  
55 Broad Street, Suite 13B  
New York, NY 10004

or please complete the electronic application on our Website:  
<http://www.mot-tim.poly.edu>.

2. Please also arrange to have transcripts for previous college and university work sent directly by the academic institution to the MOT-TIM Master's Degree Program Administrative Director at the above address.

3. Please arrange for two letters of recommendation to be sent to the Executive Master's Degree Program Director. These letters are generally from a supervisor or high-level colleague who are familiar with your professional work.

4. The final step to admission is a personal interview with one of the program co-directors to discuss career objectives and to make sure your aims fit the goals of the program to which you have applied.

For further information please contact us:

Tel: 212/547-7030 ext. 207

Fax: 212/547-7029

E-mail: [mot-tim@poly.edu](mailto:mot-tim@poly.edu)

Web: <http://www.mot-tim.poly.edu>

## MANAGEMENT OF TECHNOLOGY

### DEGREE REQUIREMENTS AND CURRICULUM

This 36-credit program consists of the following:

#### FIRST ACADEMIC YEAR

##### First Semester

MG 609	<i>Managerial Accounting and Finance</i>
MG 603	<i>Organizational Behavior and Management Process in Innovative Corporations</i>
MG 865	<i>Managing the Innovative Process</i>

#### Second Semester

MG 607	<i>Marketing</i>
MG 608	<i>Managerial Economics and the Economic Environment</i>
MG 693	<i>Information Technologies, Systems and Management in Organizations</i>

#### SECOND ACADEMIC YEAR

##### Third Semester

MG 610	<i>Quantitative Analysis for Managerial Decisions</i>
MG 775	<i>Operations Management For Knowledge-Based Enterprises*</i>
MG 820	<i>Project Assessment and Management For Technology Managers</i>
MG	<i>Elective Course I** (select one from the list below)</i>

##### Fourth Semester

MG 783	<i>New Frontiers in Electronic Business*</i>
MG 795	<i>New Product and Services Development*</i>
MG 867	<i>Technology Strategy</i>
MG 950	<i>MOT Capstone Project Course</i>
MG	<i>Elective Course II** (select one from the list below)</i>

##### Elective Course Portfolio

MG 784	<i>Negotiation in Technology-Intensive Sectors**</i>
MG 785	<i>High-Technology Leadership**</i>
MG 786	<i>High-Technology Entrepreneurship**</i>
MG 787	<i>Intellectual Property for Technology and Information Managers**</i>
MG 788	<i>Modern Supply Chain Management: Integration Through Technology**</i>
MG 789	<i>Special Elective Topics for MOT and TIM**</i>
MG 797	<i>Financing for Value Creation (Venture Capital, IPOs)**</i>

Note: \* (½ semester course)

\*\* (½ semester courses offered in third or fourth semesters)

### SPECIAL MOT TRACK MANAGEMENT OF TECHNOLOGY AND INNOVATION IN FINANCIAL SERVICES [MOTIFS]

Management of Technology and Innovation in Financial Services [MOTIFS] is a special "Track" within the overall MOT Program. The degree that is awarded is the same degree awarded for the overall MOT Program.

MOTIFS is designed for professionals in the financial services industry who aim for and require greater understanding of innovation, technology and information management in financial services. MOTIFS provides a MOT curriculum with an emphasis on technologi-

cal and competitive challenges facing securities, insurance, banking and other financial services segments.

The MOTIFS curriculum is as follows:

#### FIRST ACADEMIC YEAR

##### First Semester

MG 609	<i>Managerial Accounting and Finance</i>
MG 796	<i>Modern Financial Institutions and their Competitive Environment</i>
MG 865	<i>Managing the Innovative Process</i>

##### Second Semester

MG 607	<i>Marketing</i>
MG 608	<i>Managerial Economics and the Economic Environment</i>
MG 693	<i>Information Technologies, Systems and Management in Organizations</i>

#### SECOND ACADEMIC YEAR

##### Third Semester

MG 798	<i>Managing Technological Innovation and Emerging Technologies In Financial Services</i>
MG 820	<i>Project Assessment and Management for Technology Managers</i>
FE 603	<i>Money, Banking and Financial Markets***</i>
MG	<i>Elective Course I** (select one from the list below)</i>

##### Fourth Semester

MG 783	<i>New Frontiers in Electronic Business*</i>
MG 799	<i>Modern Financial Products*</i>
MG 867	<i>Technology Strategy</i>
MG 950	<i>MOT Capstone Project Course*</i>
MG	<i>Elective Course II** (select one from the list below)</i>

##### Elective Course Portfolio

MG 784	<i>Negotiation in Technology-Intensive Sectors**</i>
MG 785	<i>High-Technology Leadership**</i>
MG 786	<i>High-Technology Entrepreneurship**</i>
MG 787	<i>Intellectual Property for Technology and Information Managers**</i>
MG 788	<i>Modern Supply Chain Management: Integration Through Technology**</i>
MG 789	<i>Special Elective Topics for MOT and TIM**</i>
MG 797	<i>Financing for Value Creation (Venture Capital, IPOs)**</i>

Note: \* (½ semester course)

\*\* (½ semester courses offered in third or fourth semesters)

\*\*\* Existing financial engineering course, see FE catalog course section



<b>COURSE DESCRIPTIONS</b>
--------------------------------

The following courses are unique to this executive management program. For other course descriptions, refer to the "Management" section of this catalog.

**MG 603 Organizational Behavior and Management Process in Innovative Corporations** 2%:0:0:3

Introduction to issues and concepts in organizational and administrative behavior, with emphasis on designing and maintaining organizations that can innovate and adapt. Management processes for flexible and innovative organizations. The evolution of technology intensive business organizations. The role of technology in the growth of the modern firm. Human resource management and organization development in technology-intensive firms.

**MG 607 Marketing** 2%:0:0:3

Marketing concepts, processes and institutions; positioning, segmentation, 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. Global marketing and marketing on the Internet.

**MG 608 Managerial Economics and the Economic Environment** 2%:0:0:3

Microeconomic analysis and the macroeconomic environment for managers. Economic basis for managerial decisions in production, investment and technology strategy. Economics of the firm, business cycles, economic growth, international trade, financial institutions and currency systems. The economics of innovation and entrepreneurial activity. The role of technology in economic growth and in international competition.

**MG 609 Managerial Accounting and Finance** 2%:0:0:3

Principles and practices of the modern finance function including accounting and corporate finance, and their relevance for all information business managers. 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 610 Quantitative Analysis for Managerial Decisions** 2%:0:0:3

Applications to the management of technology of quantitative and analytical techniques, such as probability, statistical inference, correlation and regression, decision theory, forecasting, linear programming and queuing models. Production/operations management techniques. Cases and problems selected from real-world technology-management experience, including computer-supported decision making and simulation.

**MG 693 Information Technologies, Systems and Management in Organizations** 2%:0:0:3

This course is designed for managers who need to understand the role and potential contribution of information technology (IT) within organizations. The focus of the course 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, emerging issues in IT such as intelligent systems, business process re-engineering, knowledge management and group support systems. The format of the course is interactive with concept presentation followed by open discussion on real-world applications of IT and business cases.

**MG 775 Operations Management For Knowledge-Based Enterprises** (half-semester course) 1%:0:0:1%

Services and product development and process change. Managing the learning curve. Conflicts between innovation and productivity. Operations management as an element of overall strategy. Flexible operations systems and automation and information systems, CAD/CAM and computer-integrated operations. Quality control in this course. Students will develop and understanding of the strategies, tools, processes and techniques for improving the profitability and competitiveness of modern businesses from an operations perspective. Among other areas that receive emphasis: developing an operations strategy; managing operations as technology and economics change; measuring and improving "productivity" in the modern manufacturing and service sectors using activity-based costing in operations management; and theory of constraints and understanding "quality."

**MG 783 New Frontiers in Electronic Business** (half-semester course) 1%:0:0:1%

The basic objective of this course is to investigate the management implications of electronic business. Topics include:

- accelerated new product development
- impact of technology on the value chain, the changing role of intermediaries
- electronic commerce business models and strategies for competitive survival and dominance
- business applications involving collaborative communication, computation and teamwork

The course material is designed to be 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 will also 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 are conducted using the case method and a high level of class interaction is expected.

## DEPARTMENT OF MANAGEMENT

### **MG 784 Negotiation in Technology-Intensive Sectors**

(half-semester course) 1½:0:1½

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 through practice; students in this class develop the art of negotiation by negotiating with each other in realistic cases. A wide variety of negotiation applications is covered in this class, including one-time and repeated negotiation, single and multi-issue negotiations, and two-party and multi-party bargaining. Special emphasis is placed on negotiations in technology-intensive environments. This class is taught using the case method. Many of the examples used in this course will be cases that the students actually negotiate with each other. Students' grades will be based on their performance in these negotiations and on their class participation.

### **MG 785 High-Technology Leadership**

(half-semester course) 1½:0:1½

Focuses on the essential role of multifaceted leadership in diverse high-technology management settings. Discusses different forms of modern high-technology leadership; e.g., the general management leader, the project leader, the technology leader, the visionary leader and the operational team leader. Case studies and actual examples of high-technology leadership are emphasized.

### **MG 786 High-Technology Entrepreneurship**

(half-semester course) 1½:0:1½

Focuses on entrepreneurship as a critical engine for wealth creation in the high-technology, innovation-intensive economy. Deals with such key issues as:

- assessing attractiveness of opportunities
- launching a new venture
- obtaining the necessary financial, human and technology resources
- managing the transition from a small entrepreneurial firm to a large, sustainable professionally managed but still entrepreneurial corporation
- being an entrepreneur and promoting entrepreneurship in a large corporation

### **MG 787 Intellectual Property for Technology and Information Managers**

(half-semester course) 1½:0:1½

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 are used, with examples representing both classical and digital innovations.

### **MG 788 Modern Supply Chain Management: Integration Through Technology**

(half-semester course) 1½:0:1½

This course provides an introduction to the role of information technology in supply chain management. It builds on some of the concepts covered by the MG 783, *New Frontiers in Electronic Business*. Both qualitative and quantitative aspects of supply chain management are covered. Articles pertaining to leading-edge research and management thought are discussed and analyzed by students. 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 are conducted using the case method, and a high level of class interaction is expected.

### **MG 789 Special Elective Topics for MOT and TIM**

(half-semester course) 1½:0:1½

Covers selected key emerging trends and issues in the MOT and TIM domains. Discussion with industry leaders and specialists from business, government and academia. Topical treatment of technologies, markets, business practices, government regulations and the relationships among them.

### **MG 795 New Product and Services Development**

(half-semester course) 1½:0:1½

Focuses on the challenges of launching a new product or service. Emphasizes need for a blend of vision, commitment, market familiarity and sufficient resources. Contrasts differences in this activity between products and services and between physical and digital space. Students are expected to develop a plan for a new product or service.

### **MG 796 Modern Financial Institutions and their Competitive Environment**

2½:0:0:3

This unique course intersects technological innovation and management with regard to the financial services industry. The course focuses on the management of modern financial enterprises, innovation and technology management in these organizations, and the risk-return tradeoff from a financial-institution perspective. The course deals with both 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 through a mixture of textbook reading assignments and discussions of concepts in real business contexts through case studies. The objective of the course is to provide technology managers with a firm knowledge of the normative consequences on financial management decision-making to create shareholder value.

### **Mg 797 Financing For Value Creation (Venture Capital, IPOs)**

(half-semester course) 1½:0:1½

This course explains how the venture capital and private equity industry works and the conditions that determine the specific forms of this type of financing. The course focuses on the "private equity cycle" by considering how private equity funds are raised and structured, and how venture capitalists earn a return on their investments. The case studies explore how investments are evaluated, structured, and overseen, and how venture capital and private equity organizations interface with pension funds, investment managers, entrepreneurs, investment bankers and distribution managers. While this course is primarily geared to managers of firms currently or prospectively financed by venture capitalists or other private equity investors, it also shows how critical aspects of private equity investing can be transferred to the management of corporate venture capital projects in established organizations. The course will be based primarily on case studies, with presentations by guest speakers from the private equity investment industry.

**MG 798 Managing Technological Innovation and Emerging Technologies in Financial Services**

2½:0:0:3

This course is designed to introduce the emerging information technologies and their applications in financial services industries to current and future managers. The course covers three major financial services industries: banking, investment and insurance. Knowledge development is primarily done through nurturing deeper understanding of concepts and analyzing in real business context through case studies. The emphasis of the course is to provide adequate technical knowledge and discuss in-depth the related managerial issues.

**MG 799 Modern Financial Products**

(half-semester course) 1½:0:0:1½

This is an intensive half-semester course that examines critical management issues of the technology domain that characterizes modern financial products used for investment, hedging or trading purposes. The description and use of these instruments were introduced in MG 796 and MG 693 provides the necessary background discussion of information technologies and systems. The principal focus of this course is on managing the technological challenges in the valuation and risk management of these data-intensive modern financial products. *Prerequisite: MG 796 and MG 693*

**MG 820 Project Assessment and Management for Technology Managers**

2½:0:0:3

Managing technology-based projects ranging from individual research and development to large-scale and complex technological systems. 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. Cost estimation, capital budgeting, cost controls and effective matrix management. Actual case studies are used in this course as are relevant and modern project management software applications.

**MG 865 Managing the Innovative Process**

2½:0:0:3

Managing research, development and engineering; technical and support professionals; and technology transitions. Deals with the changing nature of modern innovation as it encompasses both physical and digital domains. Staffing, organizing, budgeting, planning, controlling and evaluating R&D projects. Integrating R&D management with other business functions, such as corporate strategy, new product development, marketing, production and finance. Project selection and balancing the portfolio. Technology forecasting and applications assessment. Communication of technical information within the corporation; corporate acquisition of technical knowledge. Among the questions this course is designed to help students answer are:

- What is different about managing in a technology-driven firm?
- What preparation should a general manager in a technology-driven company possess, in terms of technical expertise and managerial experience?
- When are innovation strategies first formulated and then implemented, and how do they emerge?
- What are the characteristic responses of organizations to innovation?
- Does innovation change fundamentally in an electronic business setting?
- How does a new business develop or acquire follow-on products?
- What are the characteristics of firms that innovate successfully in a competitive environment?

**MG 867 Technology Strategy**

2½:0:0:3

Technology as a strategic variable. Entrepreneurial high-tech strategies: from start-up companies to large corporations. Introducing new technologies: timing and choice. Strategic alliances. The changing role of industrial R&D in technology strategy. The emerging "new" technology strategy for electronic commerce and the Internet. Technology strategy for global markets, including Europe, the Pacific Rim, Israel, India and others. Several guest speakers participate.

**MG 950 MOT Capstone Project Course**

(half-semester course) 1½:0:0:1½

This course provides a capstone, integrative and state-of-the-art intellectual experience for participants at the conclusion of the program. The whole class focuses on a selected major subject that is of broad and compelling managerial concern and that is related in important ways to the innovation, technology-intensive and/or information business arenas. The class will initially be divided into small groups to tackle various aspects of the overall subject. Also, individual participants are expected to submit their own analysis of a specific issue or firm associated with the general subject. Participants are encouraged to employ relevant concepts and insights which they have acquired during the course of the entire program.

# ORGANIZATIONAL BEHAVIOR PROGRAM

*Academic Director:* Harold G. Kaufman

## THE MASTER OF SCIENCE IN ORGANIZATIONAL BEHAVIOR

This leading-edge graduate program provides professionals and managers with the latest knowledge and techniques for addressing critical human issues in rapidly changing organizations to achieve high quality and productivity. The course of study is designed for students with a wide variety of experience and needs. 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

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 people and organizations.
- Motivating knowledge workers in professional and technical positions to stay up-to-date with developments in their fields.
- Conflict resolution in turbulent and uncertain environments.
- Designing new organizational structures that are more responsive to rapid change.
- Career management in restructuring companies.
- Training and development innovations to cope with changing job requirements.
- Utilizing job and workplace design to improve motivation and performance.
- Addressing human resource issues in organizations affected by globalization.

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 and to work closely with faculty as well as classmates, often in teams.

An active, award-winning student chapter of the Society for Human Resource Management (SHRM) provides extra curricular opportunities for professional seminars, workshops and networking to enhance individual career development. With the unique knowledge and skills acquired from the Organizational Behavior Program, 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. An applicant who does not meet all the criteria may be admitted as a nondegree student with the opportunity subsequently to become a degree candidate. Satisfactory scores on the Graduate Management Admission Test (GMAT) or an acceptable equivalent test such as the Graduate Record Examination (GRE) may be used as support for admission to degree studies.

Students who have not completed an undergraduate course in statistics will be required to enroll in MG 505, Probability and Managerial Statistics. This course is in addition to the degree requirements of 12 courses or 36 units, which must be completed with an average of B or better. A maximum of 9 units of transfer credits may be granted for graduate courses taken elsewhere, as evaluated by the academic director.

For the most current information, please visit the departments Website at: <http://www.ite.poly.edu/mg>.

## CERTIFICATE PROGRAMS IN ORGANIZATIONAL BEHAVIOR

The Organizational Behavior Program offers state-of-the-art graduate certificate programs designed primarily for professionals and managers with work experience. Individualized programs make it highly appropriate for specialists as well as generalists to improve and update their knowledge and skills in critical areas ranging from the redesign of jobs and organizations to human resource information systems. In consultation with the academic director, students may design a custom-made certificate program with appropriate courses to meet their professional development needs.

Applicants for certificate programs must hold a bachelor's degree. A certificate program requires five courses which are selected according to individual needs. Upon completion of a sequence with an average grade of B or better, students are issued a certificate.

Those who choose to apply for a Master's of Science in organizational behavior are able, upon admission, to apply all courses taken for a certificate toward fulfillment of the graduate degree requirements. Additional information may be obtained from the academic director of the Organizational Behavior Program.

## THE CURRICULUM

### 1. Core Courses

An organizational behavior foundation consists of three core courses upon which the student can build a specialization within the degree program. Core courses provide an introduction to the theory, research and practice basic to the field of organizational behavior. Students who have previously completed courses 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.

#### The Required Core Courses:

- MG 601 *Organizational Behavior*  
 MG 631 *Organization Theory and Design*  
 MG 633 *Research Methods*

#### 2. Areas of Concentration.

Students must choose an area of concentration consisting of six courses. This may be one of three concentrations listed below or, with the academic director's approval, may consist of a series of six courses designed to meet students' special needs.

Courses in each of the three areas of concentration are shown below:

##### Human Resource Management

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 612 *Human Resource Management*  
 MG 617 *Performance Measurement and Reward Systems*  
 MG 622 *Staffing Organizations*

##### Select three:

- MG 611 *Career Management*  
 MG 613 *Labor Relations*  
 MG 614 *Conflict Management*  
 MG 625 *Seminar in Organization and Career Change*  
 MG 626 *Human Resource Information Systems*  
 MG 865 *Managing Technological Change and Innovation*

##### Management of Change

The concentration in Management of Change provides human resource professionals 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 616 *Job and Workplace Design*  
 MG 624 *Organization Development*  
 MG 625 *Seminar in Organization and Career Change*  
 or  
 MG 865 *Managing Technological Change and Innovation*

##### Select three:

- MG 611 *Career Management*  
 MG 612 *Human Resource Management*  
 MG 614 *Conflict Management*  
 MG 623 *Training in Organizations*  
 MG 625 *Seminar in Organization and Career Change*  
 MG 635 *Managing for Quality*

##### Training and Development

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 611 *Career Management*  
 MG 623 *Training in Organizations*  
 MG 624 *Organization Development*

##### Select three:

- MG 612 *Human Resource Management*  
 MG 614 *Conflict Management*  
 MG 616 *Job and Workplace Design*  
 MG 625 *Seminar in Organization and Career Change*  
 MG 635 *Managing for Quality*  
 MG 865 *Managing Technological Change and Innovation*

#### 3. Free Electives.

Two appropriate graduate courses may be chosen from any program at Polytechnic with the academic director's consent.

#### 4. Research Project

Applied Research Methods (MG 634). All students are required to submit an independent research project. In special cases, MG 997, Thesis for Degree of Master of Science, may be substituted for students who wish to produce a major research study in a specialty.

### BS/MS ACCELERATED HONORS PROGRAM

The Department of Humanities and Social Sciences and the Department of Management offer an honors program for exceptional first year or advanced undergraduate students. Through this program a student can earn a Bachelor of Science degree in social sciences (with a concentration in behavioral sciences) and a Master of Science degree in organizational behavior in four to five years. For further information please refer to the description in the catalog section of the Department of Humanities and Social Sciences.

### GRADUATE AND UNDERGRADUATE COURSES

For course descriptions, please refer to the Master of Science in Management Program section of this catalog.

---

# TELECOMMUNICATIONS AND INFORMATION MANAGEMENT EXECUTIVE PROGRAM

---

*Academic Co-Directors:* Mel Horwitch  
and Nina Ziv

The Department of Management of Polytechnic University, supported by the Department of Computer and Information Science and other relevant departments, offers a Master of Science degree program in Telecommunications and Information Management (TIM).

TIM deals with managing in a drastically transformed, challenging and critical business environment. This setting includes:

- Knowledgeable and demanding IT customers
- Emergence of electronic business, electronic commerce and the Internet
- A reconfigured telecommunications industry
- Deregulation/reregulation/privatization
- New information-based markets and businesses
- New organizational forms and management
- New and revitalized established competitors
- Speed, feedback and co-creation with customers, suppliers and other partners as key elements in new business models
- IT providers/integrators/users as innovators
- Continuous development and introduction of information technology thereby adding value to markets and firms

This program began in 1984 and has been maintained at the state-of-the-art. TIM serves a wide variety of executives faced with new challenges and opportunities in the rapidly developing areas of networking telecommunications and networking information management. The Master of Science in Telecommunications and Information Management is a rigorous two-year, four-semester state-of-the-art program.

The TIM Program provides the most advanced and sophisticated learning experience dealing with the critical interface that integrates networking telecommunications, information technologies, the Internet and management.

The perspective of TIM is high-level yet grounded. The orientation of TIM is pragmatic and managerial (not simply technical). TIM is geared for the growing set of professionals who must use information and networking technology and the Internet in carrying out critical tasks and in developing and delivering value within their organizations and for customers. The TIM Program has several key characteristics, including the following:

- Explores how networking, telecommunications, information technology, electronic business and the Internet can transform enterprises
- Examines how networking, telecommunications, information technology, electronic business and the Internet create and change markets
- Uncovers and helps build new effective business models that take advantage of networking, telecommunications, information technology, electronic business and the Internet

Courses in TIM are managerial, technological or integrative (blending management and information technology). The entire curriculum is 36 credits.

TIM is an executive program. As such, TIM has the following important general features:

- close interaction and teamwork
- a professional, modern and informal learning environment
- participants viewed as real 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)

- a curriculum that is continually updated
- close collaboration with respected partners in industry and the relevant scholarly community
- full courses and new half-semester courses to make the most of the limited time available
- carefully selected elective courses to maintain flexibility in meeting diverse professional needs
- blend of live class experience with use of modern, Web-based technology
- effective remote-collaboration learning and teamwork that are also enabled by technology
- learning materials which are often in digital Web-based format to take advantage of new Internet based technologies and methods
- the incorporation of technology is undertaken with ease of use and access as key watchwords

The TIM Executive Program meets every other week for two full days, Friday and Saturday or Thursday and Saturday at the New York Information Technology Center, 55 Broad Street, in 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, please visit the program's Website at <http://www.mot-tim.poly.edu>

## ADMISSIONS INFORMATION

Admission to the TIM 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, an ability to benefit professionally from our rigorous two-year executive programs and significant promise of future career advancement. Because of the heavy demands of these programs, it is important that employers also explicitly support such professional education.

In general, GRE and GMAT tests are not required for applying to the MOT or TIM Programs. But the TIM Executive Master's Management Degree Programs office may ask an applicant to submit scores later in the admissions process.

### How to apply

1. Please mail your completed application and application fee to:

Administrative Director, MOT-TIM  
Polytechnic University  
55 Broad Street, Suite 13B  
New York, NY 10004

or please complete the electronic application on our Website:  
<http://www.mot-tim.poly.edu>.

2. Please also arrange to have transcripts for previous college and university work sent directly by the academic institution to the MOT-TIM Master's Degree Program Administrative Director at the above address.

3. Please arrange for two letters of recommendation to be sent to the Executive Master's Degree Program Director. These letters are generally from a supervisor or high-level colleague familiar with your professional work.

4. The final step to admission is a personal interview with one of the program co-directors to discuss career objectives and to make sure your aims fit the goals of the program to which you have applied.

For further information please contact us:  
Tel: 212/547-7030 ext. 207  
Fax: 212/547-7029  
E-mail: [mot-tim@poly.edu](mailto:mot-tim@poly.edu)  
Web: <http://www.mot-tim.poly.edu>

## TELECOMMUNICATIONS AND INFORMATION MANAGEMENT

The courses that constitute this program curriculum are:

### FIRST ACADEMIC YEAR

Initiation and TIM Technology Immersion (no credit weekend, may be waived)

#### First Semester

- MG 609 *Managerial Accounting and Finance for Information Businesses*  
MG 690 *Management Processes and Decision Making for Information Businesses*  
MG 790 *Foundations of Telecommunications and Networking Technologies*

#### Second Semester

- MG 693 *Information Technologies, Systems and Management in Organizations*  
MG 695 *Economics For Business Decisions\**  
MG 780 *Marketing in Information-Intensive Sectors\**  
MG 791 *Principles of Modern Networking*

### SECOND ACADEMIC YEAR

#### Third Semester

- MG 792 *Modern Network Environment Management*  
MG 793 *Global Environment of the Networking, Telecommunications and Information Industries\**  
MG 820 *Project Assessment and Management For Technology Managers*  
MG *Elective Course I\*\* (select one from the list below)*

#### Fourth Semester

- MG 781 *Selected Topics in Networking and Information Technologies*  
MG 782 *Competitive Information Strategy\**  
MG 783 *New Frontiers in Electronic Business\**  
MG 960 *TIM Capstone Project Course\**  
MG *Elective Course II\*\* (select one from the list below)*

#### Elective Course Portfolio

- MG 784 *Negotiation in Technology-Intensive Sectors\*\**  
MG 785 *High-Technology Leadership\*\**  
MG 786 *High-Technology Entrepreneurship\*\**  
MG 787 *Intellectual Property for Technology and Information Managers\*\**  
MG 788 *Modern Supply Chain Management: Integration Through Technology\*\**  
MG 789 *Special Elective Topics for MOT and TIM\*\**  
MG 797 *Financing for Value Creation (Venture Capital, IPOs)\*\**

Note: \* (½ semester course)

\*\* (½ semester courses offered in third or fourth semesters)

## COURSE DESCRIPTIONS

### MG 609 Managerial Accounting and Finance 2½:0:0:3

Principles and practices of the modern finance function including accounting and corporate finance, and their relevance for all information business managers. 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 690 Management Processes and Decision Making for Information Businesses 2½:0:0:3

Introduction to issues and concepts in organizational and administrative behavior with an emphasis on continually changing organizations in the information sectors. Management processes for flexible and innovative information businesses. The evolution of technology-intensive industries and information-business organizations, including structures for electronic businesses. The role of information technology in the growth of the modern firm. Human resource management and organization development in information-intensive firms.

### MG 693 Information Technologies, Systems and Management in Organizations 2½:0:0:3

This course is designed for managers who need to understand the role and potential contribution of information technology (IT) within organizations. The focus of the course 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,

## DEPARTMENT OF MANAGEMENT

emerging issues in IT such as intelligent systems, business process re-engineering, knowledge management and group support systems. The format of the course is interactive with concept presentation followed by open discussion on real-world applications of IT and business cases.

### **MG 695 Economics For Business Decisions**

(half-semester course) *1%:0:0:1%*

Foundations of economic thinking for information business managers. Analysis of supply and demand. Competitive implications of market structure—perfect competition, monopoly, monopolistic competition and oligopoly.

### **MG 780 Marketing in Information-Intensive Sectors**

(half-semester course) *1%:0:0:1%*

Emphasizes the imperative to be customer-focused in the information sectors. 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 781 Selected Topics in Networking and Information Technologies**

*2%:0:0:3*

This course comprises an in-depth exploration of selected modern networking and information technologies. The specific topics studied will vary from year to year. Examples are mobile communications, IP telephony, enterprise data systems, etc. The course builds on previous TIM courses. The course provides a solid technology grounding in a learning context which also emphasizes how these selected technologies affect markets, industries, providers, integrators and user's. The technical content of this course is supplemented with actual case examples and relevant guest speakers.

### **MG 782 Competitive Information Strategy**

(half-semester course) *1%:0:0:1%*

This course deals with applied competitive strategy and draws upon recent experiences associated with the impact of information technology upon diverse industries, ranging from securities trading to consumer-packaged goods retailing. Students completing this course will have mastered 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 will be introduced to the often poorly structured process of evaluating potential systems innovations. They will then be able to participate in strategic planning and systems planning from a managerial point of view.

### **MG 783 New Frontiers in Electronic Business**

(half-semester course) *1%:0:0:1%*

The basic objective of this course is to investigate the management implications of electronic business. Topics include:

- accelerated new product development
- impact of technology on the value chain, the changing role of intermediaries
- electronic commerce business models and strategies for competitive survival and dominance
- business applications involving collaborative communication, computation and teamwork

The course material is designed to be 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 will also 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

are conducted using the case method and a high level of class interaction is expected.

### **MG 784 Negotiation in Technology-Intensive Sectors**

(half-semester course) *1%:0:0:1%*

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 through practice; students in this class develop the art of negotiation by negotiating with each other in realistic cases. A wide variety of negotiation applications is covered in this class, including one-time and repeated negotiation, single and multi-issue negotiations, and two-party and multi-party bargaining. Special emphasis is placed on negotiations in technology-intensive environments. This class is taught using the case method. Many of the examples used in this course will be cases that the students actually negotiate with each other. Students' grades will be based on their performance in these negotiations and on their class participation.

### **MG 785 High-Technology Leadership**

(half-semester course) *1%:0:0:1%*

Focuses on the essential role of multifaceted leadership in diverse high-technology management settings. Discusses different forms of modern high-technology leadership; e.g., the general management leader, the project leader, the technology leader, the visionary leader and the operational team leader. Case studies and actual examples of high-technology leadership are emphasized.

### **MG 786 High-Technology Entrepreneurship**

(half-semester course) *1%:0:0:1%*

Focuses on entrepreneurship as a critical engine for wealth creation in the high-technology, innovation-intensive economy. Deals with such key issues as:

- assessing attractiveness of opportunities
- launching a new venture
- obtaining the necessary financial, human and technology resources



- managing the transition from a small entrepreneurial firm to a large, sustainable professionally managed but still entrepreneurial corporation
- being an entrepreneur and promoting entrepreneurship in a large corporation

**MG 787 Intellectual Property for Technology and Information Managers**

(half-semester course) 1%:0:0:1%

This course focuses on the role of intellectual property (e.g., patents, trade secrets, copyrights, trademarks) as a major element in modern technology and information strategy. Relevant concepts and case studies are used, with examples representing both classical and digital innovations.

**MG 788 Modern Supply Chain Management: Integration Through Technology**

(half-semester course) 1%:0:0:1%

This course provides an introduction to the role of information technology in supply chain management. It builds on some of the concepts covered by the MG 783, *New Frontiers in Electronic Business*. Both qualitative and quantitative aspects of supply chain management are covered. Articles pertaining to leading-edge research and management thought are discussed and analyzed by students. 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 are conducted using the case method, and a high level of class interaction is expected.

**MG 789 Special Elective Topics for MOT and TIM**

(half-semester course) 1%:0:0:1%

Covers selected key emerging trends and issues in the MOT and TIM domains. Discussion with industry leaders and specialists from business, government and academia. Topical treatment of technologies, markets, business practices, government regulations and the relationships among them.

**MG 790 Foundations of Telecommunications and Networking Technologies**

2%:0:0:3

This course introduces basic concepts of telecommunications and networking technologies. It examines on a macro-level how data communications and networking have become integral, vital parts of an organization. It discusses business information requirements and applications of data communications and networking, such as e-mail, Groupware, document sharing and the Internet and World Wide Web. It reviews the following technical concepts and discusses their managerial implications: components of network architecture; data communications hardware; data transmission concepts; data communications models, such as OSI, TCP/IP and IPX/SPX; detailed study of data link layer and network layer; components of Local Area Networks (LANs); and types of LANs. It further reviews the importance of networking standards and standards-making organizations.

**MG 791 Principles of Modern Networking**

2%:0:0:3

This course focuses on advanced concepts and issues in enterprise networking. It reviews technical concepts and managerial implications of: client/server architecture; components of Wide Area Networks (WANs); dedicated and switched circuit services, such as T-1 lines, ISDN, SMDS and DSL; high speed/ broadband/backbone networks; network components, such as hubs, bridges, switches, routers, brouters and gateways; fiber distributed data interface (FDDI); internetworking; IP addressing and routing; wireless/ mobile networks; electronic data interchange (EDI); multimedia networking. It focuses on high-level managerial issues, such as network design and implementation, network management tools, WAN performance and fault management, cost management, network security and regulatory issues. It also introduces other aspects of the networking environment, including software and appliances.

**MG 792 Modern Network Environment Management**

2%:0:0:3

This course explores emerging issues and trends in modern enterprise networking. It examines implications of such developments in the business environment and infrastructural needs of organizations and clusters of organizations. It reviews ramifications of the TCP/IP revolution leading to commercialization of the Internet/World Wide Web. The course discusses the network infrastructure required to implement Intranets/ Extranets, electronic commerce and interorganizational business communication and collaboration generally. It evaluates electronic business and emerging technologies (such as data warehouses, electronic payment systems, corporate digital libraries, multicasting, firewalls and digital signatures). The course also deals with the implications of internetworking, such as digital cities, smart buildings, distance learning, telecommuting and teleconferencing and appliances that are merging.

**MG 793 Global Environment of the Networking, Telecommunications and Information Industries**

(half-semester course) 1%:0:0:1%

Major players and the impacts of the changing environment. Analysis of issues and opportunities arising from technological advances, market responses, privatization of state enterprises, liberalization of markets and global alliances. National and global information infrastructure. De-regulation, in-regulation, privatization, competition and innovation.

## DEPARTMENT OF MANAGEMENT

### **Mg 797 Financing For Value Creation (Venture Capital, IPOs)**

(half-semester course)      1%:0:0:1%

This course explains how the venture capital and private equity industry works and the conditions which determine the specific forms of this type of financing. The course focuses on the "private equity cycle" by considering how private equity funds are raised and structured, and how venture capitalists earn a return on their investments. The case studies explore how investments are evaluated, structured, and overseen, and how venture capital and private equity organizations interface with pension funds, investment managers, entrepreneurs, investment bankers, and distribution managers. While this course is primarily geared to managers of firms presently or prospectively financed by venture capitalists or other private equity investors, it also shows how critical aspects of private equity investing can be transferred to the management of corporate venture capital projects in established organizations. The course will be based primarily on case studies, with presentations by guest speakers from the private equity investment industry.

### **MG 820 Project Assessment and Management For Technology Managers**

2%:0:0:3

Managing technology-based projects ranging from individual research and development to large-scale and complex technological systems. 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. Cost estimation, capital budgeting, cost controls and effective matrix management. Actual case studies are used in this course as are relevant and modern project management software applications.

### **MG 960 TIM Capstone Project Course**

(half-semester course)      1%:0:0:1%

This course provides a capstone, integrative and state-of-the art intellectual experience for participants at the conclusion of the Program. The whole class focuses on a selected major subject that is of broad and compelling managerial concern and that is related in important ways to the innovation, technology-intensive and/or information business arenas. The class will initially be divided into small groups to tackle various aspects of the overall subject. Also, individual participants are expected to submit their own analysis of a specific issue or firm associated with the general subject. Participants are encouraged to employ relevant concepts and insights that they have acquired during the course of the entire program.

# DEPARTMENT OF MATHEMATICS

*Head:* Erwin Lutwak

The Department of Mathematics has the mission of developing innovative curricula and research that bridge mathematics with various engineering disciplines. Current active areas of research include differential geometry, partial differential equations, mathematical finance, mathematical physics and sports science. Additionally, the department offers a complete spectrum of courses in abstract and applied mathematics, granting bachelor's, master's and doctoral degrees in mathematics.

Additional information can be obtained by visiting the departmental office in room 305 in Rogers Hall, by calling 718/260-3850 or by sending an e-mail message to [chair@magnus.poly.edu](mailto:chair@magnus.poly.edu).

## FACULTY

### PROFESSORS

**Keith Ball**, Professor of Mathematics  
PhD, Cambridge University  
*Functional analysis, combinatorics, convexity*

**Burton Lieberman**, Professor of Mathematics  
PhD, New York University  
*Differential equations, stochastic processes, statistics, sports science*

**Erwin Lutwak**, Professor of Mathematics and Department Head  
PhD, Polytechnic Institute of Brooklyn  
*Convexity*

**Edward Y. Miller**, Professor of Mathematics  
PhD, Harvard University  
*Topology*

**Lesley Sibner**, Professor of Mathematics  
PhD, New York University  
*Partial differential equations, global analysis*

**Deane Yang**, Professor of Mathematics  
PhD, Harvard University  
*Differential geometry, nonlinear partial differential equations, overdetermined systems of partial differential equations*

**Yisong Yang**, Professor of Mathematics  
PhD, University of Massachusetts at Amherst  
*Partial differential equations, mathematical physics*

**Erich Zauderer**, Professor of Mathematics  
PhD, New York University  
*Nonlinear wave propagation, partial differential equations, diffraction problems*

### ASSOCIATE PROFESSORS

**Kathryn Kuiken**, Associate Professor of Mathematics  
PhD, Polytechnic Institute of New York  
*Complex analysis, group theory*

**Joel Rogers**, Associate Professor of Mathematics  
PhD, Massachusetts Institute of Technology  
*Partial differential equations, fluid mechanics, numerical methods*

### ASSISTANT PROFESSOR

**Gaoyong Zhang**, Assistant Professor of Mathematics  
PhD, Temple University  
*Geometric tomography, integral geometry and geometric probability*

### 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, Hamilton 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*

### INSTRUCTORS

**Jerome Epstein**, Instructor of Mathematics  
PhD, New York University  
*Mathematical physics*

**Abdelhamid Kadik**, Instructor of Mathematics  
MS, Polytechnic University  
*Medical physics*

**Alan Lash**, Instructor of Mathematics  
BS, Polytechnic University  
*Real analysis*

**Maya Martcheva**, Instructor of Mathematics  
PhD, Purdue University  
*Mathematical biology*

## DEPARTMENT OF MATHEMATICS

**Chandni Shah**, Lecturer of  
Mathematics and Director of Freshman  
Mathematics  
PhD, University of Texas at Austin  
*Commutative rings*

**Hanna Ulman**, Instructor of  
Mathematics  
MA, Tel-Aviv University (Israel)  
*Real analysis*

**Vladimir Umanskiy**, Instructor of  
Mathematics  
PhD, Azerbaijan Institute of  
Mathematics and Mechanics  
*Partial differential equations*

**Lindsey Van Wagenen**, Instructor of  
Mathematics  
PhD, Columbia University  
*Applied physics*

### ADJUNCT FACULTY

**Carmen Vlad**, Adjunct Professor  
PhD, Polytechnic University

**Walter Vohs**, Adjunct Instructor  
MS, New York University

### EMERITUS FACULTY

**George Bachman**

**Emeric Deutsch**

**Aaron Fialkow**

**Heinrich Guggenheimer**

**Leon Herbach**

**Harry Hochstadt**

**Clifford W. Marshall**

**Andrew J. Terzuoli**

**Hermann Waldinger**

**Georges Weill**

# MATHEMATICS PROGRAM

The degree programs in mathematics are administered by the Department of Mathematics, which is located in room 305 in Rogers Hall. More information can be obtained by calling 718/260-3850 or by sending an e-mail message to [chair@magnus.poly.edu](mailto:chair@magnus.poly.edu).

Mathematics is devoted to the solution of problems by the use of symbolic language and formal logical operations. It serves as a foundation for other scientific disciplines and is an indispensable tool for engineering. Today, mathematicians find employment not only in schools and colleges but also in every branch of industry and government.

A complete spectrum of mathematics courses is offered at Polytechnic, ranging from first-year courses to the doctoral level, covering all branches of abstract and applied mathematics, and leading to bachelor's, master's and doctoral degrees. In addition, a sequence of elective courses is available in theoretical and applied statistics which enables students to prepare themselves for careers in statistics or in a field utilizing statistical theories and techniques. The graduate curriculum is more specialized. Courses, thesis work and informal departmental activities are designed to familiarize students with mathematics in general while they become specialists in their particular areas of choice.

## UNDERGRADUATE PROGRAMS

The undergraduate program in mathematics provides both a background for advanced study or subsequent research in abstract or applied mathematics and training for those students who expect to terminate their formal education with a bachelor's degree. In addition, a sequence of elective courses in theoretical and applied statistics prepares students for careers in statistics or in fields utilizing statistical theories and techniques.

For science and engineering majors, mathematics provides the theory and methods essential for comprehension of

the mathematical aspects of their respective fields.

With these objectives, the Department of Mathematics offers courses in abstract and applied mathematics and, for the mathematics major, specific programs leading to the degree of Bachelor of Science.

Students wishing to pursue the bachelor's degree in mathematics may elect to follow either of two courses of study. Students wishing to focus their studies within mathematics itself and in applying mathematics to other fields may elect the program leading to the BS in mathematics. Students wishing to incorporate extensive physics into their mathematical training may elect the program leading to the BS in mathematics and physics. These two programs provide basic grounding in mathematical knowledge. Details of each follow.

### REQUIREMENTS FOR THE BACHELOR OF SCIENCE IN MATHEMATICS

	Credits
MA 106, 107, 108, 109, 153, 154, 201, 202, 217, 223, 224, 260, 358, 385, 386	47
CS 200; PH 107, 108, 109, 118, 119; CM 101, 102, 111, 112	19
HU 101, 110, 200; SS 104	12
Minor Specialties*	18
Humanities/Social Science electives	15
Free electives, with adviser approval	17
	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. The faculty adviser of the department of interest should be consulted. 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 minor concentrations:

- Chemical Engineering
- Chemistry
- Computer Engineering
- Computer Science
- Economics
- Electrical Engineering
- Environmental Science
- Management
- Mechanical Engineering
- Physics
- Psychology
- Statistics
- Technical Writing
- Transportation

**Advanced Placement** - Advanced placement credits may be given for 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

A dual major BS in mathematics and physics is offered at the Polytechnic 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 purpose of the dual major is to offer students the opportunity to gain competence in two different and substantial fields of science to such an extent that, upon earning a bachelor's degree, they are able to qualify for industrial positions in two distinct areas or to go on to graduate studies in either of the two subjects.

## Typical Course of Study for the Bachelor of Science in Mathematics

### FRESHMAN YEAR

#### Fall Semester

Course No.	Subject	Hours/Week				Cr.
		Class	Lab	Rec.		
MA 106	Calculus II	3	0	1		4
CS 200	Intro. to Prog.	3	0	1		3
CM 101	Gen. Chem. I	3	0	0		2
CM 111	Gen. Chem. Lab. I	0	1.5	0		0.5
HU 101	Writing & the Humanities II	3	0	0		3
	Free Elective					3
SL 101	Freshman Sem.	1	0	1		0
						16

#### Spring Semester

Course No.	Subject	Hours/Week				Cr.
		Class	Lab	Rec.		
MA 107	Calculus II <sup>1</sup>	3	0	1		4
PH 107	Mechanics	3	0	1		3
CM 102	Gen. Chem. II	3	0	0		2.5
CM 112	Gen. Chem. Lab. II	0	1.5	0		.5
HU 200	Writing & the Humanities II <sup>1</sup>	3	0	0		3
	Free elective	3				
						16

### SOPHOMORE YEAR

#### Fall Semester

MA 108	Diff. Eqs. & Num. Meth.	3	0	0		3
PH 108	Elec., Magn. & Fluids	3	0	1		3
PH 118	Lab for PH 108	0	1.5	0		1.5
MA 153	Lin. Alg.	3	0	0		3
SS 104	Contemp. World Hist.	3	0	0		3
	Minor Spec.					3
						15.5

#### Spring Semester

MA 109	Multidimensional Calc.	3	0	0		3
HU 110	Prof. Report Writing	3	0	0		3
MA 154	Elem. Abs. Alg.	3	0	0		3
PH 109	Waves, Optics, & Thermo.	3	0	1		3
PH 119	Lab for PH 109	0	1.5	0		0.5
	Minor Spec.					3
						15.5

### JUNIOR YEAR

#### Fall Semester

MA 201	App. Anal. I	3	0	0		3
MA 223	Intro. to Prob.	3	0	0		3
MA 358	Numerical Anal.	3	0	0		3
HS	Hum/SS Elect.2					3
	Minor Spec.					3
	Free Elect.					3
						18

#### Spring Semester

MA 202	App. Anal. II	3	0	0		3
MA 224	Intro. to Math. Stat.	3	0	0		3
MA 260	Vect. Anal. & PDE	3	0	0		3
HS	Hum/SS Elect. <sup>2</sup>	3				
	Minor Spec.					3
						15

### SENIOR YEAR

#### Fall Semester

MA 217	Comp. Var.	3	0	0		3
MA 385	Guided Reading	3	0	0		3
HS	Hum/SS Elect. <sup>2</sup>	3				
	Minor Spec.					3
	Free Elect.					5
						17

#### Spring Semester

MA 386	Guided Reading	3	0	0		3
HS	Hum/SS Elect. <sup>2</sup>					6
	Minor Spec.					3
	Free Elect.					3
						15

**Total credits required for graduation:**

**128**

Consult the "University Degree Requirements" section of the catalog for variations in the mathematics and humanities sequences which may be required based upon placement examination performance.

<sup>1</sup>HU/SS electives must meet the concentration requirements described in the section of this catalog entitled "University Degree Requirements," subsection "Humanities and Social Science Electives for Engineering and Computer Science Majors."

#### Electives

Elective courses are chosen in consultation with the undergraduate adviser.

**MINOR IN MATHEMATICS**

A student may obtain a minor in mathematics by taking 15 mathematics course credits, 12 of which are in addition to the major department's requirement in mathematics. At least 6 of these 12 credits must be taken while in residence at Polytechnic.

<b>GRADUATE PROGRAMS</b>
------------------------------

The Department of Mathematics offers graduate-level mathematics courses in foundations and logic, analysis, geometry and topology, algebra and number theory, applied mathematics, and probability and statistics. 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 degrees in abstract mathematics. Doctoral degrees are offered in abstract mathematics and applied mathematics. Departmental requirements for these degrees are supplemented by certain 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 IN MATHEMATICS**

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. In case of acceptance without these credits, students are asked to take the sequence MA 621-622 at Polytechnic in addition to other requirements listed below for the master's degree.

Thirty-six units are required. Six units may be devoted to a thesis.

MA 600-601	<i>Applied Matrix I, II</i>	6
MA 621-622	<i>Elements of Real Analysis I, II</i>	6
MA 630	<i>Elements of Complex Analysis</i>	3
MA 640	<i>Elem. of Geometry and Topology</i>	3
	<i>Elective courses</i>	12
	<i>Additional electives</i>	6
		36

The thesis option includes an examination of the thesis material by faculty advisers and certification that the work is satisfactory. Students offering only course work must pass comprehensive oral examinations before degrees are awarded. Examinations cover the student's program of study and are scheduled towards the end of the semester in which work is completed.

**REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY IN MATHEMATICS**

Requirements for the doctoral degree are primarily qualitative rather than quantitative. All students' programs must have the approval of the guidance committee.

The number of graduate units of course work usually associated with doctoral programs is 72. These are normally selected to form well-balanced programs in one major and two minor fields. One minor field may be outside the Department of Mathematics, selected from such fields as applied mechanics, electrophysics, circuit theory, physics, industrial engineering and industrial management.

Forty-eight credits of courses, including MA 701, MA 721, MA 722, MA 740, MA 781, and at least 24 thesis credits are required. Only courses with grades of B or better can be used to satisfy the PhD requirements. A PhD candidate must maintain at least a 3.25 average. 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 the dissertation 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 is an oral exam on the student's dissertation.

Students must demonstrate the ability to read mathematical text written in French, German or Russian.

Additional details are contained in brochures which may be obtained from the departmental office.

<b>UNDERGRADUATE COURSES</b>
----------------------------------

**MA 105 Introduction to Calculus**

3:0:0:2

Basic algebraic manipulations, such as working with fractions, factorization, and simplification. Solving polynomial and rational equations and inequalities. Qualitative study of function concepts and graphs. Graphs and behavior of common functions. The trigonometric functions and their graphs. Introduction to the derivative. Applications to physics. Introduction to the integral. Integrals of basic functions.

**MA 106 Calculus I**

3:0:1:4

Qualitative approach to functions and graphs. The concept of derivative and its application to curve sketching, optimization and physics problems. The concept of integration and its application to various fields in mathematics, physics and engineering. *Prerequisite: Placement exam.*

**MA 107 Calculus II**

3:0:1:4

Techniques of integration, numerical approximations of definite integrals and applications of the definite integral. Differential equations, solutions of first- and second-order linear differential equations. Approximations of functions, Taylor series. *Prerequisite: MA 106 or equivalent.*

**MA 108 Differential Equations and Numerical Methods**

3:0:0:3

First-order differential equations. Second-order linear and nonlinear equations. Higher order linear equations. Series solutions of second-order linear equations. Matrices. Systems of first-order differential equations. Numerical algorithms. Numerical solution of ordinary differential equations. Linear algebraic systems. Numerical computation of eigen values. *Prerequisite: MA107 or equivalent.*

## DEPARTMENT OF MATHEMATICS

### MA 109 Multidimensional Calculus 3:0:0:3

Polar coordinates. Parametric equations, vectors and vector-valued functions. Functions of several variables. Partial differentiation. Double and triple integration. Line and surface integrals. Applications. *Prerequisite: MA 107 or equivalent.*

### MA 143 Introduction To Number Theory 3:0:0:3

Properties of integers and prime numbers. Congruences. Theorems of Fermat, Euler and Wilson. Quadratic residues. Diophantine equations. *Prerequisite: MA 107 or equivalent.*

### MA 153+ Elements of Linear Algebra 3:0:0:3

Introduction to vector concept. Linear transformations. Matrices and determinants. Characteristic roots and diagonalization. *Prerequisite: MA 107 or equivalent.*

### MA 154+ Elements of Abstract Algebra 3:0:0:3

Basic properties of groups, rings, fields, Euclidean rings and modules. Field extensions and Galois theory. Finite fields. *Prerequisite: MA 153.*

### MA 201-202 Applied Analysis each 3:0:0:3

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. *MA 201 Prerequisite: MA 108 and MA 109. MA 202 prerequisite: MA 201.*

### MA 217 Complex Variables 3:0:0:3

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.  
*Prerequisite: MA 108 and MA 109.*

### MA 222 Introduction to Probability and Statistics 3:0:0:3

A one-semester course in probability and statistics which treats the basic theory of probability, random variables, expectation and distribution theory. Statistical applications are made to parameter estimation, hypothesis testing, linear regression and analysis of variance. Statistical software support is integrated into the course. *Prerequisite: MA 107 or equivalent.*

### MA 223+ Introduction to Probability 3:0:0:3

Standard first course in probability, recommended for those planning further work in probability or statistics. Probability of events, random variables and expectations, discrete and continuous distributions, joint and conditional distribution, moment generating functions, central limit theorem. *Prerequisite: MA 109.*

### MA 224+ Introduction to Mathematical Statistics 3:0:0:3

Standard first course in mathematical statistics, recommended for those planning to take advanced courses in statistics. Sampling distributions, tests of hypotheses, significance tests, point and interval estimation, regression and analysis of variance. *Prerequisite: MA 223.*

### MA 231+ Statistical Methods I 3:0:0:3

Descriptive statistics computed from data. Means, variances and histograms. Applications of binomial, normal, t and chi square distributions. Point estimation. Statistical tests. Confidence intervals. *Prerequisite: MA 107 or equivalent.*

### MA 232+ Statistical Methods II 3:0:0:3

Analysis of variance with simple experimental designs. Sampling procedures, including sequential analysis. Nonparametric statistical methods. Statistical decisions. *Prerequisite: MA 231 or MA 224.*

### MA 260+ Vector Analysis and Partial Differential Equations 3:0:0:3

Vector algebra and vector calculus. Surface, line and volume integrals. Theorems of Gauss, Green and Stokes. Curvilinear coordinates. Fourier series, Legendre polynomials and Bessel functions. Dirichlet and Neumann problems. Heat flow, wave motion, vibration problems. *Prerequisite: MA 108 and MA 109.*

### MA 341 Discrete Computational Structures I 3:0:0:3

Basic concepts of discrete mathematics. Logic and proof techniques. Sets, relations and functions. Introductory combinatorics. Directed and undirected graphs. Boolean algebra. *Prerequisite: MA 106.*

### MA 342 Discrete Computational Structures II 3:0:0:3

Extends graph theory to network algorithms and covers material from finite state machines, computability and formal languages. Introduces basic concepts of queuing theory. *Prerequisite: MA 341.*

### MA 358+ Introductory Numerical Analysis 3:0:0:3

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. *Prerequisite: MA 108 and some experience in computer programming.*

### MA 385-386 Reading Seminar in Mathematics I, II each 3:0:0:3

Reading, study and investigation of selected topics in mathematics. Problem discussions and presentations by participating students. *Prerequisite: Departmental adviser's permission.*



<b>GRADUATE COURSES</b>
-------------------------

**MA 531-532 Applied Mathematics in Engineering and Science I, II**

each 2%:0:0:3

Vector algebra and vector analysis. Determinants and matrices. Jordan normal forms. Eigen values of symmetric matrices by iteration. Applications to systems of differential equations, matrix exponential, Sturm-Liouville problems. Legendre polynomials and Bessel functions. Applications. Not acceptable for graduate credit in the Department of Mathematics. *MA 531 Prerequisite: MA 108 and MA 109 or equivalent. MA 532 prerequisite: MA 531.*

**MA 600 Elements of Discrete Mathematics**

2%:0:0:3

Mathematical models, mathematical reasoning, primitives of naive set theory, inductive and recursive procedures, functions, relations, orderings, introduction to graph theory, counting and algorithm analysis, introduction to algebraic structures. *Prerequisite: permission of adviser.*

**MA 601-602 Applied Matrix Theory I, II**

each 2%:0:0:3

Systems of linear equations. Matrices and determinants. Vector spaces and linear transformations. In-depth introduction to theory and application of linear operators and matrices in finite-dimensional vector spaces. Eigen values, eigenvectors, diagonalization and symmetric matrices. Invariant subspaces, elementary divisors and canonical forms. Minimax theorems for eigen values of Hermitian pencils. Introduction to numerical methods of linear algebra. *MA 601 Prerequisite: MA 108 and MA 109 or equivalent. Also listed under EL 613. MA 602 prerequisite: MA 601.*

**MA 610 Graph Theory**

2%:0:0:3

Graphs and subgraphs. Connectivity, trees and girth, planarity, embeddings,  $n$ -connectivity and edge-connectivity. Hamilton graphs, matchings, factorization and covering, graphs and groups,

graph isomorphism and reconstruction, colorings, map colorings, Ramsey and extremal graph theory, enumeration, connectedness in digraphs. Euler and Hamilton graphs, tournaments and networks. *Prerequisite: MA 600 or permission of adviser.*

**MA 612 Queuing Theory**

2%:0:0:3

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 600 or permission of adviser.*

**MA 614 Optimization: Linear and Non-linear Programming**

2%:0:0:3

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. Applications, problem formulation and computer solutions. *Prerequisite: MA 600 or permission of adviser.*

**MA 618 Topics in Algebra**

2 1/2:0:0:3

Course content varies. In spring of year prior to course offering, a detailed description is posted and mailed to all graduate mathematics students. *Prerequisite: MA 154, MA 601 and MA 602.*

**MA 621-622 Elements of Real Analysis I, II**

each 2%:0:0:3

Functions, sequences, bounds, limits. Properties of continuous functions. Mean-value theorems, infinite series, power series and Taylor series. Partial differentiation. Extreme value problems with constraints. Implicit functions. Transformations. Line integrals and Green's theorem. Transformation of double integrals. Uniform continuity. Theory of the Riemann integral. Uniform convergence. Improper integrals. *MA 621 Prerequisite: MA 108 and MA 109 or equivalent. MA 622 prerequisite: MA 621.*

**MA 623 Theory of Ordinary Differential Equations**

2%:0:0:3

Ordinary differential equations. Existence and uniqueness theorems. Linear systems. Isolated singularities. Self-adjoint eigenvalue problems. Geometric theory of differential equations in the plane. *Prerequisite: MA 621 and MA 622.*

**MA 624 Theory of Partial Differential Equations**

2%:0:0:3

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. *Prerequisite: MA 621 and MA 622.*

**MA 630 Elements of Complex Analysis**

2%:0:0:3

Analytic functions of a complex variable. Complex numbers, differentiation and integration. Cauchy theorems. Power and Laurent series. Evaluation of integrals by residues. Conformal mappings and Schwarz-Christoffel transformations. *Prerequisite: MA 108 and MA 109 or equivalent (not open to students who have taken MA 217).*

**MA 631 Applications of Complex Analysis**

2%:0:0:3

A brief review of important characteristics of analytic functions. The use of conjugate functions in the solution of two-dimensional potential problems. The study of conformal mappings with emphasis on Schwarz-Christoffel transformations and their applications. *Prerequisite: MA 630.*

**MA 639 Topics in Analysis**

2%:0:0:3

Course content varies. In spring of year prior to course offering, a detailed description is posted and mailed to all graduate mathematics students. *Prerequisite: MA 621 and MA 630.*

## DEPARTMENT OF MATHEMATICS

### **MA 640 Elements of Geometry and Topology** 2%:0:0:3

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. *Prerequisite: MA 108, MA 109 and MA 153 or equivalent.*

### **MA 649 Topics in Geometry and Topology** 2%:0:0:3

Course content varies. In spring of year prior to course offering, a detailed description is posted and mailed to all graduate mathematics students. *Prerequisite: MA 740.*

### **MA 651 Applied Statistics I (Data Analysis)** 2%:0:0:3

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 107 or equivalent.*

### **MA 652 Regression—Analysis of Variance—Time Series Analysis** 2%:0:0:3

Discussion of models and computational schemes associated with correlation, regression coefficients, analysis of variance and time series models. *Prerequisite: MA 224 or MA 651.*

### **MA 658 Calculus of Variations** 2%:0:0:3

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 202 or MA 622.*

### **MA 665 Numerical Analysis** 2%:0:0:3

Interpolation. Approximation of functions by polynomials. Fast Fourier transform. Numerical integration. Solution of

nonlinear equations. Iterative improvement of solutions of linear equations. Eigen values of matrices. Numerical solution of ordinary differential equations. *Prerequisite: MA 108, MA 109 and MA 153 and some experience in computer programming.*

### **MA 666 Numerical Solution of Partial Differential Equations** 2%:0:0:3

Stability, consistency and convergence of finite difference methods for initial value problems. Implicit and explicit schemes. Method of lines. Alternating direction methods. Direct and iterative solutions of elliptic equations. Finite element methods. *Prerequisite: MA 601 and MA 622 and some experience in computer programming.*

### **MA 668 Partial Differential Equations of Mathematical Physics** 2%:0:0:3

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 621 or equivalent.*

### **MA 679 Topics in Applied Mathematics** 2%:0:0:3

Course content varies. In spring of year prior to course offering, a detailed description is posted and mailed to all graduate mathematics students. *Prerequisite: MA 601 and MA 621.*

### **MA 681 Elements of Probability** 2%:0:0:3

Probability of events, distribution of random variables, joint distribution, transformations. *Prerequisite: MA 108, MA 109 and MA 223 or equivalent.*

### **MA 682 Stochastic Processes** 2%:0:0:3

Normal and stationary processes, Wiener processes, Poisson and renewal processes, Markov processes. *Prerequisite: MA 681 or equivalent.*

### **MA 683-684 Statistical Inference I, II** each 2%:0:0:3

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. *MA 683 prerequisite: MA 681 or equivalent. MA 684 prerequisite: MA 683.*

### **MA 685 Multivariate Analysis** 2%:0:0:3

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 684.*

### **MA 686 Regression and Analysis of Variance** 2%:0:0:3

Linear regression of one or more independent variables. Least square estimates of 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 684.*

### **MA 687 Nonparametric Methods in Statistics** 2%:0:0:3

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 681.*

### **MA 691-692 Time Series Analysis I, II** each 2%:0:0:3

Careful study of tractable models for statistical analysis of scalar time series. Models treated: (1) "error plus trend" models, (2) stationary stochastic process models with special emphasis on autore-

gressive models. Estimation, tests of hypotheses and multiple-decision procedures for these models. Spectral representation and filtering, estimation of spectral density. *MA 691 Prerequisite: MA 681 and MA 684. MA 692 prerequisite: MA 691.*

**MA 699 Topics in Probability and Statistics** 2%:0:0:3

Course content varies. In spring of year prior to course offering, a detailed description is posted and mailed to all graduate mathematics students. *Prerequisite: MA 681 and MA 683.*

**MA 701 Abstract Algebra** 2%:0:0:3

Basic algebraic structures, groups, rings, fields, integral domains and modules. Field extensions and Galois theory. *Prerequisite: MA 601 or equivalent.*

**MA 721 Real and Complex Analysis I** 2%:0:0:3

Cardinal numbers, topology of  $n$ -dimensional Euclidean space, introduction to measure theory, Lebesgue integration theory, measurable functions, functions of bounded variation, absolutely continuous functions, differentiation and convergence theorems. Radon-Nikodym theorems, Lusin's theorem, product measure, Fubini theorems. *Prerequisite: MA 621 and MA 622 or equivalent.*

**MA 722 Real and Complex Analysis II** 2%:0:0:3

Rigorous development of theory of functions of a complex variable. Complex number systems, differentiation and integration, analytic and meromorphic functions, residue theory, introduction to Riemann surfaces, conformal mappings, Blaschke products, Picard theorems. *Prerequisite: MA 721.*

**MA 731-732 Functional Analysis I, II**  
each 2%:0:0:3

Hilbert spaces, Banach spaces, Banach algebras, linear operators, spectral theory, perturbation theory, completely continuous operators. Gelfand theory. Applications to classical analysis. *MA 731 Prerequisite: MA 601 and MA 721. MA 732 prerequisite: MA 731.*

**MA 740 Topology** 2%:0:0:3

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. *Prerequisite: MA 621 and MA 622 or equivalent.*

**MA 750 Manifolds and Lie Groups** 2%:0:0:3

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. *Prerequisite: MA 621 and MA 622.*

**MA 754 Topological Methods in Analysis** 2%:0:0:3

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 202 or MA 622.*

**MA 781 Probability** 2%:0:0:3

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 721.*

**MA 783-784 Stochastic Processes I, II**  
each 2%:0:0:3

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. *MA 783 prerequisite: MA 781. MA 784 prerequisite: MA 783.*

**MA 808 Advanced Topics in Discrete Mathematics** 2%:0:0:3

Course content varies. In spring of year prior to course offering, a detailed description is posted and mailed to all graduate mathematics students. *Prerequisite: MA 701.*

**MA 818 Advanced Topics in Algebra** 2%:0:0:3

Course content varies. In spring of year prior to course offering, a detailed description is posted and mailed to all graduate mathematics students. *Prerequisite: MA 701.*

**MA 828 Advanced Topics in Real and Complex Analysis** 2%:0:0:3

Course content varies. In spring of year prior to course offering, a detailed description is posted and mailed to all graduate mathematics students. *Prerequisite: MA 721 and MA 722.*

**MA 838 Advanced Topics in Differential Equations** 2%:0:0:3

Course content varies. In spring of year prior to course offering, a detailed description is posted and mailed to all graduate mathematics students. *Prerequisite: MA 623, MA 624, MA 721 and MA 722.*

**MA 846 Fourier and Laplace Transforms** 2%:0:0:3

Application of transform methods to partial differential equations of mathematical physics. Includes introduction to the Wiener-Hopf technique. *Prerequisite: MA 630.*

**MA 848 Advanced Topics in Topology** 2%:0:0:3

Course content varies. In spring of year prior to course offering, a detailed description is posted and mailed to all graduate mathematics students. *Prerequisite: MA 740 and MA 750.*

**MA 858 Advanced Topics in Differential Geometry** 2%:0:0:3

Course content varies. In spring of year prior to course offering, a detailed description is posted and mailed to all graduate mathematics students. *Prerequisite: MA 740 and MA 750.*

## DEPARTMENT OF MATHEMATICS

### **MA 868 Advanced Topics in Applied Mathematics** 2½:0:0:3

Asymptotic expansions of definite integrals and of solutions to differential equations. Perturbation theory. Variational methods. Nonlinear vibrations. Distributions and spectral representation of linear operators. Relaxation methods. Boundary value problems. *Prerequisite: MA 601 and MA 630.*

### **MA 888 Advanced Topics in Probability** 2½:0:0:3

Course content varies. In spring of year prior to course offering, a detailed description is posted and mailed to all graduate mathematics students. *Prerequisite: MA 782.*

### **MA 898 Advanced Topics in Statistics** 2½:0:0:3

Course content varies. In spring of year prior to course offering, a detailed description is posted and mailed to all graduate mathematics students. *Prerequisite: MA 684.*

### **MA 941-944 Reading in Mathematics I-IV** each 2½:0:0:3

Courses intended primarily for students who have completed two years of full-time graduate study and who wish to do research in a specialized area. Reading done under guidance of faculty members and devoted mainly to scholarly papers. *Prerequisite: permission of department.*

### **MA 958-959 Selected Topics in Advanced Mathematics I, II** each 2½:0:0:3

Review of current mathematics research. Specific topics vary, depending on instructor. *Prerequisite: permission of department.*

### **MA 997 Thesis for Master of Science Degree** each 3 units

Thesis to present results of independent investigation of suitable problem in abstract or applied mathematics. Study must include adequate investigation of existing literature relating to subject. Regular reports on progress of work and regular conferences with assigned faculty adviser required. Reregistration fee, any part: 3-unit charge. *Prerequisite: degree status.*

### **MA 999 Dissertation for Doctor of Philosophy Degree** each 3 units

Results of independent investigation of some problem in mathematics. The student must demonstrate the ability to do creative work and include original research of a caliber deemed worthy of publication in recognized scientific journals. Oral examination on the dissertation subject and related topics is required. A minimum of 24 dissertation units is required for the degree. Reregistration fee, any part: 3-unit charge. *Prerequisite: degree status and qualifying examination.*

### **ST 999 Dissertation for Doctor of Philosophy Degree (Statistics)** each 3 units

Results of independent investigation of some area of statistics. The student must demonstrate the ability to do creative work and include original research of the caliber deemed worthy of publication in recognized scientific journals. An oral examination on the dissertation subject and related topics is required. Reregistration fee, any part: 3-unit charge. *Prerequisite: degree status and qualifying examination.*

† Students in other departments should note that there are certain undergraduate courses in mathematics that may be accepted for graduate credit in their departments. Such courses are identified by a † following the course number (e.g., MA 223).

# DEPARTMENT OF MECHANICAL, AEROSPACE AND MANUFACTURING ENGINEERING

*Head:* Sunil Kumar

Mechanical, aerospace and manufacturing engineers design and build the modern products and devise the processes that society needs. The wide range of dynamic and continually evolving areas where such engineers are the prime movers include bioengineering, energy systems, aircraft, aerospace, environmental engineering, controls for mechanical systems, mechanical-electrical devices, automobiles, materials engineering, automated manufacturing, structural engineering, robotic systems, fluidic systems and devices, production planning and control, combustion processes and systems, and others too numerous to list. The diversity and multidimensionality of this modern engineering profession that designs and manufactures complex modern products requires a sophisticated educational background that spans fundamental understanding of the underlying science, the design methodology, manufacturing processes, methods and techniques, material properties, and economic and industrial implications. The department offers a comprehensive array of programs and courses that address each facet of this exciting profession. These are discussed in the following paragraph and in the individual sections related to the mechanical, aerospace, industrial, manufacturing engineering and materials science programs.

The Department of Mechanical, Aerospace and Manufacturing Engineering offers undergraduate programs leading to the BS in mechanical engineering and a BS in mechanical engineering with a concentration in aerospace engineering; graduate programs leading to the MS in mechanical engineering (with concentrations in thermal/fluids, mechanical analysis/design, and systems/controls/robotics), in aerospace engineering, in industrial engineering, in materials science and in manufacturing engineering; and the PhD in mechanical engineering with concentrations in thermal/fluids, mechanical analysis/

design, systems/controls/robotics, materials science, and aerospace. The undergraduate degrees are ABET (Accreditation Board for Engineering and Technology) accredited and the doctoral degree is approved by the New York State Doctoral Program Review.

## ***Mechanical Engineering Program***

The objective of the undergraduate mechanical engineering program is to provide a balanced education that will be the basis for continuing professional development, either in engineering practice or in further studies. Students are encouraged to understand that education must be continually renewed and that learning is a life-long process. At the same time, it is the goal of the program to provide the students with skills suited to the modern job market and to prepare them for the changing needs of the society and industry.

The mechanical engineering curriculum achieves balance between principle and practice. Computer and laboratory experiences are an integral part of the curriculum, as is the emphasis on engineering design both the systematic process of design, as well as the creative content. Three aspects of design are addressed through the course content of many different engineering courses. These 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 includes both the creative element and project work, at least when the problem does not have a unique solution. The second includes instruction on the systematic process, as represented by concurrent engineering, quality management and the product realization process, as well as other concepts that set the framework for modern design. The third includes design tools, such as CAD and finite element analysis, as well as the underlying engineering theory for designing and analyzing components and systems.

The integrated design exposure and

experience in the curriculum is described as follows: In the freshman year, the students in Introduction to Engineering (EG 101) learn how things are built and why; they explore devices and address why products are designed as they are. In Introduction to Design (EG 102) a series of lectures on the design concept, the process of design, the tools of design and design considerations are presented, along with discussions of ethics in engineering, introduction to computer-aided drafting tools and projects done by teams. The CAD (ME 101) course in the sophomore year further develops proficiency in computer-aided drawing and has many design projects. Mechanical Properties of Materials (MT 305) examines the impact of material properties on design. In the junior year, Instrumentation (ME 321) and Instrumentation Lab (ME 324) conduct design projects. The design of power and refrigeration cycles is introduced in Thermodynamics I (ME 201). The design of piping networks and systems is performed in Fluids I (ME 231) along with a design project, and Synthesis of Mechanical Systems (ME 301) considers the design of mechanical systems. In the senior year, the Design of Machine Elements (ME 302) course introduces the design methodology for designing and analyzing machine elements and the Finite Elements Analysis (ME 341) course develops computer-based skills for analyzing and designing components and systems.

The technical electives available to juniors and seniors also contain significant design experience. The Design of Energy Systems (ME 204) course teaches skills necessary to design fluid-thermal systems, such as heat exchangers and pumps. Heating Ventilating and Air Conditioning (ME 212) teaches design of HVAC systems. Internal Combustion Engines (ME 243) addresses engines, and Product Design (MN 303) offers the methodology of design via concurrent engineering and other modern concepts.

The design experience culminates with the capstone Senior Design Project

sequence (ME 361-362), during which students, working in teams of two or three, design, fabricate and test projects and systems. In addition to the systematic and creative processes of design, engineering consideration of safety, ethics, economy, project planning and budgeting, quality and presentation are all included in the capstone design experience.

## PROGRAMS

### Bachelor of Science

- Mechanical Engineering
- Mechanical Engineering with Aerospace Concentration

### Master of Science

- Mechanical Engineering (Concentrations in Thermal/Fluids, Mechanical Analysis/Design, Systems/Controls/Robotics)
- Aerospace Engineering
- Industrial Engineering
- Manufacturing Engineering
- Materials Science

### Doctor of Philosophy

- Mechanical Engineering (Concentrations in Thermal/Fluids, Mechanical Analysis/Design, Systems/Controls/Robotics, Aerospace, Materials Science)

## FACULTY

### PROFESSORS

**Jerome M. Klosner**, PE, Professor of Mechanical and Aerospace Engineering  
PhD, Polytechnic Institute of Brooklyn  
*Structural dynamics, fluid-structure interaction, thermal stress analysis*

**William R. McShane**, Professor of Mechanical and Systems Engineering and Dean of Engineering and Applied Sciences  
PhD, Polytechnic Institute of Brooklyn  
*Quality control, controls and simulation, engineering economics*

**Said Nourbakhsh**, Professor of Materials Science  
PhD, Leeds University (England)  
*Phase transformation, electron microscopy, mechanical behavior, composite materials, smart materials, ferroelectric thin films*

**William P. Vafakos**, PE, Professor of Mechanical Engineering  
PhD, Polytechnic Institute of Brooklyn; JD, Brooklyn Law School  
*Solid mechanics, structures, vibrations*

**Sung H. Whang**, Professor of Materials Science  
DEngSc, Columbia University  
*Deformation and microstructure in titanium alloys and ordered intermetallic materials, alloy stability, dislocation structures, rapid solidification processing, processing for both metallic and ceramic superconducting materials*

### ASSOCIATE PROFESSORS

**Iraj M. Kalkhoran**, Associate Professor of Aerospace Engineering  
PhD, University of Texas at Arlington  
*Gas dynamics, high speed flows, wind tunnel testing, shock tubes*

**Sunil Kumar**, Associate Professor of Mechanical Engineering and Department Head  
PhD, University of California at Berkeley  
*Thermal fluid sciences, applied mathematics*

**M. Volkan Otugen**, Associate Professor of Mechanical Engineering  
PhD, Drexel University  
*Experimental and theoretical fluid mechanics, unsteady and turbulent flows, optical diagnostics, combustion aerodynamics.*

**Richard S. Thorsen**, Associate Professor of Mechanical Engineering and Vice President, Development and University Relations  
PhD, New York University  
*Heat transfer, nuclear reactor safety, solar energy.*

**Anthony P. Tzes**, Associate Professor of Mechanical Engineering  
PhD, Ohio State University  
*Robotics, adaptive control, computer integrated manufacturing, artificial intelligence, neural networks*

**George C. Vradis**, Associate Professor of Mechanical Engineering  
PhD, Polytechnic University  
*Computational fluid dynamics and heat transfer, non-Newtonian flows, flow measurement, combustion, energy systems*

### ASSISTANT PROFESSOR

**Vikram Kapila**, Assistant Professor of Aerospace Engineering  
PhD, Georgia Institute of Technology  
*Robust control, periodic and multi-rate control, fixed architecture control, delay systems and rate saturation control*

### INDUSTRY FACULTY

**Charles Bartlett**, Industry Professor and Director of Manufacturing Program  
PhD, Massachusetts Institute of Technology  
*Electronic systems design and manufacture, production science, manufacturing systems engineering*

**James Bentson**, Industry Professor of Mechanical and Aerospace Engineering  
PhD, Polytechnic Institute of Brooklyn  
*Computational methods, electrophysics, simulation, vehicle dynamics*

**Charles W. Hoover Jr.**, Distinguished Industry Professor of Manufacturing Engineering  
PhD, Yale University  
*Physical design, manufacturing processes, electronic device assembly*

**Nathan Levine**, Industry Professor of Mechanical Engineering  
PhD, University of Illinois  
*Quality control and improvement, quality engineering using robust design*

#### ADJUNCT FACULTY

**Robert Atkash**  
PhD, Columbia University  
*Numerical analysis, finite elements, plasticity*

**Steven Bernstein**  
MS, University of Michigan  
*Physical design*

**Joseph Boroweic**  
PhD, Polytechnic University  
*Finite elements, numerical methods*

**Charles M. Chodash**  
MS, Northeastern University  
*Production planning and control, facilities planning and design, design strategies*

**David Fleck**  
MAABS, Leadership Institute of Seattle  
*Building high performance teams*

**David Friedman**  
PhD, Georgia Institute of Technology  
*Manufacturing*

**Martin Goldberg**  
PhD, Rensselaer Polytechnic Institute  
*Structural mechanics*

**Michael Greenstein**  
MBA, University of Louisville  
*Design for manufacturability*

**Jai Menon**  
PhD, Cornell University  
*Geometric modelling, CAD/CAM, computer graphics, virtual reality*

**Cal Oltrogge**  
PhD, New York University  
*Change management, work design, personnel research, retraining and resource balancing.*

**Subramani Rajaram**  
PhD, State University of New York at Buffalo  
*Heat transfer and thermal design*

**Reuven Shapira**  
MS, University of Tel-Aviv (Israel)  
*Production planning and control, ISO9000, quality driven process management*

**David Soukup**  
MS, University of Tennessee  
*Factory simulation, project planning and control*

**Arthur Szeglin**  
PhD, Hofstra University  
*Design*

**John Thomas**  
MBA, University of Rochester  
*Production control and manufacturing resources planning*

**Blair R. Williams**  
MBS, University of Chicago  
*Computer integrated manufacturing*

#### EMERITUS FACULTY

**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

**Martin H. Bloom**, Institute Professor  
PhD, 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

**George J. Fischer**, Professor Emeritus  
MMetE, Polytechnic Institute of Brooklyn

**Joseph Kempner**, PE, Professor Emeritus  
PhD, Polytechnic Institute of Brooklyn

**Harold Margolin**, Professor Emeritus  
DEngSc, Yale University

**Morris Morduchow**, Professor Emeritus  
DAcE, Polytechnic Institute of Brooklyn

**Gino Moretti**, Professor Emeritus  
PhD, University of Turin (Italy)

**Wheeler K. Mueller Jr.**, Professor Emeritus  
PhD, University of Illinois

**Sebastian V. Nardo**, Professor Emeritus  
PhD, Polytechnic Institute of Brooklyn

**Huo-Hsi Pan**, Professor Emeritus  
PhD, University of California at Berkeley

**Sharad A. Patel**, Professor Emeritus  
PhD, Polytechnic Institute of Brooklyn

**Bernard W. Shaffer**, PE, Professor Emeritus  
PhD, Brown University

# AEROSPACE ENGINEERING PROGRAM

*Director:* Iraj M. Kalkhoran

Among the programs offered by the Department of Mechanical, Aerospace and Manufacturing Engineering are the undergraduate program leading to a Bachelor of Science in mechanical engineering with a concentration in aerospace engineering and the graduate program leading to the Master of Science in aerospace. The department also offers a Doctor of Philosophy in mechanical engineering with an option in aerospace engineering. The undergraduate program is offered at the Brooklyn campus. Students pursuing the graduate degrees are expected to take their required courses at both the Brooklyn and Long Island campuses.

## THE AEROSPACE ENGINEERING PROFESSION

Aerospace engineering is the art and science associated with the design and performance of aircrafts, missiles and spacecrafts. The scientific aspects of space vehicle design are rooted in the broad areas of the flow of liquids and gases, strength and stability of extremely lightweight structures, propulsion, guidance and control, materials, environmental conditions, thermodynamics and heat transfer.

From the standpoint of complexity, scope of engineering and scientific problems, and audacity of the mission, vehicles currently being designed or projected for the future stagger the imagination. Until recently, long range missiles, moon vehicles, deep space probes and space habitats had been confined to the realm of science fiction. To meet the challenges of the design of these vehicles, aerospace engineering training is based on scientific principles that provide the engineer with the greatest possible potential and flexibility. Conflicting requirements imposed by considerations of safety, reliability, cost, maintenance,

production and handling often demand compromises based upon the engineer's skill and experience in order to attain an optimum design. It is the responsibility of the aerospace engineer to resolve such issues.

## UNDERGRADUATE PROGRAM

The undergraduate aerospace engineering program not only affords students an understanding of basic scientific principles but trains them in the applications of such principles to the challenges of their profession. The sophistication of aerospace systems is such that students must necessarily master some of the more powerful analytic techniques to evolve efficient designs. The training is broad, so that graduating students can apply their knowledge to such diverse problem areas as air and noise pollution, land and sea vehicles, oceanography and biomechanics, in addition to air and space vehicles.

During the first two years of study, the foundation for future professional subjects is established by courses in each of the basic sciences: physics, chemistry and mathematics. The student begins training in a number of engineering science areas such as computers, design elements, mechanics, material science and strength of materials. In addition, the principles and concepts in fundamental and basic sciences are also taught during the first two years.

In the junior and senior years, professional courses include fluid mechanics, solid mechanics, stability and control, flight mechanics, aerodynamics and propulsion.

The undergraduate program leads to the degree of bachelor of science in mechanical engineering with a concentration in aerospace engineering and is accredited by the Accreditation Board for Engineering and Technology (ABET). For additional information, see the mechanical engineering description.

## GRADUATE PROGRAM

Programs of study are offered leading to the degrees of Master of Science in aerospace and doctor of philosophy in mechanical engineering with an option in aerospace. Bachelor's degrees in aerospace or mechanical engineering are generally required. Applicants with degrees in other fields may be admitted with deficiencies.

To obtain any graduate degree or certificate, a student must have a 3.0 grade point average or better in all graduate courses taken (whether or not some of these courses are being used to satisfy specific degree requirements) and a B or better average in all guided studies (readings, project, thesis and dissertation). Additionally, students must establish an overall B average in those departmental courses submitted in partial fulfillment of degree requirements. All courses submitted for degrees must have been completed within the time periods given in the University catalog.



## Typical Program of Study for the Bachelor of Science in Mechanical Engineering with Aerospace Concentration

### FRESHMAN YEAR

#### Fall Semester

Course No.	Subject	Hours/Week			
		Class	Lab	Rec.	Cr.
EG 101	Intro. to Eng.	2	3	0	3.0
MA 106	Calculus I	3	0	2	4.0
CM 101	Gen. Chem. I	3	0	0	2.5
CM 111	Chem. Lab. I	0	0.5	0	0.5
CS 200	Prog. Meth.	3	0	1	3.0
HU 101/103	Writ. & Hum. I	3	0	0	3.0
SL 101	Fresh. Sem.	1	1	0	0.0
<b>TOTAL</b>					<b>16.0</b>

#### Spring Semester

Course No.	Subject	Hours/Week			
		Class	Lab	Rec.	Cr.
EG 102	Intro. to Eng. Des.	2	3	0	3.0
MA 107	Calculus II	3	0	2	4.0
CM 102	Gen. Chem. II	3	0	0	2.5
CM 112	Chem. Lab. II	0	1.5	0	0.5
PH 107	Mechanics	4	0	0	3.0
HU 200	Writ. & Hum. II	3	0	0	3.0
<b>TOTAL</b>					<b>16.0</b>

### SOPHOMORE YEAR

#### Fall Semester

MA 108	Des. & Num. Meth.	3	0	0	3.0
PH 108	Elec. & Fluids	4	0	0	3.0
PH 118	Physics Lab. I	0	1.5	0	0.5
SS 104	History	3	0	0	3.0
ME 111	Statics	3	0	0	3.0
MT 305	Mech. Prop. Mat.	3	0	0	3.0
ME 101	Eng. Graphics	1	3	0	2.0
<b>TOTAL</b>					<b>17.5</b>

#### Spring Semester

MA 109	Multidim. Calc.	3	0	0	3.0
PH 109	Waves, Therm.	4	0	0	3.0
PH 119	Physics Lab. II	0	1.5	0	0.5
ME 112	Dynamics	3	0	0	3.0
ME 121	Mech. Materials	3	0	0	3.0
TC 110	Prof. Rpt. Writ.	3	0	0	3.0
<b>TOTAL</b>					<b>15.5</b>

### JUNIOR YEAR

#### Fall Semester

MA 222	Intro. Prob. & Stat.	3	0	0	3.0
ME 201	Thermodynamics	3	0	0	3.0
ME 321	Instrum.	3	0	0	3.0
AE 231	Fluid Mechanics	3	0	0	3.0
HU/SS	Elective	3	0	0	3.0
<b>TOTAL</b>					<b>15.0</b>

#### Spring Semester

ME 301	Synth. Mech. Syst.	3	0	0	3.0
ME 324	Instr. Lah	0.5	1.5	0	1.0
ME 351	Fluid Mechanics Lab	0.5	1.5	0	1.0
ME	ME Core Elective	3	0	0	3.0
ME	ME Core Elective	3	0	0	3.0
AE 232	Compressible Flow	3	0	0	3.0
HU/SS	Elective	3	0	0	3.0
<b>TOTAL</b>					<b>17.0</b>

### SENIOR YEAR

#### Fall Semester

ME 302	Des. Mach. Elem.	3	0	0	3.0
ME 361	Senior Des. Proj. I	0	6	0	2.0
ME	Lab I	0.5	1.5	0	1.0
AE 311	Aircraft Performance	3	0	0	3.0
ME 341	Finite Element	3	3	0	4.0
HU/SS	Elective	3	0	0	3.0
<b>TOTAL</b>					<b>16.0</b>

#### Spring Semester

ME 362	Senior Des. Proj. I	0	6	0	2.0
ME	Lab II	0.5	1.5	0	1.0
AE 241	Propulsion	3	0	0	3.0
AE 312	Stability and Control	3	0	0	3.0
AE 235	Aerodynamics	3	0	3.0	
HU/SS	Elective	3	0	0	3.0
<b>TOTAL</b>					<b>15.0</b>

**Total credits required for graduation: 128**

**Notes:** ME Core requires that students select two out of the following three courses and take the corresponding laboratories in the senior year.

ME 271	Stress Analysis	(Lab: ME 273 Stress Lab)
ME 203	Heat Transfer	(Lab: ME 352 Heat Transfer Lab)
ME 322	Automated Controls	(Lab: ME 325 Control Lab)

The third course of the above (with or without the corresponding lab) may be taken as an elective.

**REQUIREMENTS FOR THE MASTER OF SCIENCE**

ME 600	Applied Computational Methods	3
ME 604	Transport Phenomena	3
ME 621	Stress Analysis I	3
ME 660	Feedback Control	3
AE Electives	At least 3 AE courses	9
Tech Electives	At least 2 AE/ME/IE/MN Courses	6
Free Electives		9
		36

**Note:** All electives may include AE project or thesis credits.

In the above master's degree program students may pursue a project (up to 6 units counted toward the degree) or a thesis (up to 12 units counted toward the degree) under the guidance of a faculty sponsor or may elect to complete the program solely with courses. At least 9 elective credits must be approved ME/AE/IE/MN courses or project or thesis credits. The remaining 9 elective credits may be any graduate-level course but must be approved by the graduate adviser and should be consistent with a definable objective associated with the master's program. Students pursuing the MS in aerospace are expected to take their required courses at both the Brooklyn and Long Island campuses. Students may take out-of-department elective courses at either the Brooklyn or the Long Island campus (subject to approval by the graduate adviser).

The department limits to 9 the total of transfer, reading (guided studies) and validation credits which can be applied toward master's degrees. The certification of validation credits is administered by the departmental graduate advisers. Issues related to transfer credits and electives are the same as in the Mechanical Engineering Program.

**REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY**

The Department of Mechanical, Aerospace and Manufacturing Engineering offers this degree as an option (aerospace) within the Doctor of Philosophy in mechanical engineering. Refer to the requirements for the Doctor of Philosophy degree in mechanical engineering.

**UNDERGRADUATE COURSES**

**AE 231 Fluid Mechanics 3:0:0:3**

Fluids, kinematics, hydrostatics. Derivations of continuity, momentum and energy equations. Flux concepts and relation to divergence theorem. Control volume equations and applications. Bernoulli equation. Discussion of vorticity and stream function. Potential flows over simple geometric configurations. Flows in pipe networks and ducts, heat losses, friction factors. *Prerequisite: MA 109 and ME 112. Also listed under ME 231.*

**AE 232 Compressible Flow 3:0:0:3**

Compressible flow. Integral and differential forms of conservation equations for inviscid compressible flows. One-dimensional compressible flow, normal shocks, Fanno and Rayleigh flows. Oblique shock and expansion waves. Laval nozzle flow. *Prerequisite: AE 231 and ME 201. Also listed under ME 232.*

**AE 233 Viscous Flow 3:0:0:3**

Introduction to viscous flow theory. Viscous effects. Stress-strain relations, Reynolds transport theorem. Derivation of Navier-Stokes equations. Rayleigh problem and diffusion time. Similarity theory. Prandtl boundary layer equations, flow over a flat plate. Compressibility and turbulence effects. Approximate methods, numerical methods. Separated flows. *Prerequisite: AE 231.*

**AE 235 Aerodynamics 3:0:0:3**

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, high-lift devices. *Prerequisite: AE 232.*

**AE 241 Propulsion 3:0:0:3**

Operation, performance and design methods for flight vehicle propulsion systems. Airbreathing engines: turbojet, turboprop, turbofan, ramjet and their components. Elements of rocket propulsion systems. *Prerequisite: AE 232.*

**AE 242 Rocket Propulsion 3:0:0:3**

Development and design of rocket engines. Basic principles of mechanics, thermodynamics, aerodynamics and combustion reviewed. Propellants, rocket engine elements (solid and liquid), heat transfer, cooling accessories. Heat transfer fundamentals. *Prerequisite: AE 232.*

**AE 251 Space Dynamics 3:0:0:3**

Motion of a particle, systems of particles, rigid bodies. Momentum and energy principles and applications. Impulsive forces and moments. Projectiles with air resistance, trajectories and orbits, gyroscopic theory. *Prerequisite: ME 112 and MA 108.*

**AE 271 Stress Analysis 3:0:0:3**

Stress, equilibrium equations, strains, compatibility conditions, stress strain relations, superposition, strain energy. Bending of beams: unsymmetric bending of arbitrary section beams, bending stresses, deflections, shear stresses on thin-walled section beams, shear center. *Prerequisite: MA 108 and ME 121. Also listed under ME 271.*

**AE 272 Advanced Stress Analysis 3:0:0:3**

Torsion of thin-walled open and closed section beams. Membrane and hydrodynamic analogies. Bredt's formula, multi-celled cross sections. Strain energy, Castigliano's theorems. Statically indeterminate beams, frames, rings. *Prerequisite: AE 271. Also listed under ME 272.*

**AE 311 Aircraft Performance 3:0:0:3**

Principles of powered flight. Development of equations of motion. Level flight performance of turbojet and propeller driven aircraft, climbing flight, ceiling, take-off and landing. Steady turning flight. *Prerequisite: ME 112.*

**AE 312 Stability and Control** 3:0:0:3

Static and dynamic stability and control of aircraft and missiles. Development of rigid body equations of motion, linearization of equations of motion of airplanes. *Prerequisite: AE 311.*

**AE 341 Introduction to Aerodesign** 1:3:0:2

Consideration of the nature of design synthesis and analysis as it pertains to aerospace vehicles. Qualitative and quantitative aspects of feasibility, design methodology and modeling.

**AE 342 Aircraft Design** 2:3:0:3

Preliminary design of commercial jet transport. Development of aerodynamic configuration, power plant selection, fuselage layout, wing design, weight and balance estimation, drag estimation, and performance, analysis of final design. *Prerequisite: AE 311.*

**AE 344 Spacecraft Design** 2:3:0:3

Design of hypervelocity vehicles. Trajectory and orbit analyses, problems of re-entry, propulsion system design, staging. Design of a boost vehicle for satellite missions and a re-entry vehicle for earth return. *Prerequisite: AE 251.*

**AE 349 Fluids Laboratory I** 0:3:0:1

Laboratory experiments in the area of incompressible inviscid and viscous flows. Measurement techniques, conservation laws, boundary layers, aerodynamics. *Prerequisite: AE 231.*

**AE 350 Fluids Laboratory II** 0:3:0:1

Laboratory experiments in the area of inviscid and viscous flows. Measurement Techniques: hot wire and laser Doppler anemometry. Supersonic flows, shock tube. *Prerequisite: AE 232 and AE 349.*

**AE 381-382 Senior Hours Work in Aerospace Engineering I, II**  
*credit to be arranged*

Independent project undertaken by qualified honors students in aerospace engineering resulting in a written report. Credit may be awarded toward technical elective requirement. *Adviser*

*approval required. Consultation with adviser well in advance of registration is recommended.*

**AE 391-392 Guided Studies in Aerospace Engineering I, II**  
*credit to be arranged*

Guided readings in specific subject areas for qualified students in aerospace engineering. *Adviser approval required.*

**GRADUATE COURSES**

**AE 651 Advanced Dynamics I** 2½:0:0:3

Kinematics and dynamics of a particle in space; translating and rotating frames of reference. Systems of particles; plane motion of rigid bodies. Two-body central force problem. LaGrange equations with holonomic and nonholonomic constraints; applications. *Prerequisite: AE adviser's approval. Also listed under ME 651.*

**AE 652 Advanced Dynamics II** 2½:0:0:3

General motions of rigid bodies, Euler's equations, gyroscopic motions and stability, impulsive motions, linear oscillations of two-degree and n-degree-of-freedom systems, matrix formulations, applications, variational principles. *Prerequisite: AE 651. Also listed under ME 652.*

**AE 732 Computational Methods in Thermal and Fluid Mechanics** 2½:0:0:3

Numerical analyses. Finite difference approximations, error and stability analyses, numerical dispersion and damping, matrix inversion methods. Implicit and explicit procedures, SOR, ADI, hopscotch and direct solvers for evaluating linear and nonlinear diffusion and convection problems. *Prerequisite: AE adviser's approval. Also listed under ME 715.*

**AE 740 Principles of Fluid Dynamics** 2½:0:0:3

Conservation laws of mass momentum and energy. Elements of potential theory. Applications of inviscid flow to simple internal and external geometries; differential approach to fluid dynamic problems; thin airfoil theory. *Prerequisite: AE adviser's approval.*

**AE 741 Compressible Flow** 2½:0:0:3

Subsonic, transonic and supersonic flows over two dimensional and axisymmetric bodies. Shock wave development in both one-dimensional unsteady and two-dimensional steady flow systems. Internal and external flows are considered. *Prerequisite: AE adviser's approval. Also listed under ME 713.*

**AE 742 Viscous Flow** 2½:0:0:3

Molecular and macroscopic transport, concepts of stress and strain, and derivation of the Navier-Stokes equations. Applications to problems of diffusion, boundary layers and slow motion. Analytic and numerical methods are presented. *Prerequisite: AE adviser's approval. Also listed under ME 711*

**AE 743 Turbulent Flow** 2½:0:0:3

General theories of turbulence, Reynolds transport theorem, turbulent heat and mass transfer, instability, transition, statistical approach to turbulence, mathematical modeling, experimental methods, analysis of turbulent external flows; jets, wakes, mixing layers, turbulence in boundary flows. *Prerequisite: AE 742. Also listed under ME 712.*

**AE 746 Fluid Dynamics of Rotating Machinery** 2½:0:0:3

Methods of analysis of flow in rotating machines. Cascades, performance, radial equilibrium, secondary flows, viscous flows. Supersonic and transonic flows in compressors and turbines. *Prerequisite: AE 741 and AE 742.*

**AE 755 Experimental Methods in Thermal and Fluid Mechanics**  
2½:0:0:3

Measurement principles including mechanical, electrical, electromagnetic, thermal and optical techniques. Applications to measurements of forces, pressures, heat transfer, velocity and electron density. Schlieren, interferometry, laser, Raman scattering. *Prerequisite: AE adviser's approval.*

**AE 803 Vehicle Dynamics I** 2½:0:0:3

Atmospheric flight mechanics of airplanes, quasisteady and dynamic performance in various flight regimes, energy methods. Space vehicles, partial motion in central force field, launch and re-entry trajectories. Land and seaborne vehicles: automobile, tracked vehicles, ship and GEM vehicles. *Prerequisite: AE adviser's approval.*

**AE 810 Theory of Propulsion**  
2½:0:0:3

Principles of modern high-speed propulsion based on chemical energy sources. Air-breathing engines, combustion thermodynamics, flows with chemical reactions, thermochemistry of solid and liquid rocket engines. Engineering parameters in engine design. *Prerequisite: AE adviser's approval.*

**AE 819 Special Topics** 2½:0:0:3

Topics of particular current interest in aeronautics and astronautics. *Prerequisite: AE adviser's approval.*

**AE 901-904 Guided Readings, I, II, III, IV**  
each 3 units

Open to qualified graduate students interested in special advanced topics. Directed study including analytical work and/or laboratory investigations. *Prerequisite: written permission of departmental head.*

**PROJECT, THESIS AND DISSERTATION**

**AE 996 Project** each 3 units

Engineering project pursued with guidance of faculty member. Project titles submitted in writing to department head and adviser appointed for the project. May be extended to thesis with project adviser's recommendation. Credit only upon completion of project. Re-registration fee: 3-unit charge. *Prerequisite: degree status.*

**AE 997 MS Thesis** each 3 units

Master's thesis to present results of original investigation in field of student's specialty. Thesis an extension of AE 996, on recommendation of project adviser. Continuous registration required. Maximum of 12 units of AE 996-997 counted toward degree. Reregistration fee: 3-unit charge. *Prerequisite: AE 996 or AE adviser's approval.*

**AE 999 PhD Dissertation** each 3 units

Doctor's dissertation evincing independent study and original contributions in field of specialization. Oral examination on subject of dissertation and related topics required. Minimum of 24 units; also continuous registration at minimum of 3 units per semester required until dissertation completed. Reregistration fee: 3-unit charge. *Prerequisite: degree status.*

**THE FOLLOWING GRADUATE COURSES ARE OFFERED IRREGULARLY IN RESPONSE TO INDUSTRY DEMAND:**

- AE 623-624 *Computational Methods in Mechanical & Aerospace Engineering I & II*
- AE 704 *Aerothermo Chemistry*
- AE 714 *Radiation Gas Dynamics*
- AE 744 *Viscous Compressible Flow*
- AE 745 *Hydrodynamics*
- AE 748 *Dynamics of Rarefied Gases*
- AE 751-752 *Aerodynamics of Urban Environment I & II*
- AE 801 *Trajectories and Orbits*
- AE 806 *Physics of the Atmosphere*
- AE 811 *Engine-Airplane Integration*

# INDUSTRIAL ENGINEERING PROGRAM

*Director:* Charles J. Bahl

The Department of Mechanical, Aerospace and Manufacturing 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:

- Mechanical engineering
- Manufacturing
- Operations management
- Construction management

The graduate adviser will work with the student to develop a suitable program for either full-time or part-time study, with a product or service orientation.

There are opportunities 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;
- Apply their knowledge in manufacturing and service industries, including finance, health care, logistics and construction

Industrial engineers seek to allocate limited resources in an effective manner. A unifying theme focusing this body of knowledge and methods into a coherent entity is the systems point of view. 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 — these characterize industrial engineering. 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 very wide range of organizations. There are industrial engineers in banks, hospitals, government, transportation and communications, construction, social service, facilities design, manufacturing, warehousing and information processing.

Many industrial engineers move from the analysis and design of productive systems to the administration of 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.

## **REQUIREMENTS FOR THE MASTER OF SCIENCE**

The general Polytechnic requirements for the Master of Science degree 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 an engineering discipline from an accredited institution, with a superior undergraduate academic record. A student not meeting these requirements is considered for admission on an individual basis and may be admitted subject to the completion of appropriate undergraduate courses to remove deficiencies.

Students are encouraged to seek waivers (and have an appropriate substitute designated) for all required courses in which they can demonstrate competence, so that they can use their time most effectively.

The requirements for the MS in industrial engineering are identified in four groups, plus a computer literacy prerequisite. Courses in Group B may be waived if equivalent courses were taken previously. In such cases, additional Group D courses may be taken.

All students must have a Program of Study (POS) on file, which describes the approved plan of study for the degree.

### **Group A: Prerequisite Courses (or equivalent knowledge)**

Students must be computer literate and have knowledge of engineering economy and probability and statistics. If the prospective student lacks the relevant knowledge, the requirement may be satisfied by the following:

- Probability and statistics (MA 651 or equivalent)
- Engineering economy (MG 608 or equivalent)
- Computer literacy (ME 101 or equivalent)

Up to 6 credits of graduate courses in this category of prerequisite knowledge can be counted for degree credit as electives, although the electives needed for the student's concentration must also be satisfied.

**Group B: Required Courses 18 units**

- IE 611 *Quality Control and Improvement*
- IE 619 *Production Planning and Control*
- IE 620 *Project Planning and Control*
- IE 621 *Facility Planning and Design*
- IE 682 *Factory Simulation*
- MN 789 *Production Science*

**Group C: Major Electives 9 units**

Select at least two of the groups shown below, and take at least one course from each group. Additional courses from any group may be used as Group D electives.

**Group C1**

- IE 785 *Computer Integrated Manufacturing Systems (CIMS)*
- IE 788 *Manufacturing Systems Engineering*
- IE 792 *Design for Manufacturability*

**Group C2**

- IE 612 *Quality Engineering Using Robust Design*
- MG 635 *Introduction to TQM*
- IE 685 *System Reliability*

**Group C3**

- ME 600 *Applied Computational Methods*
- ME 660 *Discrete Time Feedback Control*
- ME 700 *Finite Elements*
- ME 718 *Thermal Issues in Manufacturing Processes*
- MN 796 *Electronic Systems Manufacturing*

**Group C4**

- MG 820 *Project Assessment and Management*
- MG 825 *Construction Administration*
- MG 826 *Construction Estimates and Costs*
- MG 827 *Specification and Contracts*

**Group C5**

- IE 645 *Productivity Management*
- MG 617 *Performance Measurement and Reward Systems*
- MN 618 *Managing the Human Side of Technological Change*

**Group C6**

- MA 703 *Linear Algebra*
- MA 614 *Linear Programming*
- IE 650 *(Queuing Systems) or MA 612 (Theory of Queues)*

**Group D: Other Approved Electives 9 units**

Select other appropriate courses in consultation with the adviser. Concentrations in areas suited to the student's career interest are encouraged, such as mechanical engineering, manufacturing, operations management and construction management. Courses from computer science (such as databases or EDI) or from management (such as new enterprise and small business management) may supplement such a concentration. Courses such as Manufacturing Resource Planning (IE 776) or Industrial Safety Engineering (IE 775) may also be used in Group D.

**CERTIFICATE PROGRAM**

The department offers a certificate program designed for the professional with work experience. A certificate program requires five courses, which are selected in accordance with the needs of the individual. Applicants for a certificate program must hold a bachelor's degree. On completion of the sequence with a B average or better, the student is issued a certificate. Students who later are admitted to study for a master's degree are usually able to apply all certificate courses toward the master's degree.

If a student has taken the equivalent of any required courses as an undergraduate, or more than one as a graduate student, then substitute courses must be selected in consultation with the adviser. Additional information may be obtained from the department. The certificate program is shown below.

**Advanced Industrial Engineering:**

- IE 612 *Quality Engineering Using Robust Design*
- IE 619 *Production Planning and Control*
- IE 645 *Productivity Management OR*
- MG 617 *Performance Measurement and Reward Systems*
- MN 618 *Introducing New Methods: Leading Change*
- IE 620 *Project Planning and Control*
- or
- MG 820 *Project Assessment and Management*

<b>GRADUATE COURSES</b>
-----------------------------

**IE 611 Quality Control and Improvement** 2%:0:0:3

The goal of this course is to provide the student 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. 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 651 or familiarity with the concepts of probability and statistics. Also listed under MN 611.*

**IE 612 Quality Engineering Using Robust Design** 2%:0:0:3

The goal of this course is to provide a broad review of 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: IE 611. Also listed under MN 612.*

**IE 619 Production Planning and Control** 2%:0:0:3

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 620 Project Planning and Control (Project Management)** 2%:0:0:3

Discussion of the knowledge and process required to manage a project throughout its life cycle from concept to completion. Topics include engineering analysis, screening and selection, configuration and total quality management, scheduling using PERT and CPM, budgeting and resource management, computer support and software. Case studies are used to illustrate the process. **Also listed under MG 810 and CE 828**

**IE 621 Facility Planning and Design** 2%:0:0:3

Topics covered 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. Guidance on selecting alternative facility plans and application of queuing methods and computer modeling for facility design and evaluation are presented.

**IE 645 Productivity Management** 2%:0:0:3

Modern approaches to productivity measurement, evaluation, planning and improvement in both manufacturing and service industries. Participants will develop productivity models for various types of organizations. **Also listed under MG 645.**

**IE 682 Factory Simulation** 2%:0:0:3

Modeling and simulation of complex industrial, commercial and service systems, such as factories and hospitals. Students develop, run and experiment with several simulation models using different software packages. *Prerequisite: computer literacy.*

**IE 776 Manufacturing Resources Planning (MRP II)** 2%:0:0:3

Computerized systems to effectively run a manufacturing business are discussed as well as the process of software specification, evaluation, selection and implementation. Topics include MRP logic, enterprise resource planning, manufacturing execution systems, inventory management and bill of mate-

rials. Several different software systems and their features are highlighted. **Also listed under MN 776.**

**IE 785 Computer Integrated Manufacturing Systems (CIMS)** 2%:0:0:3

The basic concepts of manufacturing complex products with complex processes relying heavily on computer and data processing technologies are introduced. All aspects relative to products and processes—planning, design, manufacturing and shipping—are addressed from a variety of perspectives. Techniques for managing and optimizing manufacturing productivity are explored. **Also listed under MN 785.**

**IE 788 Manufacturing Systems Engineering** 2%:0:0:3

Topics 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 788.**

**IE 792 Design for Manufacturability (DFM)** 2%:0:0:3

Concepts and techniques for the economic, functionally sound and high-quality product design for manufacture are introduced. Emphasis is placed on designing for easy assembly, both robotics and manual, and on the effective use of plastics for manufacturing cost reduction. Managerial and organizational approaches and case studies of successful designs are reviewed. **Also listed under MN 792.**

**IE 911-912 Selected Topics in IE**  
each 2%:0:0:3

Areas not covered in other courses. Specific topics vary according to instructor, who may be a visiting professor. Topics and prerequisites announced during term prior to offering.

**IE 930-931 Readings in Industrial Engineering I, II** *each 3 units*

Individual reading of selected papers and current literature in specialized area of study, guided by faculty member. *Prerequisite: approval of adviser, instructor and department head.*

**IE 997-998 Thesis for the Degree of Master of Science** *each 3 units*

Original investigation in topic chosen by student. Conferences and progress reports required during work and final written report required; oral examination may be requested by department. Registration and degree credit beyond first 6 units require separate approval. *Prerequisite: degree status and approval of supervising professor, adviser and department head.*

**INDUSTRIAL ENGINEERING UNDERGRADUATE COURSES AVAILABLE AS ELECTIVES ONLY**

These courses are under the administrative control of the Department of Mechanical, Aerospace and Manufacturing Engineering and are available as undergraduate electives in ME and other programs.

**IE 300 Engineering Economy** *3:0:0:3*

Economic and financial considerations in engineering decisions. Decision criteria under certainty, risk, uncertainty. Cost concepts, financial calculations, capital sources, accounting data, depreciation. Comparison of alternatives by annual cost, present worth and discounted cash flow methods. Minimum cost and maximum profit determination, replacement and economic life, breakeven analysis, effect of taxes, intangible factors. *Prerequisite: junior status.*

**IE 311 Quality Control and Quality Assurance** *3:0:0:3*

Introduction to the concepts of the cost of quality, quality assurance, quality process control and total quality management. Emphasis on process management and control. Control charts and their use: the concept of "out of control"; charts based upon variables and charts based upon attributes. Specifications and tolerances. Acceptance sampling by lots, including concepts of producer's and consumer's risks. Course project required. *Prerequisite: MA 223.*

**IE 321 Facility Planning and Design** *3:0:0:3*

Development of quantitative models for analysis of facility layout and location problems. Solutions by both mathematical optimization and heuristic algorithms. Locations of single and multiple facilities in existing and new layout design. Other topics include computerized layout planning, materials handling systems, evaluation and improvement of facility productivity. *Prerequisite: MA 223.*

**IE 342 Robotics Applications** *2½:1½:0:3*

Applied robotics and the cost-effective integration of robots into manufacturing processes. The course will cover total systems, robotic cell design and selection of robot types to suit each phase of industrial engineering. Laboratory experiments will include construction and use of robots and scaled models. Plant visits, field trips and case studies. *Prerequisite: junior status.*

**IE 380 System Simulation** *2:3:0:3*

Modeling and simulation of discrete stochastic systems, including random variables and statistical phenomena. Case studies of simulation applications. Intensive applications of PC-based simulation software packages. Economic factors supporting simulation techniques. Students develop, run and experiment with several simulation models. *Prerequisite: MA 224.*

**THE FOLLOWING COURSES ARE OFFERED IRREGULARLY IN RESPONSE TO INDUSTRY DEMAND**

- IE 600 *Engineering Economy*
- IE 606 *Work Design and Measurement*
- IE 618 *Inventory Models*
- IE 627 *Operations Research: Deterministic Models*
- IE 628 *Operations Research: Stochastic Models*
- IE 650 *Queuing Systems I*
- IE 685 *System Reliability*
- IE 765 *Human Factors in Engineering Design*
- IE 775 *Industrial Safety Engineering*



# MANUFACTURING ENGINEERING PROGRAM

*Director:* Charles J. Bartlett

A graduate program leading to a Master of Science in manufacturing engineering is offered by the Department of Mechanical, Aerospace and Manufacturing Engineering. Some courses are offered at the undergraduate level as technical electives for various engineering programs.

In recent years, much has been written about how to improve the productivity, profitability and competitiveness of U.S. manufacturers. Many new approaches have been introduced. The first wave of these focused on improving competitiveness through improving quality and reducing inventory and cycle time by focusing on design, the introduction of product realization processes and the introduction of specific new methods such as TQM, JIT/TQC, new production control systems and activity based costing. The program at Polytechnic emphasizes these methods and supports them through courses in robust design and the design of experiments techniques. As for production, there are courses in CIM and modern methods of production control such as Goldratt's synchronous manufacturing. Success in the application of these new methods depends upon getting acceptance for their use, so 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 in U.S. industry, attention is being focused on reducing variability in production, thereby improving asset utilization and hence profitability and customer satisfaction. New courses in production science have been introduced that specifically address these issues.

Polytechnic's comprehensive program in manufacturing engineering focuses this array of new methods which are generally applicable and thus portable. Students may acquire specific knowledge in any of the professional disciplines offered at Polytechnic through a concentration consisting of

up to four courses. The program is interdisciplinary and is designed for working professionals who have responsibilities in manufacturing and for those who plan to enter manufacturing after completing the masters program.

Because hands-on experience is so important, the program has made arrangements with local manufacturers for full-time students and those part-time students that do not work full-time to do internships in nearby manufacturing industry. Pursued full-time, the MS program, including the internship, can be completed in one year.

## **MASTER OF SCIENCE IN MANUFACTURING**

The MS in manufacturing engineering can be taken full time or part time in either Brooklyn or Westchester.

Students are drawn from a wide variety of manufacturing firms, large and small. Students have come from firms such as Symbol Technologies, Standard Motor Products, IBM, Loral, Medical Labs Automation, Guild Moulders, Photocircuits Corporation, Pitney Bowes, Kraft-General Foods, Kepeco, Lucent Bell Labs and many others.

This program is designed to:

- Empower the engineer to identify, evaluate and implement production improvement by the application of new methods.
- Provide experience in design and production through internships and projects.
- Provide hands-on experience in the use of software for design and simulation.

Students graduating from this program will be equipped with working knowledge of advanced methods and techniques in manufacturing that are in use throughout the world. They will have sufficient knowledge and hands-on experience to enable them to contribute significantly to productivity improvement and to provide the leadership that such programs require. They will be well positioned to advance their own careers.

## **UNDERGRADUATE PARTICIPATION IN MANUFACTURING**

Undergraduate courses in manufacturing Engineering are offered at Polytechnic. These courses allow students in the different engineering disciplines to use manufacturing courses as electives in their undergraduate programs.

## **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 to participate in the program.

## **REQUIREMENTS FOR THE MS IN MANUFACTURING ENGINEERING**

The degree program requires 36 credits, typically made up of eleven courses and a 3-credits master's report or 10 courses and a 6-credits master's report. Credit may be granted for up to three relevant graduate level courses (9 credits) completed elsewhere with a grade of B or better. Issues relating to the transfer of courses are addressed in the "Mechanical Engineering" section of the catalog.

### **Prerequisite Courses (or equivalent knowledge)**

Students must be computer literate and have knowledge of engineering economy and probability and statistics. If the prospective student lacks the relevant knowledge, the requirement may be satisfied by the following courses:

Probability and Statistics  
(MA 651 or equivalent)

Engineering Economy  
(MG 608 or equivalent)

Computer Literacy  
(ME 10) or equivalent)

## DEPT. OF MECHANICAL, AEROSPACE AND MANUFACTURING ENGINEERING

Up to 6 credits of graduate courses in this category of prerequisite knowledge can be counted for degree credit as electives, although the electives needed for the student's concentration must also be satisfied.

### Required Core Courses 18 Units

MN 611	<i>Quality Control and Improvement</i>
MN 618	<i>Managing the Human Side of Technological Change</i>
MN 785	<i>Computer Integrated Manufacturing Systems</i>
MN 788	<i>Manufacturing Systems Engineering</i>
MN 789	<i>Production Science</i>
MN 792	<i>Design for Manufacturability (DFM)</i>

### Other Courses 18 units

Students are encouraged to organize their electives into "concentrations." Concentrations are designed to suit the student's career needs and, for those who are working, the needs of the firm. Concentrations are designed by the student together with a faculty adviser and/or his employer. Any course in the Polytechnic catalog that is so approved may be elected as part of a concentration.

### Illustrative Concentrations:

#### Product Realization Concentration

MN 612	<i>Quality Engineering Using Robust Design</i>
IE 619	<i>Production Planning and Control</i>
MN 632	<i>High Performance Teams</i>
MN 651	<i>Design Strategies</i>
MN 771	<i>The Product Realization Process</i>

#### Production Concentration

MN 612	<i>Quality Engineering Using Robust Design</i>
MN 651	<i>Design Strategies</i>
IE 682	<i>Factory Simulation</i>
MN 771	<i>The Product Realization Process</i>
MN 776	<i>Manufacturing Resources Planning (MRP)</i>

### Electronics Manufacturing Concentration

MN 612	<i>Quality Engineering Using Robust Design</i>
MN 796	<i>Electronic Systems Manufacturing</i>
MN 802	<i>Thermal Design of Electronics Systems for Performance and Reliability</i>
MN 804	<i>Thermal Issues in Manufacturing Processes</i>

### LABORATORY AND PROJECT WORK

Students may use the laboratory facilities at Polytechnic in their master's report work or in special courses focused on such tools. Consult the academic adviser to arrange for a special offering if needed.

### MASTER'S REPORT

The MN 996, MS Report, is normally 3 credits. It may be expanded to 6 units by use of MN 997 as an elective. The MS Report is done in an industrial lab setting whenever possible. Local industries with plants accessible to both campuses offer internships in many types of manufacturing.

Part-time students may draw upon their work to provide appropriate master's reports. Full time students may also 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 PROGRAM

The department offers certificate programs designed for the professional with work experience. A certificate program requires five courses, which are selected in accordance with the needs of the individual. Applicants for a certificate program must hold a bachelor's degree. On completion of the sequence with a B average or better, the student is issued a certificate. Students who later are admitted to study for a master's degree are usually able to apply all certificate course credits towards the master's degree.

If a student has taken the equivalent of any required courses as an undergraduate, then substitute courses must be selected in consultation with the adviser. Additional information may be obtained

from the department. The certificate programs are shown below:

### Manufacturing Excellence by Design: A Holistic Approach

#### Required Courses:

MN 612	<i>Robust Design</i>
MN 651	<i>Design Strategies</i>
MN 792	<i>Design for Manufacturability</i>

#### Elective Courses (choose 2):

MN 771	<i>Product Realization Process</i>
MN 788	<i>Manufacturing Systems Engineering</i>
MN 796	<i>Electronic Systems Manufacturing</i>

### Manufacturing Engineering and Production Science

#### Required Courses:

MN 788	<i>Manufacturing Systems Engineering</i>
MN 789	<i>Production Science</i>
IE 619	<i>Production Planning and Control</i>

#### Elective courses (choose 2):

MN 611	<i>Quality Control and Improvement</i>
MN 618	<i>Managing the Human Side of Technology</i>
MN 632	<i>Building High Performance Teams</i>
MN 776	<i>Manufacturing Resources Planning</i>
MN 785	<i>Computer Integrated Manufacturing</i>
MN 796	<i>Electronics Systems Manufacturing</i>
IE 682	<i>Factory Simulation</i>

### Achieving World Class Quality

#### Required Courses:

MN 611	<i>Quality Control and Improvement</i>
MN 612	<i>Robust Design</i>
MN 632	<i>Building High Performance Teams</i>

#### Elective Courses (choose 2):

MN 651	<i>Design Strategies</i>
MN 771	<i>Product Realization Process</i>
MN 788	<i>Manufacturing Systems Engineering</i>

### LABORATORY FACILITIES AT POLYTECHNIC

The laboratories used in the Manufacturing Engineering Program include a network of workstations. The laboratory and project activities associated with manufacturing include:

Simulation Laboratory, including such tools as Witness, Avena, Promodel, Simfactory, and Xcell+; design for manufacturability software used for studying and evaluating designs, such as vehicle subsystems; MRP software such as Macola and Process and Work Flow; and methods that include applications of LabView for efficient real-time data collection and closed-loop control.

## GRADUATE COURSES

*The courses with MN designations below are followed by a set of courses from other programs that are commonly taken by manufacturing engineering students.*

### **MN 611 Quality Control and Improvement** 2%:0:0:3

The goal of this course is to provide the student 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. 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 651 or familiarity with the concepts of probability and statistics.* **Also listed under IE 611.**

### **MN 612 Quality Engineering Using Robust Design** 2%:0:0:3

The goal of this course is to provide a broad review of 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: IE 611.* **Also listed under IE 612.**

### **MN 618 Managing the Human Side of Technological Change** 2%:0:0:3

The introduction of new technology brings with it the need to sensitize and educate engineers and managers to the impact these changes have on the technical as well as the general work force. This course concentrates on the manner in which new technologies and the associated new work structures can be intro-

duced to a technology-sensitive organization. Issues of learning, communication, motivation, the appropriate management of change and the leadership responsibility in "making it happen" are extensively discussed.

### **MN 632 Building High Performance Teams** 2%:0:0:3

Successful manufacturing programs require the teaming of a number of professionals having a variety of expertise, from product design, manufacturing process design, production engineering, quality control, testing, packaging, etc. 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 is available to conclude 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, creating a productive team culture, surfacing and resolving critical issues and implementing strategies for organizational support.

### **MN 651 Design Strategies** 2%:0:0:3

Product design is a major determinate of product cost, quality and customer satisfaction. The design process is explored including establishing customer requirements, 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 771 Product Realization Process (PRP)** 2%:0:0:3

Getting new products developed and to market is a major factor in determining global competitiveness. Case studies will be used 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 new product development management.

### **MN 776 Manufacturing Resources Planning (MRP II)** 2%:0:0:3

Computerized systems to effectively run a manufacturing business are discussed as well as the process of software specification, evaluation, selection and implementation. Topics include MRP logic, enterprise resource planning, manufacturing execution systems, inventory management, and bill of materials. Several different software systems and their features are highlighted. **Also listed under IE 776.**

### **MN 785 Computer Integrated Manufacturing Systems (CIMS)** 2%:0:0:3

The basic concepts of manufacturing complex products with complex processes relying heavily on computer and data processing technologies are introduced. All aspects relative to products and processes—planning, design, manufacturing, shipping—are addressed from a variety of perspectives. Techniques for managing and optimizing manufacturing productivity are explored. **Also listed under IE 785.**

### **MN 788 Manufacturing Systems Engineering** 2%:0:0:3

Topics 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 IE 788.**

### **MN 789 Production Science** 2%:0:0:3

Just-in-time and synchronous manufacturing methods are reviewed. The basic dynamics of factories are analyzed 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 792 Design for Manufacturability (DFM)** 2½:0:0:3

Concepts and techniques for the economic, functionally sound and high-quality product design for manufacture are introduced. Emphasis is placed on designing for easy assembly, both robotics and manual, and on the effective use of plastics for manufacturing cost reduction. Managerial and organizational approaches and case studies of successful designs are reviewed. **Also listed under IE 792.**

**MN 796 Electronics Systems Manufacturing** 2½:0:0:3

The physical design and manufacturability of modern electronics systems is a result of 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 911-912 Selected Topics in Manufacturing Engineering I-II** 3 units

Areas not covered in other courses. Specific topics vary according to the instructor, who may be a visiting professor. Topics and prerequisites will be announced during the term prior to the offering.

**MN 930-931 Readings in Manufacturing Engineering I-II** 3 units

Individual reading of selected papers and current literature in specialized area of study, guided by faculty member. The topic must be beyond the scope of regularly offered courses. The topic must be agreed upon by the student and adviser prior to registration. A written report on the topic is required. *Prerequisite: approval of adviser, instructor and department head.*

**MN 996 MS Report I** 3 units

Independent project demonstrating professional maturity and graduate-level knowledge completed under guidance of departmental adviser. Experimental work, software development and extensive analysis are commonly expected. Report must include results in one or more of these areas, critical analysis and interpretation of pertinent literature and should represent worthwhile contribution to the field. Written report (unbound) is required. *Prerequisite: adviser's approval.*

**MN 997 MS Report II** 3 units

With the approval of the graduate adviser, some students may undertake a 6 credit MS report. This should be planned in advance, during the registration for MN 996. In such cases, MN 997 is used for the second half of the registration. A grade of "S" or "U" is awarded in MN 996 in these cases, and the letter grade given in MN 997 applies to all 6 units. *Prerequisite: Adviser's approval.*

**THE FOLLOWING GRADUATE COURSES ARE OFFERED IRREGULARLY IN RESPONSE TO INDUSTRY DEMAND**

- MN 794 *Physical Design of Products*
- MN 802 *Thermal Design of Electronics System for Performance and Reliability*
- MN 804 *Thermal Issues in Manufacturing Processes*

**MANUFACTURING ENGINEERING UNDERGRADUATE COURSES AVAILABLE AS ELECTIVES ONLY**

These courses are under the administrative control of the Department of Mechanical, Aerospace and Manufacturing Engineering, and are available as undergraduate electives in ME and other programs.

**MN 301 The Contemporary Productive Enterprise** 3:0:0:3

This course is designed to meet the needs identified by leaders in manufacturing and service industries so that engineering school graduates are able to effectively apply what they have learned and quickly become effective in the work environment. The course provides an engineering treatment of factors that are common to both manufacturing and service enterprises including the operations process, financial, materials and products. It also provides the foundation for follow-on courses in the manufacturing sequence and prepares students to learn from factory visits. *Prerequisite: junior status or instructor's permission.*

**MN 303 Product Design** 3:0:0:3

A product must meet both a customer need and goals of performance, cost, quality, reliability, testability and the environment to be successful in the marketplace. The course addresses the issues that are critical to the design of a product for manufacture and the methods that have been found to be successful in addressing these issues. Selected manufacturing processes are studied to establish the relationship between product design and manufacturing process complexity. *Prerequisite: junior status or instructor's permission.*

# MATERIALS SCIENCE PROGRAM

*Director:* Said Nourbakhsh

Materials scientists are specialists in the most effective utilization of metals, alloys, ceramics, semiconductors, composites, plastics and polymers. Their expertise is vital to the solution of problems arising from the intensive quest for superior materials in our rapidly advancing technological age.

Challenges remain for imaginative individuals to probe, understand, process, fabricate and use effectively metallic materials, semiconductors and composites in fields ranging from electronic devices and integrated circuits to new energy production processes and aerospace applications.

Furthermore, materials scientists may work in research and development, plant operations or do consulting. They are instrumental in contributing to progress in medical prosthetics, dental materials, environmental protection, electronic devices and materials, superconducting materials, thermoelectric materials and advanced aerospace materials, to name a few.

## MATERIALS SCIENCE

It is estimated that nearly 40% of all engineering research is in the area of materials science, which is defined as the study of the interrelations among atomic structure, crystal structure, microstructure and properties of materials. The fundamental principles, which involve basic physics and chemistry, are universally applied to metals, ceramics, polymers, semiconductors, nanomaterials, intermetallic compounds and composites. With this understanding it is possible to tailor materials with specific properties for particular applications.

### DEGREES OFFERED

The program prepares students for a Master of Science in materials science and the degree Doctor of Philosophy in mechanical engineering with an option in materials science. The MS and PhD are offered at the Brooklyn campus.

Both fundamental and applied research are carried out within the department. Excellent facilities are available for work in electron microscopy, surface analysis, deformation and fracture and other fields. Fundamental research is carried out on alloy hardening, deformation and fracture, phase transformations, thermomechanical working, microstructures and properties, failure analysis, intermetallic compounds and composites, surface analysis, ferroelectric thin films and rapid solidification. In applied research, the department is involved in studies of materials for aerospace, electronics and energy-related applications.

### DEGREE REQUIREMENTS

Full-time graduate students enrolled in the master's program will generally be required to do a master's thesis. Part-time students will be required to complete a master's project. Under special circumstances students may take courses and pass an oral examination in lieu of a thesis or project.

A minimum of 36 units of required and elective courses and thesis or project is necessary for the MS degree.

### Required Courses for the MS in Materials Science:

Enrollment in the program is open to students with undergraduate degrees in engineering or the physical sciences.

MT 600	<i>Structure-Property Relationships</i>	3
MT 640	<i>Reactions in Solids</i>	3
MT 660	<i>Ceramic Technology</i>	3
ME 600	<i>Applied Computational Methods</i>	3

### Project or Thesis\*

MT 996	<i>Report Project for MS</i>	3-6
	OR	
MT 997	<i>Thesis for MS</i>	9-12

### Elective Course Work:

*With adviser's approval courses may be chosen from the catalog and others in areas related to materials science - e.g., physics, chemistry and polymers.*

12-21

*Total* 36

*\*Part-time students take project.*

**COURSE DESCRIPTIONS**

**INTERDEPARTMENTAL COURSES**

**MT 305 Mechanical Properties of Materials** 3:0:0:3

Structure-property relationships of engineering materials. Testing methods and interpretation of tests, mechanical properties of materials. Engineering properties of ferrous and nonferrous alloys and nonmetallic materials including polymers, ceramics and composites. Strong emphasis is placed on engineering applications and case histories of product and component failures.

**MT 306 Nature and Properties of Structural Materials** 2:3:0:3

Physical and mechanical properties of concrete, metals, plastics, composites and asphaltic materials related to structures. Experimental investigation of mechanical properties of selected structural materials and physical properties of cement and concrete mixes. Introduction to polymeric materials including geosynthetics. **Also listed under CE 306.**

**MT 309 Introduction to Materials** 2:3:0:3

The aim of this course is to introduce students to the science and engineering aspects of modern materials used in technology. They will be taught the concepts of atomic coordination and bonding which leads to the different types of solids, viz., metals, ceramics and polymers. The structure of these materials at atomic, microscopic and macroscopic levels and their relation to various properties will be discussed. Single phase "bulk" materials will be compared with special structures such as composites, nanostructures, thin films, fibers etc. Engineering properties stressed upon will be mechanical behavior, electrical, dielectric and optical properties, chemical and environmental behavior. The mechanisms of materials degradation and corrosion which influence service life and recycling options will be presented.

**MT 340 Manufacturing Processes** 3:0:0:3

Mechanical behavior of metals. Properties of materials relating to fabrication methods. Metal cutting mechanics, cutting fluids, thermal and vibrational aspects of machining. Machinability criteria. Deformation processing, hot and cold, mechanics of deformation. Unconventional processing: EDM and ECM. Numerical control. Metrology. *Prerequisite: MT 305. Also listed under IE 340.*

**MT 345 Materials Characterization** 3:0:0:3

This course is designed to familiarize the student with the state-of-the-art techniques being used to characterize the structure, microstructure, chemical composition and properties of modern materials. The techniques covered in the course are optical, scanning and transmission electron microscopy, mechanical and electrical testing, x-ray diffraction, and photoelectron and energy dispersive spectroscopy. The course not only covers the underlying principles behind each technique but also provides the student with the opportunity to obtain hands-on experience by using these techniques.

**MT 375 Semiconductor Technology** 3:0:0:3

Principal techniques involved in design and fabrication of semiconductor devices and integrated circuits, including material preparation, junction forming, circuit integration, packing. **Also listed under EE 119.**

**MT 421 Metallurgical Failure Analysis** 1:6:0:3

Integrated knowledge of materials principles applied to analysis of in-service failure of materials. Discussion of actual case histories. Laboratory assignments require students to prepare written reports and give oral presentations analyzing six in-service failures. *Prerequisite: MT 305.*

**GRADUATE COURSES**

**MT 600 Structure-Property Relationships in Materials** 2½:0:0:3

Dependence of physical properties on the structure and symmetry of crystalline materials: a unified approach to thermal, electrical and mechanical properties. Symmetry elements and point groups, tensors and matrices, electrical properties, stress, strain, elasticity, thermal expansion, piezoelectricity, Pyroelectricity, thermodynamics of equilibrium properties, transport properties (thermal and electrical conductivity).

**MT 601-602 Special Topics in Structure-Property Relationships, I, II** each 2½:0:0:3

Advanced or specialized topics in structure-property relationships in materials presented at irregular intervals. *Prerequisite: MT 600.*

**MT 603 Introduction to Electron Microscopy I** 2½:0:0:3

Resolving power. Lens aberrations. Properties of magnetic lenses. Designs of transmission and scanning electron microscopes, their applications and limitations. Real and reciprocal lattices. Scattering of fast electrons by atoms. Theories of electron diffraction. Bragg Law. Ewald sphere construction.

**MT 604 Introduction to Electron Microscopy II** 2:2:0:3

Image formations. Fresnel half period zones. Kinematical theory of image formation. Column approximation. Images of perfect and imperfect crystals, stacking faults, dislocations, precipitates. Amplitude phase diagram and its applications. Breakdown of kinematical theory. Introduction to dynamical theory of image formation. Specimen preparation techniques: thin foil, replicas. Uses of the scanning and transmission electron microscopes.

**MT 610 Thermodynamics of Metals and Alloys** 2½:0:0:3

Fundamentals of classical and statistical thermodynamics with emphases on solid states, phenomenology of metallic surfaces, phase equilibria in multicomponent metallic systems, calculations of phase diagrams, thermodynamics of lattice defects and substructure.

**MT 611-612 Special Topics in Thermodynamics and Statistical Mechanics of Metals, I, II**  
each 2½:0:0:3

Advanced or specialized topics in thermodynamics and statistical mechanics of metals. *Prerequisite: MT 610.*

**MT 620 Plastic Deformation and Fracture** 2½:0:0:3

Classical concepts of slip related to dislocation theories of stress-strain behavior of single crystals. Mechanical twinning and its relationship to crystal structure. Theories of yielding, brittle and ductile fracture in polycrystalline materials.

**MT 621-622 Special Topics in Deformation and Fracture I, II**  
each 2½:0:0:3

Advanced or specialized topics in deformation and fracture. *Prerequisite: MT 620.*

**MT 630 Theory of Metals** 2½:0:0:3

Quantum theory as applied to metals and alloys, theories of thermal properties of metals, theory of alloy phases, theories of electrical conductivity and magnetic properties of metals, influences of structural imperfections on properties of metals and alloys.

**MT 631-632 Special Topics in Theory of Metals I, II** each 2½:0:0:3

Advanced or specialized topics in electronic properties of materials. *Prerequisite: MT 630*

**MT 640 Reaction in Solids** each 2½:0:0:3

Bases of kinetic theory; diffusion controlled transformation; nucleation and growth in liquids and solids; surfaces and interfaces in solids; diffusionless phase transformation.

**MT 641-642 Special Topics in Reactions in Solids I, II**  
each 1½:0:0:3

Advanced or specialized topics in reactions in solids. *Prerequisite: MT 640 or instructor's permission.*

**MT 650 Advanced Engineering Metallurgy** 2½:0:0:3

Requirements for resistance to stress, oxidation and corrosion, and to structural instability in metals and alloys for low, normal and high temperature service, theories of high temperature deformation and fracture, alloy designs and designs of alloys for challenging environments.

**MT 651-652 Special Topics in Advanced Engineering Metallurgy I, II**  
each 2½:0:0:3

Advanced or specialized topics in advanced engineering metallurgy presented at regular intervals.

**MT 660 Ceramic Technology** 2½:0:0:3

Bonding and structure of ceramic solids; structure of crystalline compounds; structure of glasses; defects in stoichiometric and non-stoichiometric ceramics; surfaces and interfaces; diffusion in crystalline oxides and glasses; grain growth, sintering and vitrification; special microstructures; optical ceramics; electrical and dielectric ceramics; brittle fracture, thermal stresses, and strengthening mechanisms in ceramic compounds.

**MT 706 Magnetism and Magnetic Materials** 2½:0:0:3

Origin of magnetism in atoms and solids. Diamagnetic vs. paramagnetic behavior. Ferromagnetic domain theory. Antiferromagnetism and ferromagnetism. Structure and properties of magnetic materials.

**MT 707 Thin Film Technology** 2½:0:0:3

Preparation, structure, evaluation and properties of thin films: metallic, semiconductor and dielectric film techniques, nucleation and growth considerations, epitaxy, and metastable configurations. *Prerequisite: instructor's permission.*

**MT 708 Semiconductor Materials and Devices** 3:0:0:3

Nature of semiconductor materials, stressing interrelations among band structure, chemistry and microstructure of materials. Elemental, compound, amorphous and polymeric semiconductors. Examples of applications of materials for devices are given to illustrate how materials properties are matched to device characteristics for optimum performance.

**MT 709 Integrated Circuit (VLSI) Fabrication Techniques** 3:0:0:3

Study of process technology used to produce integrated circuits. Silicon technology: bipolar, MOS and VLSI processes. Process requirements defined in terms of circuit structure, i.e., concentration profiles and topographical layout as defined by mask set previously determined. Steps from crystal growth through diffusion, ion implantation, oxidation, photolithography, metallization, interconnection and packaging to final test are analyzed. The impact of process on design rules are printed out. **Also listed under EL 646.**

**MT 714 Electrochemical Processes** 2½:0:0:3

A presentation of the fundamentals of electrochemical reactions, focussing on those aspects which have application to metals and semiconductors. Electrode reactions; kinetics of electrode processes, theory and applications of chemical etching; corrosion of metals and alloys; electrosolution and deposition.

**MT 720 Advanced Materials  
Analyses Mechanisms in Metals**

*each 2½:0:0:3*

Characterization of microstructure, defects, dopants and impurities, composition profiles. What to use when and why. Hands-on uses of selected equipment. Applications discussed based on interest of students.

**MT 763-764 Seminar in Metallurgy  
and Materials Science**

*each 0:0:0:2½*

Preparation and presentation by students of seminars on topics of physical metallurgy, metallurgical engineering or materials science in which students critically review technical papers selected by students with approval of faculty advisers. For students enrolled in doctoral programs.

**MT 996 Report Project for the Degree  
of Master of Science**

*3-6 units*

Independent project demonstrating professional maturity and graduate level knowledge completed under guidance of departmental advisers. Reports include critical analysis and interpretation of pertinent literature, and should represent worthwhile contributions to the field. Oral final examinations and project reports required.

**MT 997 Thesis for the Degree of  
Master of Science**

*9-12 units*

An original topic of research for the master's degree is decided upon by student and faculty adviser. Close contact is to be maintained between student and faculty adviser during the thesis investigation. After the thesis is written and approved, the student is required to defend his thesis during an oral examination.

**THE FOLLOWING  
GRADUATE COURSES ARE  
OFFERED AS NECESSARY:**

MT 700	<i>Welding Metallurgy</i>
MT 710	<i>Powder Metallurgy II</i>
MT 715	<i>Corrosion &amp; Oxidation Mechanism in Metals</i>
MT 725	<i>Noble Metal Metallurgy</i>
MT 726	<i>Metallurgy of Nuclear Reactor Materials</i>
MT 727	<i>Bioengineering Metallurgy</i>
MT 740	<i>Materials in Manufacturing</i>

**ADMISSIONS  
REQUIREMENTS:**

In order to be admitted to the master's program, an applicant must have the equivalent of a bachelor's degree in metallurgy or materials science. An applicant with a bachelor's degree in a field of science or engineering other than metallurgy or materials science may have to remove some undergraduate deficiencies as determined by the Department Advisery Committee.

**FELLOWSHIPS/  
ASSISTANTSHIPS:**

Financial assistance is available in the form of teaching assistantships, research assistantships and half tuition to full-time students. Awards are based on scholarship.



# MECHANICAL ENGINEERING PROGRAM

The undergraduate degree in mechanical engineering is offered on both the Brooklyn and Long Island campuses, and may be taken by full-time students at either location. A concentration in aerospace engineering is also offered. Students choosing the Co-op Program are accommodated. There is no evening program, and as a result, part-time students have to take the same classes as full-time students. Transfer students are welcome and are required to meet the minimum residence requirements set by the University. There are preplanned programs or articulation agreements with several schools which ease the transfer. The Office of Admissions should be consulted for details.

Graduate degrees in mechanical engineering are offered on the MS and PhD levels. For each level, the student has to choose one of the specialty areas: thermal and fluid sciences, mechanical analysis and design or controls and robotics. At the PhD level, two more options exist, in aerospace and materials science. All mechanical engineering graduate degrees are offered to both full-time and part-time students at the Brooklyn campus. PhD students may work on their dissertation research at the campus most suited to the adviser and the topic.

## THE MECHANICAL ENGINEERING PROFESSION

Mechanical engineering is a dynamic and continually evolving profession and the most diverse among all engineering disciplines. Mechanical engineers develop the physical systems and devices that modern society needs or wants, from automobiles to air conditioning, robots to power plants, people movers to artificial limbs, and rocket engines to communications satellites. It also has a long tradition of leadership in helping to develop the natural environment by breaking new ground in such areas as resource conservation, improved efficiency of energy-

consuming devices, development of codes for a safer technological environment, new energy sources and the like. While undergraduate and graduate programs in mechanical engineering are designed primarily to develop talents in areas such as design of components, fluid and thermal systems, controls and robotic systems, graduating students eventually apply their training to the additional diversified fields of bioengineering, manufacturing, astronautics, systems engineering, management and law. As students mature and realize their abilities, their professional lives may center on engineering research, government, business or education.

## UNDERGRADUATE PROGRAM

All Polytechnic undergraduates begin their engineering education in the freshman year with the EG 101-102 sequence. They are also introduced to programming methodology (CS 200) and to the physical sciences. Also, a five-semester sequence in mathematics starts in the freshman year. The table on the next page shows the typical four-year curriculum in mechanical engineering. Mechanical engineering students take their first courses in their major in the beginning of the sophomore year. During this year they take courses in engineering graphics, mechanics, strength of materials and mechanical properties of materials. In the junior year, mechanical engineering majors take the core courses of their discipline, which fall into three areas: thermal-fluids, mechanical analysis and design, and instrumentation and controls. Many courses emphasize the design aspect of the profession, beginning in the freshman year and continuing through the capstone design sequence in the senior year. Several courses require design projects. There is also a strong emphasis on hands-on lab experience as well as computational labs in graphics and in finite element methods.

To provide a broader education and understanding of the world, 24 credits of study in the humanities and social sciences are required. Several electives are included, as shown in the typical program. Throughout these courses and in several designated writing-intensive courses in the major, students are also required to use and refine their communication skills.

Students are encouraged to participate in the ASME and/or SAE student chapters, and to interact with the faculty and other students in the program. Teamwork is encouraged in the various projects undertaken by the students and in the departmental labs.

Mechanical engineering students have three technical electives available to them that must be taken within the department. In recent years available electives within the department included courses in vibrations, heating ventilation and air-conditioning (HVAC) systems, design of power plants, internal combustion engines, engineering economy, and manufacturing engineering. In addition, the program allows students to take two free electives in any discipline and at any level they choose. By proper selection of electives, students may concentrate in a certain discipline. An aerospace concentration is available where the three technical electives and the two free electives are replaced by a sequence of aerospace courses (see Aerospace Engineering Program description).

Students are encouraged to work closely with the academic adviser to design a program best fitting their needs and aspirations. The undergraduate program leads to the degree of Bachelor of Science in mechanical engineering. The program is accredited by the Accreditation Board for Engineering and Technology (ABET).

Additional information about the Mechanical Engineering Program is presented in the main departmental section of this catalog.

**SPECIAL DEPARTMENTAL REQUIREMENTS**

Students have to meet the University requirement of a 2.00 GPA for graduation. Seniors with GPAs of 3.5 or better may take honors work (ME 381-382 and AE 381-382) and certain graduate courses as electives with the departmental adviser's approval.

Students on academic probation are usually permitted to preregister for the next semester, but are obliged to consult with the ME adviser after their grades are posted, and before the beginning of classes.

**TRANSFER STUDENTS**

All transfer students are required to meet the University's minimum residency requirement. In addition, transfer students in the mechanical engineering program are required to take all junior and senior ME 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, may often fulfill the requirements for the BS in mechanical engineering in two additional years. Space does not allow illustrations of the way in which this can be done, due to the variations from college to college. However, the undergraduate advisers are familiar with our past practice with several colleges and able to guide the prospective student. With some colleges, there are formal articulation agreements and typical programs of study. Students who have some course work toward a degree may also 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, and 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 does change over the years at Polytechnic and other colleges, and it is a comparison of content that determines decisions in each case. Transfer students are strongly encouraged to have a meeting with the undergraduate adviser separate and apart from the registration process, so that a proper evaluation may be done. The Office of Admissions does have informa-

tion on past decisions for a given college, or can arrange a meeting with the departmental undergraduate adviser. Graduates of technology programs may be able to fulfill the requirements for the 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 an undergraduate adviser for details.

**TYPICAL PROGRAM OF STUDY FOR THE BS (ME)**

The program may be considered to consist of 4 components: engineering core (required, 69 credits, of which 24 are HU/SS), ME (36 credits), ME core (choose some or all courses from list, 8 credits), and electives (both Free, 6 credits, and technical, 9 credits).

**GRADUATE PROGRAM**

Programs of study leading to the MS and PhD degrees in mechanical engineering are available in each of five specialty areas:

- Thermal and Fluid Sciences (MS and PhD)
- Mechanical Analysis and Design (MS and PhD)
- Systems, Controls, and Robotics (MS and PhD)
- Aerospace (MS only)
- Materials Science (MS only)

Within each of these specialties, a student may choose to concentrate some of the electives from the other graduate programs in the department, namely, aerospace, industrial or manufacturing engineering.

A bachelor's degree and good academic record in mechanical engineering from a suitable college or university is generally required for admission to the graduate program. Applicants with degrees from fields other than mechanical engineering may be admitted, but have to undertake additional studies to achieve a comparable background. The

courses required to achieve this are specified as part of the admission evaluation or first advising session. Undergraduate courses specified for this purpose cannot count toward credits needed for the degree.

Graduate programs are subject to the prior approval of the graduate adviser designated by the department. All students are required to have a GPA of 3.00 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 and every guided studies, readings, projects, thesis and dissertation courses or credits enrolled.

**REQUIREMENTS FOR THE MASTER OF SCIENCE**

The 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 the first advising session.

Students must take at least 27 units of the MS program at Polytechnic. No more than a total of 9 units may be attributed to transfer and readings courses. Validation credit is not allowed, but specific requirements may be waived (and an appropriate substitute designated) by the graduate adviser, based upon the student's prior studies or experience. Transfer credits are not granted for courses that were undergraduate courses, courses that counted towards satisfying undergraduate degree requirements, courses that do not relate to the graduate program as stated in this catalog, or had a grade lower than B.

Studies for the MS must be completed within a five-year period, unless there is a formal leave of absence approved prior to the period for which the studies are interrupted. The degree requirements are:

ME 600	<i>Applied Computational Methods</i>	3
ME 604	<i>Transport Phenomena</i>	3
ME 621	<i>Stress Analysis</i>	3
ME 660	<i>Feedback Control</i>	3
ME	<i>Required for Specialty Area (see below)</i>	6
Dept.	<i>Electives, approved by graduate adviser</i>	9
	<i>Free Electives</i>	9
<i>Total</i>		36

## Typical Course of Study for the Bachelor of Science in Mechanical Engineering

### FRESHMAN YEAR

#### Fall Semester

Course No.	Subject	Hours/Week				Cr.
		Class	Lab	Rec.	Cr.	
EG 101	Intro. to Eng.	2	3	0	3.0	
MA 106	Calculus I	3	0	2	4.0	
CM 101	Gen. Chem. I	3	0	0	2.5	
CM 111	Chem. Lab I	0	0.5	0	0.5	
CS 200	Prog. Meth.	3	0	1	3.0	
HU 101/103	Writ. & Hum. I	3	0	0	3.0	
SL 101	Fresh. Sem.	1	1	0	0.0	
<b>16.0</b>						

#### Spring Semester

Course No.	Subject	Hours/Week				Cr.
		Class	Lab	Rec.	Cr.	
G 102	Intro. to Eng. Des.	2	3	0	3.0	
MA 107	Calculus II	3	0	2	4.0	
CM 102	Gen. Chem.		3	0	0	
	2.5					
CM 112	Chem. Lab II	0	1.5	0	0.5	
PH 107	Mechanics	4	0	0	3.0	
HU 200	Writ. & Hum. II	3	0	0	3.0	
<b>16.0</b>						

### SOPHOMORE YEAR

#### Fall Semester

MA 108	DE's & Num. Meth	3	0	0	3.0
PH 108	Elec. & Fluids	4	0	0	3.0
PH 118	Phys. Lab I	0	1.5	0	0.5
SS 104	History	3	0	0	3.0
ME 111	Statics	3	0	0	3.0
MT 305	Mech. Prop. Mat.	3	0	0	3.0
ME 101	Eng. Graphics	1	3	0	2.0
<b>17.5</b>					

#### Spring Semester

MA 109	Multidim. Calc.	3	0	1	3.0
PH 109	Waves, Them.	4	0	0	3.0
PH 119	Phys. Lab II	0	1.5	0	0.5
HU 110	Prof. Rpt. Writ.	3	0	0	3.0
ME 112	Dynamics	3	0	0	3.0
ME 121	Mech. Mater.	3	0	0	3.0
<b>15.5</b>					

### JUNIOR YEAR

#### Fall Semester

MA 222	Intro Prob. & Stat.	3	0	0	3.0
ME 201	Thermo. I	3	0	0	3.0
ME 321	Instrum.	3	0	0	3.0
ME 231	Fluids I	3	0	0	3.0
SS/HU	Elective	3	0	0	3.0
<b>15.0</b>					

#### Spring Semester

ME 301	Synth. Mech. Syst.	3	0	0	3.0
ME 324	Instr. Lab	0.5	1.5	0	1.0
ME 351	Fluid Mechanics Lab	0.5	1.5	0	1.0
ME	ME Core Elective	3	0	0	3.0
ME	ME Core Elective	3	0	0	3.0
	Technical Elective	3	0	0	3.0
SS/HU	Elective	3	0	0	3.0
<b>17.0</b>					

### SENIOR YEAR

#### Fall Semester

ME 302	Des. Mach Elem.	3	0	0	3.0
ME 361	Senior Des. Proj. I.	0	6	0	2.0
ME	Lab I	0.5	1.5	0	1.0
HU/SS	Elective	3	0	0	3.0
ME 341	Finite Elements	3	3	0	4.0
	Free Elective	3	0	0	3.0
<b>16.0</b>					

#### Spring Semester

ME 362	Senior Des. Proj. I.	0	6	0	2.0
	Technical Elective	3	1	0	3.0
ME	Lab II	0.5	1.5	0	1.0
HU/SS	Elective	3	0	0	3.0
	Technical Elective	3	0	0	3.0
	Free Elective	3	0	0	3.0
<b>15.0</b>					

**Total credits required for graduation:**

**128**

#### Notes:

One of the technical electives must come from within the mechanical, aerospace, industrial or manufacturing programs of the department. ME core requires that students select two out of the following three courses and take the corresponding laboratories in the senior year:

ME 271	Stress Analysis	(Lab: ME 273 Stress Lab)
ME 203	Heat Transfer	(Lab: ME 352 Heat Transfer Lab)
ME 322	Automated Controls	(Lab: ME 325 Controls Lab)

The third course of the above (with or without the corresponding lab) may be taken as an elective. Free electives can be from any department, including HU/SS.

Departmental electives include courses from ME/IE/MN programs, plus thesis or project credits. Students are encouraged to take at least one graduate course in mathematics as part of the non-ME courses. All courses and program details are subject to adviser approval. If any transfer credits have been granted to the students, the number of nondepartmental credits permitted as electives is reduced from 9 by the number of transfer credits granted. For example, if a student has been granted 6 credits of transfer, the total number of electives that the student can take outside of the department is 3 credits.

**Thermal and Fluid Sciences**

The required courses are at least two graduate courses with last digits in the range of 01 to 19.

ME electives that have been offered the last few years include HVAC, experimental methods in thermal/fluid science, thermal issues in manufacturing processes, turbulent flow, compressible flow and propulsion.

**Mechanical Analysis and Design**

The required courses are at least two graduate courses with last digits in the range of 20 to 59.

ME electives that have been offered the last few years include stress analysis II, dynamics of machines, fracture mechanics, and stress analysis of composite materials.

**Systems, Controls and Robotics**

The required courses are at least two graduate courses with last digits in the range of 60 to 79.

ME electives that have been offered the last few years include linear systems, adaptive control and neural networks.

**REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY DEGREE**

The PhD degree is a terminal degree beyond the MS, focused on engineering research. Students are expected to advance the state-of-the-art in their specialty by original and creative work.

An MS degree in mechanical engineering with a specialization in one of the three departmental areas (thermal/fluid sciences, mechanical analysis/design, systems/controls/robotics) or in aerospace engineering is required for admission to the PhD degree program. A grade-point average of 3.5 or better in the MS work is generally required for admission. In cases in which it is unclear that the required MS specialization has been satisfied, the MS degree requirements of the preceding section shall be used to define the necessary preparation. The same criterion shall be used when the MS degree is in other engineering disciplines.

Unless specially exempted by the faculty, the students have to take the written qualifying examination within the first two offerings of the exam after the date of joining the doctoral program. The general credit requirements for the PhD degree (beyond the BS degree and including MS degree credits) are:

	<i>Units</i>
<i>Major work related to specialty</i>	30-36
<i>Approved courses in two minor areas</i>	24-30
<i>PhD Dissertation (ME 999)</i>	24-30
<i>Total required</i>	90

An MS degree, as defined by the requirements described in the preceding section, will count for 36 credits of the above total. A minor is defined by a set of four minimum courses that are in a given area. For example, a student may choose heat transfer as a major specialty, with minors in mathematics and fluid mechanics.

Studies for the PhD degree must be completed within a five-year period following the MS degree or the date of admission, whichever is later, unless there is a formal leave of absence approved prior to the period for which the studies are interrupted. Once the dissertation is begun, the student must register for at least 3 units of ME 999 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 require-

ment may be made in the last semester of registration if that semester is primarily devoted to finalizing the work and dissertation document. Dissertation grades of U in two consecutive terms will be cause to reconsider whether the student will be permitted to continue doctoral work. Students are required to present the progress in their dissertation work to their guidance committees twice a year (typically at the beginning of each semester).

**UNDERGRADUATE COURSES**

**ME 101 Computer-Aided Engineering Drawing and Geometric Design** 1:3:0:2

Computer-aided drawing generation through the use of parametric, feature-based, 3-D solid modeling design software. Projection theory; multiview, oblique, auxiliaries, sections, dimensions, fasteners, detail, tolerances and assembly drawings. Overview of CIM, creation of CL data, CNC code generation, introduction to finite elements, kinematics analysis and other design tools. Design projects incorporate developed skills, design for manufacturing and easy assembly as well as Web publishing and part realization of selected systems through rapid prototyping. *Prerequisite: EG 102 or adviser's approval.*

**ME 111 Statics** 3:0:0:3

Three-dimensional vector treatment of the static equilibrium of particles and rigid bodies. Equivalent force and couple systems. Distributed force systems. Static analysis of trusses, frames and machines. Friction, impending motion. Methods of virtual work. *Prerequisite: Mechanics (PH 107).*

**ME 112 Dynamics** 3:0:0:3

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. Rotation and plane motion of rigid bodies. *Prerequisite: ME 111.*

**ME 121 Mechanics of Materials**

3:0:0:3

Stresses and strains in tension, torsion and bending members. Statically determinate and indeterminate structures. Deflections of beams. Column instability. *Prerequisite: MT 305.*

**ME 201 Thermodynamics**

3:0:0:3

Properties of pure substances; concepts of work and heat; closed and open systems. The fundamental laws of thermodynamics. Carnot and Clausius statements of the 2nd law. Entropy and entropy production. Heat engines, refrigerators, heat pumps, power and refrigeration, cycles, efficiencies, coefficients of performance. *Prerequisite: PH 109 and MA 108.*

**ME 202 Advanced Thermodynamics**

3:0:0:3

Continuation of ME 201. Irreversibility and availability. Power and refrigeration cycles. Maxwell's equations and other thermodynamic relations. Properties of mixtures; air conditioning. Energy and equilibrium aspects of chemical reactions; flame temperatures. Introduction to phases and chemical equilibrium. *Prerequisite: ME 201.*

**ME 203 Heat Transfer**

3:0:0:3

Fundamentals of conduction and convection heat transfer. Analysis of multi-dimensional geometric for the conduction mode. Convective heat transfer and correlations. Radiation heat transfer. Boiling and condensation. *Prerequisite: ME 201 and ME 231.*

**ME 204 Energy Systems**

3:0:0:3

Fundamentals of heat exchanger design. Parallel, counterflow and crossflow arrangements. Shell and tube considerations. Overall heat transfer coefficient. Radiation heat transfer in furnace design. Gas radiation considerations. Turbo machinery. Design optimization. Power plants. Design projects. *Prerequisites: ME 201, ME 231 and ME 203.*

**ME 212 Heating, Ventilation & Air-conditioning**

3:0:0:3

Review of thermodynamic principles, psychrometric chart and psychrometric analysis, comfort air conditioning and

indoor air quality, heating and cooling system, HVAC system design and equipment selection. Calculation of loads via software packages. *Prerequisite: ME 201.*

**ME 213 Transport Processes**

3:0:0:3

Extension of principles developed in ME 201, ME 231 and ME 203. Energy release and momentum, heat and mass transfer process. Unified treatment using transport phenomena methods. Introduction to boundary layer and development of differential formulations. Laminar and turbulent flow and heat transfer aspects. *Prerequisite: ME 201, ME 231 and ME 203.*

**ME 231 Fluids Mechanics**

3:0:0:3

Introduction to fluids, kinematics, hydrostatics thermodynamics. Basic conservation laws in integral control volume form; conservation of mass, momentum, angular momentum and energy. Bernoulli equation. Potential flow over simple geometries. Flows in pipe networks and ducts. head losses and friction factors. *Prerequisite: ME 112. Also listed under AE 231.*

**ME 232 Compressible Flow**

3:0:0:3

Introduction to compressible flow. Integral and differential form of conservation equations for inviscid compressible flows. One-dimensional compressible flow, flow in nozzles, normal shocks, Fanno and Rayleigh flows. Oblique shock and expansion waves. *Prerequisite: ME 231. Also listed under AE 232.*

**ME 243 Internal Combustion Engines**

3:0:0:3

Introduction and definitions, engine operating characteristics. Thermodynamics of internal combustion engines. Thermodynamics of combustion. Combustion in spark ignition and compression ignition engines. Design for performance and efficiency. Pollutant formation and controls, emissions tests. *Prerequisite: ME 201.*

**ME 261 Vibrations**

3:0:0:3

Undamped and damped vibrating systems. Free vibrations. Harmonic, periodic and transient forces. Forced responses.

Accelerometers. Two- and multi-degree-of-freedom systems. *Prerequisite: ME 112.*

**ME 271 Stress Analysis**

3:0:0:3

Concepts of the classical linear theory of elasticity. Stress, strain, transformations equations, equilibrium equations, compatibility, stress-strain relations, boundary conditions, superposition, St. Venant's Principle, application to extension and bending bars of arbitrary cross section. Unsymmetric bending of beams, calculation of stresses and displacements. Shear flow and shear beams of open and closed thin-walled cross section. *Prerequisite: ME 121 and MA 108. Also listed under AE 271.*

**ME 272 Advanced Stress Analysis**

3:0:0:3

Castigliano's method for trusses, beams and frames. Thick-walled cylinders, shrink fits. Beams on elastic foundations. Thermal stresses in rotors. Torsion of mechanical elements. Laboratory experiment related to determining shear centers, stress concentrations by photoelasticity. *Prerequisite: ME 271. Also listed under AE 272.*

**ME 273 Stress Laboratory**

1:1:0:1

Stress and strain instrumentation and principles. Experiments related to stress analysis and mechanics of materials. *Prerequisite: ME 271.*

**ME 301 Synthesis of Mechanical Systems**

3:0:0:3

Kinematic analysis and design of linkages. Velocity and acceleration images, coriolis acceleration. Instantaneous centers. Design of cams, ordinary and epicyclic gears trains. Geometric and algebraic methods of synthesis for path and function generators. *Prerequisite: ME 101 and ME 112.*

**ME 302 Analysis and Design of Machine Elements**

3:0:0:3

Concepts of design and selection of machine elements. Study of working stress and failure criteria; brittle and ductile materials; stress concentrations; steady and fluctuating loads; fatigue failure; modified Goodman diagram; fatigue

life and Miner's equation. Design of selected machine elements (e.g., shafting springs, screws, belts, brakes, clutches, bearings, lubrication, gears and welded and riveted connections). *Prerequisite: ME 121 and senior status.*

**ME 321 Instrumentation** 3:0:0:3

Measurement statistics: standard deviation, curves of regression, accumulation of errors. Electrical measurements and devices. Instrument systems and components: transduction of mechanical information into analog and digital signals; signal processing and filtering devices; readout devices. Static and dynamic measurements of mechanical components and systems; computer simulation studies. Introduction to digital logic. Computer interfacing. *Prerequisite: PH 108-118; MA 108.*

**ME 322 Automated Controls** 3:0:0:3

Feedback and development of control systems. Transfer functions. Block and signal flow diagram. Responses to a periodic and periodic excitations. Error considerations. Stability: Routh-Hurwitz criterion, root locus, Bode-plot techniques. Laboratory: experiments in instrumentation and controls. *Prerequisite: ME 321.*

**ME 323 Advanced Controls and Robotics** 3:0:0:3

Spatial descriptions and operators. Transformation of vectors. Link description. Link parameters. Algebraic and geometric solution of inverse kinematics. Velocities and static forces. Newton-Euler dynamic formulation. Manipulator dynamics in Cartesian and joint space. Path description and generation. The control problem for manipulators. The hybrid position: force control problem. *Prerequisite: ME 322.*

**ME 324 Instrumentation Laboratory** 1/2:1/2:0:1

Electric measurements, data acquisition, signal conditioning, temperature, strain, airflow, light, position, and velocity measurements, heater, fan, and motor operation.

**ME 325 Controls Laboratory** 1/2:1/2:0:1

ON/OFF, Proportional, and PID control design. Computer-aided control systems design. Temperature system control. Air handling system control. DC-motor control. Solar tracking system control. Pump control. *Prerequisite: ME 322.*

**ME 332 Solid Modeling and Analysis** 2:3:0:3

Study of 3D modeling techniques; application of these techniques using CAD workstations; constructive solid geometry and boundary rep methods to generate 3D objects and assemblies; mass and inertial property analysis; finite element analysis; interference checking and kinematic analysis. An independent design project at the end of this course requires application of all these techniques. *Prerequisite: ME 101.*

**ME 340 Manufacturing Process** 3:0:0:3

Properties of materials relating to fabrication methods. Casting. Metal cutting mechanics, cutting fluids, thermal and vibrational aspects of machining. Machinability criteria. Deformation processing, hot and cold, mechanics of deformation. Joining and welding. Unconventional processing. Electrochemical and electrodischarge machining. *Prerequisite: MT 305.*

**ME 341 Finite Elements** 3:3:0:4

Introduction to the finite element method as it applies to continuum boundary-value problems; development of the element equations by use of energy and variational principles and Galerkin's residual method. Application to one- and two-dimensional problems in structural mechanics, heat transfer and fluid flow. Use of a general purpose finite element code to solve realistic complex problems. *Prerequisite: ME 121 and ME 231.*

**ME 351 Fluid Mechanics Laboratory** 1/2:1/2:0:1

Fluid mechanics instrumentation and principles. Experiments related to fluid mechanics. *Prerequisite: ME 231.*

**ME 352 Heat Transfer Laboratory** 1/2:1/2:0:1

Heat transfer instrumentation and principles. Experiments related to thermodynamics and heat transfer. *Prerequisite: ME 203.*

**ME 361 Design Project I** 0:6:0:2

Seniors are required to take a two-course sequence in which they are exposed to principles of design and the design process, and then undertake one or more specific design course. The designs are generally specified by the student from a list of available projects. Students work in small groups. Written and oral status reports are required. *Prerequisite: senior status.*

**ME 362 Design Project II** 0:6:0:2

The second semester of the senior design sequence. Written and oral presentations are required, as is the design product itself. *Prerequisite: senior status; ME 361.*

**ME 381 Honors Work I**  
*credit to be arranged*

Qualified honors students can pursue independent work under the supervision of a faculty member in advanced topics. *Prerequisite: Senior year status and adviser's approval.*

**ME 382 Honors Work II**  
*credit to be arranged*

Qualified honors students can pursue independent work under the supervision of a faculty member in advanced topics. *Prerequisite: senior status and adviser's approval.*

**ME 391 Selected Topics I** 1:0:0:1

Areas not covered in other courses. Specific topics vary according to instructor, who may be a visiting professor. Topics and prerequisites announced during term prior to offering.

**ME 392 Selected Topics II** 2:0:0:2

Areas not covered in other courses. Specific topics vary according to instructor, who may be a visiting professor. Topics and prerequisites announced during term prior to offering.

**ME 393 Selected Topics III 3:0:0:3**

Areas not covered in other courses. Specific topics vary according to instructor, who may be a visiting professor. Topics and prerequisites announced during term prior to offering.

**ME 394 Selected Topics IV 4:0:0:4**

Areas not covered in other courses. Specific topics vary according to instructor, who may be a visiting professor. Topics and prerequisites announced during term prior to offering.

**GRADUATE COURSES**

**ME 600 Applied Computational Methods 2½:0:0:3**

Computational methods used in formulation and solving problems that occur in engineering. Methods of interpolation, numerical differentiation and integration, solution of linear and nonlinear equations and eigenvalue problems. Finite difference methods. Particular attention to continuum techniques, e.g., Rayleigh-Ritz, Galerkin and collocation. **Also listed under AE 623.**

**ME 700 Finite Elements 2½:0:0:3**

Derivation of element stiffness matrices. Construction of general stiffness matrices in global coordinates. Application to problems in plane stress, plates and shells under static and dynamic loads. Applications in thermal, heat transfer and fluid mechanics. Emphasis on problems involving analysis of systems with many unknowns.

**THERMAL AND FLUID SCIENCES**

**ME 601 Thermodynamics I 2½:0:0:3**

Availability functions, general thermodynamic relations, equations of state, general thermodynamic equilibrium criteria. *Prerequisite: ME 201 or equivalent. Also listed under CH 771.*

**ME 604 Transport Phenomena 2½:0:0:3**

Eulerian and Lagrangian approaches, conservation laws, momentum transfer (Navier-Stokes) equations and their derivations, energy transfer equations and derivations, mass transfer equations scaling analysis and simplifications for internal and external flows, introduction to turbulence. *Prerequisite: ME 231 or equivalent.*

**ME 605 Heat Transfer 2½:0:0:3**

Basic heat transfer mechanisms. Steady and unsteady conduction, including systems with internal heat sources. Internal and external forced and free convection. Radiation between surfaces and in gases. Dimensional and boundary layer considerations. Applications involving fins and heat exchangers. *Prerequisite: ME 203 or equivalent.*

**ME 610 Fluid Dynamics 2½:0:0:3**

Conservation laws of mass momentum and energy. Elements of potential theory and gas dynamics. Applications of inviscid flow to simple internal and external geometries; control volume and differential approach to fluid dynamic problems. *Prerequisite: ME 231 or equivalent. Also listed under CH 631.*

**ME 701 Advanced Thermodynamics 2½:0:0:3**

Continuation of ME 605. Applications of thermodynamic equilibrium criteria to various problems, including chemical reactions. *Prerequisite: ME 601.*

**ME 706 Convective Heat Transfer 2½:0:0:3**

Developments and applications of laminar hydrodynamic and thermal boundary layer equations for fluid media. Mechanics of turbulence; formulation and analysis of turbulent hydrodynamics and thermal applications; natural convection and film evaporation and condensation. *Prerequisite: ME 604 or ME 605, or adviser's permission.*

**ME 707 Conductive Heat Transfer 2½:0:0:3**

Theoretical development of transient and steady-state temperature distributions in finite and infinite solids. Appropriate mathematical techniques introduced as required. Solids undergoing phase change and two-dimensional fields. *Prerequisite: ME 604 or ME 605, or adviser's permission.*

**ME 708 Radiative Heat Transfer 2½:0:0:3**

Fundamentals of radiative mechanisms of energy transfer. Definitions of basic quantities. Equations of transfer, radiative heat flux vector and conservation equations. Properties of surfaces and participating media. Applications to engineering systems. *Prerequisite: ME 604 or ME 605, or adviser's permission.*

**ME 711 Viscous Flow and Boundary Layers 2½:0:0:3**

Introduction to molecular and macroscopic transport, concepts of stress and strain, and derivation of the Navier-Stokes equations. Application to problems of diffusion, boundary layers and slow motion. Analytic and numerical methods are presented. *Prerequisite: ME 604 or ME 610. Also listed under AE 742.*

**ME 712 Turbulent Flow 2½:0:0:3**

General theories of turbulence, basic concepts, transition, homogeneous turbulence, analysis of turbulent shear flows, turbulent heat and mass transfer, experimental methods. *Prerequisite: ME 604 or ME 610 and ME 711. Also listed under AE 743.*

**ME 713 Compressible Flow 2½:0:0:3**

Subsonic, transonic and supersonic flows over two-dimensional and axisymmetric bodies. Shock wave development in both one-dimensional unsteady and two-dimensional steady flow systems. Internal and external flows are considered. *Prerequisite: ME 604 or ME 610. Also listed under AE 741.*

**ME 715 Computational Methods in Thermal-Fluid Sciences** 2%:0:0:3

Numerical analyses. Finite difference approximations, error and stability analyses, numerical dispersion and damping, matrix inversion methods. Implicit and explicit procedures, SOR, ADI, hopscotch and direct solvers for evaluating linear and nonlinear diffusion and convection problems. *Prerequisite: ME 600 and ME604 or ME 605 or ME 610. Also listed under AE 732.*

**ME 716 Experimental Methods in Thermal-Fluid Sciences** 2%:0:0:3

Integrated survey of the principal techniques and instrumentation used for obtaining experimental data in thermal-fluid sciences. Topics include calibrations, accuracy, generalized performance characteristics, various devices for measuring flow, velocity, pressure, temperature, heat flux, computerized data acquisition, planning experimental programs, parametric mapping and noise in measuring systems. *Prerequisite: ME 604 or ME 605 or permission of graduate adviser.*

**ME 717 Thermal Design of Electronics Systems** 2%:0:0:3

Thermal modeling and simulation of electronic equipment and systems, forced and natural air cooling, cooling with water and other liquids, cryogenic cooling, use of cooling correlations, approximate numerical formulations, fan characteristics, fan and disc acoustic noise, chip thermal profiles, thermal influence on the reliability of semiconductor circuits. *Prerequisite: ME 604 or ME 605 or permission of graduate adviser. Also listed under MN 802.*

**ME 718 Thermal Issues in Manufacturing Processes** 2%:0:0:3

Thermal modeling and simulation of manufacturing and materials processing, thermally driven processes, dip coating, thin films, soldering, laser welding and cutting, heat removal from processes generating parasitic heat, thermal management of machining. *Prerequisite ME 604 or ME 605 or permission of graduate adviser. Also listed under MN 804.*

**ME 803 Combustion** 2%:0:0:3

Chemical characteristics of flames. 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. *Prerequisite: ME 201 and ME 604.*

**ME 809 Multiphase Heat Transfer** 2%:0:0:3

Conservation equations for two-phase flow systems with emphasis on gas-liquid mixtures. Bubbly, slug, annular and fog flow regimes. Pressure drops and heat transfer. Nucleate and film boiling; drop-wise and film condensation. Critical heat flux. *Prerequisite: ME 201 and ME 706.*

**MECHANICAL ANALYSIS AND DESIGN**

**ME 621 Stress Analysis I** 2%:0:0:3

Review of theory of beam bending. Use of energy methods applied to statically indeterminate structures. Columns, beam columns, beams on elastic foundations. Circular cylindrical shells. Discontinuity analysis in complex structures. *Prerequisite: ME 271 or equivalent.*

**ME 622 Stress Analysis II** 2%:0:0:3

Stress-strain relationships. Two-dimensional stress and strain analysis; equations of compatibility and equilibrium; the Airy stress function. Solutions of various classic two-dimensional problems, including those of stress concentration and thermal stress. Torsion of prismatic bars, open and closed thin-walled structures, and multi-cellular structures. *Prerequisite: ME 621.*

**ME 643 Energy Methods in Structural Analysis** 2%:0:0:3

Unified treatment of structural analysis using the principles of virtual work, total potential energy, total complementary potential and mixed energy. Applications to trusses, beams, frames, rings, sandwich structures, and to plane stress and plane strain problems. Rayleigh-Ritz

procedure, Galerkin method. *Prerequisite: mechanical engineering adviser's approval.*

**ME 644 Mechanical Vibrations I** 2%:0:0:3

Dynamics of one-, two-, and multi-degree-of-freedom systems with and without damping. Application to balancing of multicylinder engines, crank mechanism dynamics and rotating machinery. *Prerequisite: ME 261.*

**ME 645 Mechanical Vibrations II** 2%:0:0:3

Free and forced longitudinal, torsional and transverse vibrations of bars, shafts, and beams. Lagrange's equations. Rayleigh-Ritz and Dunkerley's approximations. Holzer's and transfer matrix methods. *Prerequisite: ME 644.*

**ME 651 Advanced Dynamics I** 2%:0:0:3

Kinematics and dynamics of a particle in space; translating and rotating frames of reference. Systems of particles: plane motion of rigid bodies. Two-body central force problem. Lagrange equations with holonomic and nonholonomic constraints: applications. *Prerequisite: ME 261. Also listed under AE 651.*

**ME 652 Advanced Dynamics II** 2%:0:0:3

General motions of rigid bodies, Euler's equations, gyroscopic motions and stability, impulsive motions. Linear oscillations of two-degree- and n-degree-of-freedom systems, matrix formulations, applications, variational principles. *Prerequisite: ME 647. Also listed under AE 652.*

**ME 721-722 Elasticity I, II** each 2%:0:0:3

Stress and strain tensors; generalized Hooke's Law. Formulation of elasticity problems. Plane stress and strain problems; solutions by complex variables; stress concentrations. Rotating discs and cylinders. Thermal stresses. Three-dimensional problems; St. Venant problems, extension, flexure, torsion. Energy principles and variational methods; approximation techniques. *Prerequisite: ME 621.*



**ME 724 Stress Analysis of Composite Materials** 2%:0:0:3

Composite materials (high strength filaments embedded in a matrix) have relatively a large strength-to-weight ratio as well as other desirable characteristics. Composites are analyzed first from a micromechanics point of view. The relations between the material properties of their components and those of the composite, a material stress concentration factor and its behavior beyond the elastic range are considered. The stress-strain law of composites, as a function of the directional moduli of elasticity and the directional Poisson's ratios, are presented. It is used in the analysis of various structural components of current interest. *Co-requisite: ME 622 or adviser's permission.*

**ME 735 Fracture Mechanics** 2%:0:0:3

Introduction to fracture mechanics. 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 621 or adviser's permission. Also listed under CE 645 and MT 645.*

**ME 741 Structural Dynamics** 2%:0:0:3

Dynamic response of single-degree-of-freedom systems. Theory of vibration of multidegree-of-freedom systems: influence coefficient method; analytical and numerical solution of dynamic response problems. Nonlinear analysis of single-degree-of-freedom system; emphasis on computer analysis of large complex systems. *Prerequisite: ME 645. Also listed under CE 625.*

**SYSTEMS, CONTROLS AND ROBOTICS**

**ME 660 Discrete Time Feedback Control** 2%:0:0:3

Introduction to discrete systems, z-transform, s-to-z transformation, system stability criteria, digital control design via continuous design (root locus technique, frequency domain compensation), discrete design of digital control, sampling rate selection, quantization errors. *Prerequisite: ME 322 or equivalent.*

**ME 661 Sensor Based Robotics** 2%:0:0:3

Robot mechanisms, robot arm kinematics (direct kinematics, inverse kinematics), robot arm dynamics (Lagrange-Euler formulation and Hamiltonian formulations), trajectory planning, sensing, end-effector mechanisms, force and moment analysis, introduction to control of robot manipulators. *Prerequisite: ME 660. Also listed under EL 522.*

**ME 670 Linear Systems** 2%:0:0:3

Basic system concepts. Equations describing continuous and discrete-time linear systems. Time domain analysis, state variables, transition matrix, impulse response. Transform methods. Time-variable systems. Controllability, observability and stability. *Also listed under EL 610.*

**ME 671 State Space Design For Linear Control Systems** 2%:0:0:3

Topics to be covered included canonical forms; control system design objectives; feedback system design by pole placement; linear observers; the separation principle; linear quadratic optimum control; random processes; Kalman filters as optimum observers; the separation theorem; robust control; the servo compensator problem. *Prerequisite: ME 670. Also listed under EL 725.*

**ME 761 Nonlinear Control** 2%:0:0:3

Phase-plane analysis of nonlinear systems, describing functions, introduction to Lie algebra, input-output linearization, local and global system decomposition, perturbation control, sliding control. *Prerequisite: ME 660 and ME 671.*

**ME 771 Optimal Control Theory** 2%:0:0:3

Optimal control problem for deterministic systems with various constraints. Solution for both continuous and discrete-time systems using the maximum principle and dynamics programming. Hamilton-Jacobi theory as applied to the synthesis problem. *Prerequisite: ME 671. Also listed under EL 823.*

**ME 860 Application of Nonlinear Control to Robotics** 2%:0:0:3

Differential geometric approaches for control of nonlinear systems and applications to robot manipulators. Introduction to Lie algebra and Lie bracket. Multivariable inverses for nonlinear systems, external feedback linearization, zero dynamics. Application of nonlinear control to robotics: inverse dynamics, feedforward control, PD and PID controllers, variable-structure control, adaptive control techniques (STR and MRAC) and force control. *Prerequisite: ME 661 and ME 671. Also listed under EL 822.*

**ME 870 Frequency Domain Methods in Control** 2%:0:0:3

Systems and operators, stabilizability, parameterization of stabilizing controllers, H<sub>∞</sub> weighted sensitivity minimization for rational plants, H<sub>2</sub> and H<sub>∞</sub> controller design. *Prerequisite: ME 671. Also listed under EL 724.*

**ME 871 Adaptive Control** 2%:0:0:3

Controllable and observable system models, parameter estimation (least squares, projection algorithm, lattice filters), one and multi-step ahead prediction control, minimum variance, pole placement, LQG control, model reference adaptive control. *Prerequisite: ME 671. Also listed under EL 826.*

**ME 872 Stochastic Control** 2%:0:0:3

Introduction to stochastic control, stochastic processes, covariance and spectral density, stochastic state models, spectral factorization of continuous or discrete time processes, parametric optimization, introduction to prediction and filtering theory. *Prerequisite: ME 771. Also listed under EL 827.*

**ME 873 Large-Scale Systems and Decentralized Control** 2%:0:0:3

Introduction to analysis and synthesis of large-scale systems. System order reduction algorithms, interconnected system stability, series expansion and singular perturbation. Decentralized control: decentralized fixed modes, LQR, frequency shaped cost functional and overlapping decompositions. *Prerequisite: ME 771. Also listed under EL 825.*

**SELECTED TOPICS,  
PROJECTS, THESIS  
AND DISSERTATION**

**ME 786-787 Special Topics**

2½:0:0:3

These numbers are reserved for special topics which are offered periodically by the ME program and are open to first-year graduate students. When offered, the specific subject matter is indicated as part of the title after the words "Special Topics:", and the more complete title appears on the student's transcript. *Prerequisites are tailored to the offering.*

**ME 886-887 Advanced Topics**

2½:0:0:3

These numbers are reserved for advanced topics which are offered periodically by the ME 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 more complete title appears on the student's transcript. *Prerequisites are tailored to the offering.*

**ME 901-904 Guided Readings I, II,  
III, IV**

each 3 units

Open to qualified graduate students interested in special advanced topics. Directed study including analytical work and/or laboratory investigations. *Prerequisite: adviser's permission.*

**ME 996 MS Project**

each 3 units

Engineering project pursued with guidance of faculty member. Project titles submitted in writing to department head and appointed adviser. May be extended to thesis with project adviser's recommendation. Credit only upon completion of project. *Prerequisite: degree status.*

**ME 997 MS Thesis**

each 3 units

Master's thesis to present results of original investigation in field of student's specialty. Thesis an extension of ME 996, on recommendation of project adviser. Continuous registration required. Maximum of 12 units of ME 996-997 counted toward degree. *Prerequisite: ME 996.*

**ME 999 PhD Dissertation**

each 3 units

Doctoral dissertation evincing independent study and original contributions in field of specialization. Oral examination on subject of dissertation and related topics required. Minimum of 24 units; also continuous registration at minimum of 3 units per semester required until dissertation completed. *Prerequisite: degree status.*

The following graduate courses are offered on an irregular basis in response to student demand:

ME 602	<i>Thermodynamics II</i>
ME 633	<i>Limit Analysis of Structure</i>
ME 635	<i>Pressure Vessel Analysis</i>
ME 657	<i>Computational Geometry for CAD</i>
ME 658	<i>Computer-Aided Design</i>
ME 723	<i>Experimental Stress Analysis</i>
ME 725	<i>Theory of Plates</i>
ME 726	<i>Theory of Shells</i>
ME 733	<i>Applied Plasticity</i>
ME 821	<i>Continuum Mechanics</i>
ME 831	<i>Stability of Structures</i>

# GENERAL ENGINEERING PROGRAM

Director: Neil Mahoney  
Assistant Director: Robert J. Rusnack

## PROGRAM OBJECTIVES

Engineering is a wide-ranging field of many disciplines having the common objective of applying science and technology towards the betterment of humanity. Although today's challenges are new as a result of rapidly changing technology, the basic study of engineering remains focused on the laws of nature. The realization that the work of the engineer touches all aspects of society has broadened the pursuit to now include political, social and human considerations as well as the ability to communicate one's ideas.

Emerging technologies affect businesses and entire industries in the New York metropolitan area and across the nation. The economic growth and career opportunities that this high-technology boom is spurring holds great promise for men and women who are educated in science and engineering.

With these things in mind, the goal of the General Engineering Program is to make the study of engineering a hands-on, experiential learning process which will:

1. Provide entering freshmen with meaningful knowledge and experience pertaining to what engineers do, the problem solving processes they use and some exposure to the modern technologies they employ.
2. Provide upper-level freshman engineering majors with an understanding of the engineering design process, including cost, quality and manufacturability considerations, and provide the opportunity to practice basic skills in practical design and construction projects.

3. Provide select sophomore and junior students the opportunity, on an optional basis, to continue working on realistic, interdisciplinary design projects. Some typical projects include a sound-activated motorized wheelchair, a model railroad with computerized command and control, a user-interactive information system and wireless communications systems.

4. Give students in all of these courses the opportunity to work in small interdisciplinary teams to promote the breadth of their understanding, develop interpersonal skills and provide practice to hone their writing and verbal capabilities.

General engineering facilities include three laboratories with nine workstations in each lab. Each workstation is equipped with a computer running word processing, spreadsheet, CAD (computer-aided design) and data acquisition/simulation software. In addition, all of the labs contain the professional tools and equipment needed to carry out professional engineering projects.

Any inquiries or requests for additional information can be directed to either the Freshman Engineering Office on the Brooklyn campus, located at JB152, 718/260-3938; on the Farmingdale campus, located at FMB116, 516/755-4324; or Professor Neil Mahoney, JB152A, 718/260-3938, e-mail: nmahoney@poly.edu.

## COURSE DESCRIPTIONS

### EG 101 Introduction to Engineering

1:3:1:3

Presentation of engineering data. Simple robots. Choosing engineering materials and material failure. Waves and frequen-

cy spectra. Digital electronics. Information technology. Fiber-optic communication. Thermodynamics. Use of word processing, spreadsheet and data acquisition software. This course is part of Writing and Speech Across the Curriculum.

### EG 102 Introduction to Design

1:3:1:3

The design process: generation of ideas, analysis of alternatives, prototype construction, testing and presentation. Writing proposals and progress reports. Cost estimation. Time management and efficiency. Voltage, current and power. Fluid mechanics. Simple mechanical machines. Finding and filing patents. Engineering ethics and environmental concerns. Use of word processing, spreadsheet and CAD software. This course is part of Writing and Speech across the curriculum. *Prerequisite: EG 101 or permission of the course director.*

### EG 201 Multidiscipline Projects I

½:2:½:1

Research, proposal, design, prototype construction, testing and demonstration of multidiscipline design projects for first semester sophomores. Project topics will be suggested by faculty and/or proposed by student teams for faculty approval. *Prerequisite: EG 101 and EG 102 (with a grade of B or better in both); sophomore status (with a 2.5 or better GPA); permission of department adviser and course director. Students without the stated prerequisites are encouraged to consult their department adviser regarding waiver potential.*

### EG 202 Multidiscipline Projects II

½:2:½:1

Research, proposal, design, prototype construction, testing and demonstration of multi-discipline design projects for second semester sophomores. Project topics will be suggested by faculty and/or proposed by student teams for faculty approval. *Prerequisite: EG 101 and EG 102 (with a grade of B or better*

## PROGRAMS

*in both); sophomore status (with a 2.5 or better GPA); permission of department adviser and course director. Students without the stated prerequisites are encouraged to consult their department adviser regarding waiver potential.*

### **EG 301 Multidiscipline Projects III**

*1/2:2:1/2*

Research, proposal, design, prototype construction, testing and demonstration of multidiscipline design projects for first semester juniors. Project topics will be suggested by faculty and/or proposed by student teams for faculty approval. *Prerequisite: EG 101 and EG 102 (with a grade of B or better in both); junior status (with a 2.5 or better GPA); permission of department adviser and course director. Students without the stated prerequisites are encouraged to consult their department adviser regarding waivers.*

### **EG 302 Multidiscipline Projects IV**

*1/2:2:1/2*

Research, proposal, design, prototype construction, testing and demonstration of multidiscipline design projects for second semester juniors. Project topics will be suggested by faculty and/or proposed by student teams for faculty approval. *Prerequisite: EG 101 and EG 102 (with a grade of B or better in both); junior status (with a 2.5 or better GPA); permission of department adviser and course director. Students without the stated prerequisites are encouraged to consult their department adviser regarding waivers.*

## **PARTICIPATING FACULTY**

The faculty members involved in delivering the general engineering courses participate on a revolving basis. These faculty members, as well as the student aides, represent all the departments throughout the University.

# PHYSICS PROGRAM

The degree programs in physics are administered by the Physics Task Team, chaired by Professor Kalle Levon, which is located in room 801 in Rogers Hall. More information can be obtained by calling 718/260-3339 or by sending an e-mail message to [admitme@poly.edu](mailto:admitme@poly.edu).

Physics is the basic science of the natural world—the science of matter, energy and motion. It is indispensable for any engineering or scientific career.

The training of physics majors, at both undergraduate and graduate levels, is basic and general. This broad preparation makes graduates less subject to the risks of obsolescence produced by the rapidity of technological change in modern life. Curricula are designed as backgrounds for careers in industry, government and education. Physics graduates at all levels are employed in private industry, government agencies and research foundations for fundamental research and engineering. Training in physics serves as a valuable preparation for any science-based or science-related careers.

Besides the very active fields of solid-state and nuclear physics, other general areas in which physicists are now employed are radio/television and electronics, the chemical industry and biophysics, space science and medical physics.

A complete spectrum of physics courses is offered at Polytechnic, ranging from first-year courses to the doctoral level, and leading to bachelor's, master's and doctoral degrees.

## FACULTY

### PROFESSORS

**Stephen Arnold**, Thomas Potts  
Professor of Physics and University  
Professor  
PhD, City University of New York  
*Optics, microparticle photophysics,  
organic solid-state physics*

**Hellmut J. Juretschke**, Professor of  
Physics  
PhD, Harvard University  
*Surface and condensed matter physics,  
theory of x-ray diffraction*

**K. Ming Leung**, Professor of Physics  
PhD, University of Wisconsin  
*Theoretical condensed matter*

**Peter S. Riseborough**, Professor of  
Physics  
PhD, Imperial College (London)  
*Theoretical condensed matter physics*

**Edward L. Wolf**, Professor of Physics  
PhD, Cornell University  
*Experimental condensed matter physics,  
superconductivity, scanning tunnel  
microscopy and electron tunneling spec-  
troscopy*

### ASSOCIATE PROFESSOR

**Lorcan M. Folan**, Associate Professor  
of Physics  
PhD, Polytechnic University  
*Hyperfine interactions in beta decay*

### INDUSTRY FACULTY

**Thomas M. Pannaparayil**, Industry  
Professor of Physics  
PhD, Fordham University  
*Magnetism of fine particles, Mossbauer  
spectroscopy*

**Valery A. Shevrev**, Industry Assistant  
Professor of Physics  
PhD, St. Petersburg University  
*Experimental optics, spectroscopy, plas-  
ma physics*

### RESEARCH FACULTY

**Marcu Eibschutz**, Research Professor  
of Physics and Materials Science  
PhD, The Weizmann Institute of Science  
*Experimental solid state, Mossbauer  
spectroscopy*

**Moses Fayngold**, Research Assistant  
Professor of Physics  
PhD, Nuclear Research Institute, (Russia)  
*Theoretical physics, optics, particle-  
solid interactions*

**Yuli M. Ivanchenko**, Research  
Professor of Physics  
PhD, University of Donetsk  
*Condensed matter theory, superconduc-  
tivity, tunneling*

**Vladimir I. Tsifrinovich**, Research  
Assistant Professor of Physics  
PhD, Kirensky Institute of Physics  
(Russia)  
*Theoretical condensed matter physics,  
magnetic resonance spectroscopy*

### INSTRUCTOR

**John DiBartolo**, Instructor of Physics  
PhD, University of Virginia  
*Superconductors*

### ADJUNCT FACULTY

**Benjamin Bloch**, Adjunct Professor of  
Physics  
PhD, Polytechnic Institute of Brooklyn

### EMERITUS FACULTY

**Raphael Aronson**  
**Hilda Bass**  
**John J. Dropkin**  
**Walter Kiszewick**  
**Terje Kjeldaas Jr.**

## UNDERGRADUATE PROGRAM

The aim of the four-year undergraduate program in physics is to prepare students thoroughly for any one of the many careers for which a concentration in physics forms the base. For some students, this means preparation for graduate school and further study leading to the master's or doctor's degree. For many others, it means professional work in industry, government or in high school teaching. Some students use their major in physics as preparation 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 paths.

The structure of the undergraduate program is four-fold: formal instruction in the sciences; instruction in the humanities and the social sciences; informal instruction; and additional activities.

**Formal instruction in the sciences** is described by its program of courses. This program includes—after the freshman year with its beginning courses in physics, chemistry and mathematics—a spiraling sequence of courses in the three broad areas of mechanics, electromagnetic theory and modern physics, matched at each level to the student's increasing mathematical maturity. With this background, a senior is ready for theoretical physics and electives in optics, solid-state, x-ray, nuclear physics or quantum theory.

**Instruction in the humanities and social sciences** is built around the 27 credit hours of courses in the humanities and the social sciences required of all physics majors. Students are urged to choose additional courses in these areas. The natural curiosity which brought students to choose physics as a major should also be stimulated in other areas of intellectual activity such as literature, psychology, poetry, music, economics and history.

**Informal instruction** accompanying the formal course work takes a variety of forms. All students meet regularly with members of the physics faculty to dis-

cuss their work, review problems or talk physics.

All physics freshmen take a seminar on current advances in physics; seniors may participate in another seminar. In both, students prepare talks on aspects of advanced topics in physics and present them to the critical audiences of their peers and professors.

Many students spend some time in research, either assisting in the various research programs performed by the faculty or working on relatively independent research projects assigned after consultation with their adviser. Undergraduate participation in research with graduate students and professors is becoming extremely important. A number of juniors and seniors now spend 10 weeks each summer in such full-time research activity. Opportunities for guided research during the academic year also exist.

The program offers opportunities for individual reading and advanced study under professional guidance and accepts satisfactory performance in regular course examinations as fulfillment of course requirements.

Physics students have a common study area in which they meet with other students for shop talk, problem solving and the exchange of ideas.

Information about advanced placement of freshmen is included in the section of this catalog "Admissions."

**Additional activities**, in which all physics students are urged participate, include the programs organized by the Physics-Math Society, by the chapter of Sigma Pi Sigma (the physics honor society) and by the local student chapter of the American Physical Society. Here the students listen to and meet speakers on various topics and participate in trips to industrial and government laboratories. Undergraduates are encouraged to come to the regular research colloquia where invited scientists discuss the latest advances in physics. They also attend meetings of the American Physical Society and other professional societies associated with the American Institute of Physics.

By means of these activities and through the structure of the program, students have a wide range of opportunities for interacting with their professors, their fellow students and with the world of physics. Such interaction is the most valuable preparation for any career in physics. This blending of experiences leads to appreciation of the intellectual impact of physics and to understanding why so many important thinkers have been attracted to physics and have added to its achievements.

### REQUIREMENTS FOR THE BACHELOR OF SCIENCE IN PHYSICS

The program requires 128 credits, including 37 credits of required courses in physics. The remaining credits are distributed among required and elective technical, humanities and social sciences courses and free elective courses. (See Typical Course of Study below). The distribution is as follows:

Core Courses	Credits
HU 101, 110, 200; SS 104; CS 200; EG 101 CM 101, 102, 111, 112; MA 106, 107, 108, 109; PH 107, 108, 109, 118, 119	48
<b>Required Physics Courses</b>	
PH 113, 210, 234, 302, 311, 312 323, 324, 335, 336, 390	27
<b>Elective Courses</b>	
<i>Physics/Technical</i>	23
<i>Humanities/Social Science</i>	15
<i>Mathematics</i>	9
<i>Free</i>	6
<i>Total</i>	128

### ELECTIVES

Elective courses are chosen in consultation with the departmental adviser. In mathematics 9 credits must be taken from the group MA 153, 201, 217, 222, 260 and 358. Recommended physics elective courses are PH 250, 303, 340, 347, 360, 373 and 374.

## Typical Course of Study for the Bachelor of Science in Physics

### FRESHMAN YEAR

#### Fall Semester

Course No.	Subject	Hours/Week			
		Class	Lab	Rec.	Cr.
PH 113	Seminar in Current Physics	2	0	0	2
CM 101	General Chemistry I	3	0	1	2.5
CM 111	General Chemistry Lab I	0	1.5	0	0.5
MA 106	Calculus I	3	0	1	4
EG 101	Introduction to Engineering	2	3	0	3
HU 101	Writing and the Humanities I	3	0	0	3
SL 101	Freshman Seminar <sup>1</sup>	1	1	0	0
PE 10x	Physical Education <sup>2</sup>	0	2	0	0
					15

#### Spring Semester

Course No.	Subject	Hours/Week			
		Class	Lab	Rec.	Cr.
CS 200	Intro. Prog. Meth.	3	1	0	3
CM 102	General Chemistry II	3	0	1	2.5
CM 112	General Chemistry Lab. II	0	1.5	0	0.5
MA 107	Calculus II	3	0	1	4
PH 107	Mechanics	3	0	1	3
SS 104	Contemp. World History or				
HU 200	Writing and the Humanities II	3	0	0	3
PE 10x	Physical Education <sup>2</sup>	0	2	0	0
					16

### SOPHOMORE YEAR

#### Fall Semester

MA 108	Diff. Eqns. and Num. Meth.	3	0	0	3
MA 109	Multidimensional Calculus	3	0	0	3
PH 108	Elec., Mag. & Fluids	3	0	1	3
PH 118	Laboratory for PH 108	0	1.5	0	0.5
PH 210	Analytical Mechanics	3	0	0	3
SS 104	Contemp. World History or				
HU 200	Writing and the Humanities II	3	0	0	3
PE 10x	Physical Education <sup>2</sup>	0	2	0	0
					15.5

#### Spring Semester

PH 109	Waves, Optics & Thermo.	3	0	1	3
PH 119	Laboratory for PH 109	0	1.5	0	0.5
PH 234	Intro. to Modern Physics	2	0	0	2
PH 250	Electronics for Phys. Scient. <sup>3,4</sup>	3	3	0	4
HU 110	Professional Report Writing	3	0	0	3
PE 10x	Physical Education <sup>2</sup>	0	2	0	0
	Math. Elective <sup>5,6</sup>	3	0	0	3
					15.5

### JUNIOR YEAR

#### Fall Semester

PH 311	Thermodynamics <sup>7</sup>	3	0	0	3
PH 323	Electricity and Magnetism I <sup>7</sup>	2	0	0	2
PH 302	Advanced Lab. I	1	3	0	2
PH 335	Quantum Physics <sup>7</sup>	3	0	0	3
	Math Elective <sup>5,6</sup>	3	0	0	3
	HU/SS Elective <sup>6</sup>	3	0	0	3
					16

#### Spring Semester

PH 312	Stat. Phys. & Kinetic Theory	3	0	0	3
PH 324	Electricity and Magnetism II <sup>7</sup>	2	0	0	2
PH 303	Advanced Lab. II <sup>7</sup>	1	3	0	2
PH 336	Quantum Mechanics <sup>7</sup>	3	0	0	3
	Math. Elective <sup>5,6</sup>	3	0	0	3
	HU/SS Elective <sup>6</sup>	3	0	0	3
					16

### SENIOR YEAR

#### Fall Semester

PH 373	Intro. Theo. Phys. I <sup>7</sup>	3	0	0	3
PH 347	Modern Optics <sup>7,8</sup>	3	3	0	4
PH 667	Quantum Mechanics I <sup>7</sup>	3	0	0	3
	HU/SS Elective <sup>6</sup>	3	0	0	3
	Free Elective	3	0	0	3
					16

#### Spring Semester

PH 340	Sim. Meth. in Phys. Probl. <sup>7</sup>	3	3	0	4
PH 374	Intro. Theo. Phy. II <sup>7</sup>	3	0	0	3
PH 390	Senior Seminar	2	0	0	2
	HU/SS Electives <sup>6</sup>	6	0	0	6
	Free Elective	3	0	0	3
					18

**Total credits required for graduation:**

**128**

#### Notes:

1 Consult the general "Degree Requirements" section of this catalog for University regulations.

2 Although not required, physical education is strongly recommended.

3 Electives are chosen with the adviser's approval.

4 The following course substitutions are permitted with the approval of the undergraduate adviser: ME 201 for PH 311, EE 370 & 374 for PH 250, PH 523 or EE 163 for PH 323, PH 524 or EE 164 for PH 324, PH 535 for PH 335, PH 536 for PH 336, PH 547 & 548 for PH 347.

5 Mathematics. Elective courses (9 credits) are to be chosen from MA 153, 201, 217, 222, 260 and 358.

6 Humanities and Social Sciences. Required courses (12 credits) are HU 101, 110, 200 and SS 104. Elective courses (15 credits); students are strongly urged to select two or three courses from an area of concentration described in the general degree requirements.

7 Advanced electives are strongly recommended for students intending to pursue graduate studies in physics.

## PROGRAMS

### OPTIONS

These programs offer the student an opportunity to gain competence in two different and substantial fields of science, to such an extent that upon earning a bachelor's degree, he or she may be able to qualify for industrial positions in two distinct areas, or to go on to graduate studies in either of the two subjects. Options in mathematics, electronics and materials science are described below as examples of these programs.

The option in mathematics provides strong training in both physics and mathematics, approaching the requirements for separate degrees in each subject. The options in electronics and materials may be viewed as similar to applied physics programs with concentrations in the respective areas. In all cases students benefit from the strong basic training in physics and position themselves for further training or direct employment in the area of their option.

Electronics and materials science are areas of immense importance in today's technology, providing a wide range of employment opportunities in addition to those available in physics. As examples, in the active technology areas of microelectronics and high temperature superconductivity, combined knowledge of physics and electronics or materials opens many opportunities for employment. A student with a strong basic training in physics, in addition to that in his or her option, may enjoy a career with more flexibility and a greater ability to adjust to changing requirements in technology. The changes in course requirements for each option available to students pursuing a BS in physics follow.

### Mathematics Option

Replace 9 credits of math electives and 9 credits of physics electives with the following set of math electives:

MA 153 (3:0:0:3)	<i>Elements of Linear Algebra</i>
MA 201 (3:0:0:3)	<i>Applied Analysis I</i>
MA 202 (3:0:0:3)	<i>Applied Analysis II</i>
MA 223 (3:0:0:3)	<i>Introduction to Probability</i>
MA 260 (3:0:0:3)	<i>Vector Analysis and Partial Differential Equations</i>
MA 358 (3:0:0:3)	<i>Introductory Numerical Analysis</i>

18 credits

### Electronics Option

Replace 19 credits of physics electives with the following set of electronics electives:

EE 101 (3:0:0:3)	<i>Electric Circuits I</i>
EE 102 (3:0:0:3)	<i>Electric Circuits II</i>
EE 105 (3:0:0:3)	<i>Signals, Systems and Transforms</i>
EE 109 (4:0:0:4)	<i>Solid State Devices and Circuits I</i>
EE 110 (3:0:0:3)	<i>Solid State Devices and Circuits II</i>
EE 192 (3:0:0:1)	<i>Sophomore EE Laboratory</i>
EE 195 (1:3:0:2)	<i>Junior EE Laboratory</i>

19 credits

### Materials Option

Replace 12 credits of physics electives with 12 credits in materials science:

MT 305 (3:0:0:3)	<i>Mechanical Properties of Materials</i>
MT 306 (2:3:0:3)	<i>Nature and Properties of Structural Materials</i>
MT 340 (3:0:0:3)	<i>Manufacturing Processes</i>
MT 375 (3:0:0:3)	<i>Semiconductor Technology</i>
MT 603/4 (4:1/2:0:6)	<i>Introduction to Electron Microscopy I/II</i>

or appropriate alternatives.

12 credits

## GRADUATE PROGRAM

The Physics Program offers graduate programs leading to the degrees Master of Science and Doctor of Philosophy in physics.

Experimental research programs are offered in solid state physics, low temperature physics, surface physics, and quantum optics in modern, well-equipped laboratories. Surface physics studies are performed both in the department's extensive surface science laboratories and at various synchrotron radiation facilities (e.g., National Synchrotron Light Source at Brookhaven National Laboratories and Cornell High Energy Synchrotron Source). Areas of current theoretical research are in solid state physics and statistical mechanics within the theoretical condensed matter group as well as research in the areas of field-matter interactions, image restoration and nuclear theory.

For admission to graduate study in physics, a bachelor's degree in physics is required with preparation equivalent to intermediate courses in mechanics, electromagnetic theory, optics, thermodynamics, quantum mechanics and atomic physics. Applicants with degrees in physics of different emphasis, or with a degree in another field, may be admitted with undergraduate deficiencies if approved by the department adviser. All applicants are requested to take the Graduate Record Examination (GRE).

Applicants can apply for teaching fellowships, research fellowships or partial tuition remission.



## REQUIREMENTS FOR THE MASTER OF SCIENCE DEGREE

The requirements for the Master of Science in physics conform to the general Polytechnic requirements (see "Degree Requirements.")

The minimum course requirements for the master's degree are as follows:

No.	Subject	Units
PH 667	<i>Quantum Mechanics I</i>	3
PH 901-902	<i>Physics Colloquium I, II</i>	0
PH 953-954	<i>Graduate Seminar I, II</i>	3
	<i>Elective Courses</i>	30
	Total	36

With the approval of the graduate adviser, up to 9 units of equivalent courses taken elsewhere may be used to fulfill individual course requirements. Registration for PH 901-902, Physics Colloquium, is required each semester for all full-time graduate students.

Elective courses may include a 6-unit project in physics or a 12-unit thesis in physics.

Choices of a project or thesis option and of elective courses should be made with the approval of the graduate adviser. No comprehensive examination is required for the master's degree in physics.

## REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY DEGREE

Requirements for the PhD in physics conform to general Polytechnic requirements. Entrance into the doctoral program of study and research is contingent upon passing the qualifying examination. The student entering with a bachelor's degree normally takes the qualifying examination after one year of study. The examination, given once a year at the beginning of the fall semester, consists of written questions in classical mechanics, electromagnetic theory, statistical mechanics and quantum mechanics, followed by an oral examination. Sample examination questions are available in the departmental office.

After passing the qualifying examination, the candidate suggests a guidance

committee consisting of a prospective research director, a minor adviser and at least one additional member of the physics faculty. The guidance committee must approve the candidate's choice of courses, conducts the dissertation, precis examination and the final dissertation oral examination, and must approve the dissertation before the degree can be awarded.

The minimum course requirement for the PhD degree in physics are:

No.	Subject.	Units
PH 669-670	<i>Quantum Mechanics III, IV</i>	6
PH 953-954	<i>Graduate Seminar I, II</i>	3
PH 901-902	<i>Physics Colloquium I, II</i>	0
PH 999	<i>Research in Physics</i>	24
	<i>Additional Physics courses</i>	33
	<i>Minor Courses</i>	12
	<i>Elective Courses Or</i>	
	<i>Additional Research in Physics</i>	12
	Total	90

With the approval of the graduate adviser, equivalent courses taken elsewhere may be used to fulfill individual course requirements, although a minimum of 30 units including the dissertation units must be taken at Polytechnic. General knowledge of more than one area of physics is expected of all PhD candidates. There is no foreign language requirement for the PhD in physics. Registration for PH 901-902 Physics Colloquium, is required each semester for all full-time graduate students. Once begun, registration for PH 999, Research in Physics, is required each semester consecutively until the completion of the thesis unless leave is formally granted. Until the appointment of the guidance committee, the choice of physics courses, minor courses and elective courses should be made with the approval of the graduate adviser.

Approximately three months before completion of the dissertation, a precis of the proposed work is circulated to the physics faculty and a precis examination held. Upon completion of the dissertation, an oral thesis defense is held.

## UNDERGRADUATE COURSES

### PH 107 Mechanics 3:0:1:3

An introduction to the motion of particles and objects. One-dimensional motion. Forces and acceleration. The conservation of energy and momentum. Vectors and two-dimensional motion. Rotation. The free and driven harmonic oscillator. *Prerequisite: MA 106 or a grade of C+ or better in MA 105.*

### PH 108 Electricity, Magnetism and Fluids 3:0:1:3

An introduction to electric and magnetic forces and fields. Electric charge density. Electric fields from spherical and planar charge distributions. Electric potential. Capacitance. Magnetic forces. Magnetic field from a current loop. Inductance. Ferromagnetism. Current, flow, resistance and introduction to band theory of solids. Fluids at rest and in motion. *Prerequisite: MA 106 and PH 107. Co-requisite: PH 118.*

### PH 109 Waves, Optics and Thermodynamics 3:0:1:3

Water, sound and radio waves. Reflection, scattering and absorption. Standing waves and spectra. Superposition: diffraction and beats. Geometrical optics. Applications of temperature, heat and entropy. *Prerequisite: PH 108 and MA 107. Co-requisites: PH 119 and preferably MA 108 or MA 109.*

### PH 113 Seminar in Current Physics 2:0:0:2

Analyses, lectures, readings and discussions of selected topics of current interest in physics emphasizing concepts and the underlying framework of physical understanding. Topics include astrophysics, atomic and nuclear physics, the solid state and biophysics.

## PROGRAMS

### **PH 118 Physics Laboratory for PH 108** 0:1½:0:½

Principles of measurement in electric, magnetic and thermodynamic experiments. Lab fee required. *Prerequisite:* PH 107. *Co-requisite:* Students who register for PH 118 must co-register for PH 108 unless excused in writing by the Director of the Introductory Physics Program; if they withdraw from one, they must withdraw from the other.

### **PH 119 Physics Laboratory for PH109** 0:1½:0:½

Continuation of PH 118. Experiments in optics and sound. Lab fee required. *Prerequisite:* PH 108 and PH 118. *Co-requisite:* Students who register for PH 119 must register for PH 109 unless excused in writing by the Director of the Introductory Physics Program; if they withdraw from one, they must also withdraw from the other.

### **PH 210 Analytical Mechanics** 3:0:0:3

Statics by virtual work and potential energy methods. Stability of equilibrium. Particle dynamics, harmonic oscillator and planetary motion. Plane rigid body dynamics. *Prerequisite:* PH 104. *Co-requisite:* MA 108.

### **PH 234 Introduction to Modern Physics** 2:0:0:2

Relativity; quantization of electricity, light, and energy; the nuclear atom and electron spin; electron waves; the Schrodinger equation; some properties of solids; atomic physics; nuclear physics and elementary particles. Lectures and discussion sessions. *Prerequisite:* PH 108 and PH 118. *Co-requisite:* PH 109 and PH 119; if students withdraw from PH 119 while co-registered in PH 234, they must also withdraw from PH 234.

### **PH 250 Electronics for Physical Scientists\*** 3:3:0:4

Lectures and laboratory on electrical measurements as currently applied in scientific research. Behavior and applications of discrete and integrated solid-state devices in electronic instrumentation. Introduction to measurements of small signals, noise and shielding prob-

lems, synchronous detection and counting techniques. Outlines of digital electronics and descriptions and applications of several interface standards commonly employed for minicomputers in laboratory settings. *Co-requisite:* PH 109 and MA 108.

### **PH 281 Astronomy and Astrophysics\*** 3:0:0:3

Historical development. Traditional and modern observational techniques. Theories of planets, stars, galaxies. Current advances in astrophysics and cosmology. Offered with sufficient demand. *Co-requisite:* PH 109.

### **PH 302-303 Advanced Lab I, II\*** each 1:3:0:2

Precision measurements in mechanics, heat, electricity, optics, modern physics. Lab fee required. Given alternate years. *PH 302 co-/prerequisite:* PH 335. *PH 303 co-/prerequisite:* PH 302 and PH 336.

### **PH 311 Thermodynamics\*** 3:0:0:3

Experimental bases of fundamental laws of macroscopic thermodynamics. Operational definitions of heat, internal energy, entropy, absolute temperature and other thermodynamic functions. Techniques of deriving and using thermodynamics relations. *Prerequisite:* PH 234.

### **PH 312 Statistical Physics and Kinetic Theory** 3:0:0:3

Introduction to the theory and applications of statistical physics. Entropy, probability distributions and equations of state. Elementary kinetic theory of gases including transport properties. Phase space and density of states. Applications to specific heats, blackbody radiation, physical and optical properties. Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein distributions. *Prerequisite:* PH 311 or ME 201 or instructor's permission.

### **PH 323-324 Electricity and Magnetism I, II\*** each 2:0:0:2

Properties of the electrostatic, magnetostatic and electromagnetic field in vacuum and in material media. Maxwell's

equations with applications to elementary problems. *Co-requisite:* MA 109.

### **PH 335 Quantum Physics** 3:0:0:3

Electrons and nuclear structures of the atom. Relativity, wave mechanics, natural and artificial radioactivity, fission, cosmic rays. Fundamental experiments and postulates of wave and particle physics. *Prerequisite:* PH 234.

### **PH 336 Quantum Mechanics** 3:0:0:3

Introduction to the calculational methods of quantum mechanics with examples and applications. *Prerequisite:* PH 335.

### **PH 340 Simulational Methods in Physical Problems** 2:2:0:4

Computer methods for solutions and simulations of a wide variety of problems in physics. Numerical methods applicable to problems in mechanics, electromagnetism, optics, statistical mechanics, elementary quantum mechanics and the interpretation of experimental data will be discussed. Strategies to determine if computer results are physically reasonable. Numerical simulation techniques for experimental and theoretical problems. Students have access to microcomputers. *Prerequisite:* CS 200.

### **PH 347 Modern Optics** 3:3:0:4

The physics of contemporary optics. Reflections and refractions of rays, matrix optics of optical instruments. Interferences and diffractions of waves and wave packets. Fourier transform optics. Coherence and quantum aspects of light. The laboratory includes computer simulations of optical phenomena, and emphasizes lasers, holography, crystal optics and nonlinear phenomena. *Prerequisite:* PH 324 and PH 336 or equivalents.

### **PH 360 Special Topics in Physics** 3:0:0:3

Lectures in some specialized area, such as acoustics, biophysics or relativity. Topics reflect student and faculty interests and vary from year to year. The course may be taken for credit more than once, for different subject offerings. *Prerequisite:* PH 109 and PH 234.

**PH 372 X-Ray Diffraction\*** 2:3:0:3

Production and properties of x-rays. Elements of crystallography. Stereographic projections. Powder and single crystal diffraction techniques. Structures and crystal orientations. Stress analyses and phase and quantitative chemical analysis by x-ray techniques. *Prerequisite: MA 109 and PH 109. Also listed under MT 412.*

**PH 373-374 Introduction to Theoretical Physics I, II\*** each 3:0:0:3

Mathematical methods used in classical theoretical physics. Lagrange's equations, vibrating strings and membranes, flow of fluids, flow of heat, electrostatics, electrodynamics, Maxwell's equations. *PH 373 Prerequisite: PH 210 and PH 324. PH 374 prerequisite: PH 373.*

**PH 381-382 Reading Course in Physics I, II** each 2:0:0:2

Special topics in physics, supervised by staff member. *Prerequisite: Physics major, junior status and departmental approval.*

**PH 390 Senior Seminar** 2:0:0:2

Topics of general interest prepared, reported and discussed by students. *Co-requisite: PH 336*

**PH 391-394 Bachelor's Thesis in Physics** each 2:0:0:2

An individual investigation involving theoretical, experimental and bibliographic studies of some problem of interest to physicists. Students may register for thesis in parts as noted. Total credits determined in consultation with advisers.

**PH 399 Senior Honors Work in Physics\*** credit to be arranged

Independent work undertaken by qualified honor students. Course material arranged by a faculty steering committee.

\* Not offered every year.

**GRADUATE COURSES**

**PH 523-524† Electricity and Magnetism I, II\*** each 2:0:0:2

Electrostatics boundary-value solutions to Poisson's and Laplace's equations in conductors and dielectrics, multipole expansions, electrostatic potential energy, method of images, magnetostatics, Ampere's law, time varying fields, Maxwell's equations and conservation laws, plane electromagnetic waves, radiation systems and diffraction, special theory of relativity, covariance of electrodynamics, radiation by moving charges, electromagnetic interactions with matter. *Prerequisite: PH 234 and PH 109 or equivalents.*

**PH 535-536† Quantum Physics I, II\*** each 3:0:0:3

Relativity, quantum statistics, Schrodinger wave equation and solutions, time-dependent and time-independent perturbation theory, multi-electron spectra, RS and jj coupling, collision theory, molecular spectra, wave mechanics of solids, nuclear models; and alpha, beta, and gamma decay, fission, fusion, elementary particles, quarks and leptons. *Prerequisite: PH 234 or equivalent.*

**PH 547† Modern Optics** 3:0:0:3

The physics of optics using both classical and semiclassical 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 32 and, PH 336 or equivalents.*

**PH 548† 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 547 or equivalent.*

**PH 603† Graduate Laboratory\*** 0:4:0:3

Practice in experimental research techniques through setting up and carrying out experimental projects in classical and modern physics. Lab fee required.

**PH 604† Physics of Stars\*** 2½:0:0:3

Discussion of internal constitution of stars with emphasis on nuclear reactions and generation of energy. Current theories of development of stars and of giant and dwarf stars.

**PH 605-606† Special Techniques in Experimental Physics I, II**

each 0:3:0:1½

A range of specialized techniques and processes of modern experimental physics, depending on requirements of thesis students and recommendations of advisers. Vacuum techniques, thin films, preparation of samples for solid-state studies, crystal growing, cryogenics and instrument design. Intensive training in those particular skills required in student research endeavors. Permission of advisers and director of the course required. May be taken no more than two semesters. *Prerequisite: concurrent thesis registration.*

**PH 607 Mathematical Methods of Physics I\*** 2½:0:0:3

Vector and tensor analysis. Complex variable theory. Special functions of mathematical physics. Differential equations of mathematical physics. Unifying roles of mathematics in physics on physical concepts and problems.

**PH 608 Mathematical Methods of Physics II\*** 2½:0:0:3

N-dimensional vector spaces and Hilbert space. Calculus of variations and eigenvalue problems. Green's function solutions to differential equations. Integral equations. Unifying roles of mathematics in physics and physical concepts and problems. *Prerequisite: PH 607 or consent of instructor.*

## PROGRAMS

### PH 615 Theoretical Mechanics I

2½:0:0:3

Principles of particle and rigid body dynamics. Lagrange's equations. Small vibrations of coupled systems, normal modes of oscillation.

### PH 616 Theoretical Mechanics II

2½:0:0:3

Hamiltonian mechanics. Transformation theories of mechanics including the Hamilton-Jacobi and Poisson bracket formulation and Lagrangian formulation of mechanics of continuous media. *Prerequisite: PH 615.*

### PH 624 Electromagnetic Theory I

2½:0:0:3

Maxwell's equations. Plane waves. Relativistic covariance of electromagnetic field. Motions of charges in fields. Fields of moving charges. Hertz and Lienard-Wiechert potentials. Radiation from charges, dipoles and quadrupoles.

### H 625 Electromagnetic Theory II

2½:0:0:3

Interaction of electromagnetic fields with material media from classical viewpoint. Macroscopic description of dielectric, magnetic and conducting materials, energy relations, dispersion and attenuation in dielectrics and ionized media. Wave propagation in anisotropic crystals and ferrites; waves in inhomogeneous media. *Prerequisite: PH 624. Also listed under EL 673.*

### PH 633-634† Introduction to Nuclear and Elementary Particle Physics I, II\*

each 2½:0:0:3

Fundamental properties of atomic nucleus and its constituents. Two-body problems at low energies and the theory of nuclear forces. Nuclear radioactivities such as alpha-, gamma- and beta-decay. General features of nuclear reactions and of the various nuclear models. Basic properties of elementary particles, their modes of decay, interactions, classifications and invariance laws. *PH 663 prerequisite: PH 336 or equivalent. PH 634 prerequisite: PH 633.*

### PH 635 Biophysics I\*

2½:0:0:3

Physical properties of biological systems. Natural properties of biological components. Structural strength, elasticity of bones, muscle, other tissue. Flow properties through tissue, diffusion of gases and liquids, flow through vessels. Compartmental analysis, models, trace analysis. Effects of stimuli on various body organs and mechanisms. Temperature effects, electrical excitations. *Prerequisite: PH 335 or equivalent.*

### PH 636 Biophysics II\*

2½:0:0:3

Transport processes in models of the specific organs. Application of radionuclides and dyes for static and dynamic imaging. Theoretical and practical aspects of nerve conduction with detailed discussion of the Hodgkin-Huxley and current models. Prey-predator interactions in biological systems on the cellular level, in radioimmunoassays and in population control. *Prerequisite: PH 635.*

### PH 637 Radiation Physics with Biological and Medical Applications\*

2½:0:0:3

Principles of atomic and molecular physics with stress on the problems of radiation and biological effects of ionizing radiation. Radiation dosimetry including internal and external exposures and relationship between doses, biological behavior of radionuclides, radiation and thermal radiation. *Prerequisite: PH 335 or equivalent.*

### PH 638† Quantum Mechanics with Applications

2½:0:0:3

Wave mechanics with applications to atomic and nuclear systems. Use of Schrodinger wave equation with perturbation theory for eigenvalue/eigenfunctions of harmonic oscillator and collision and applications to atomic nuclei. This course can be used by medical physics students to satisfy the requirement of PH 667 for a master's degree in physics. *Prerequisite: PH 335 and PH 336 or equivalents.*

### PH 651-652† Introduction to Solid-State Physics I, II

each 2½:0:0:3

Phenomena and theory of physics of crystalline solids. Topics from thermal, magnetic, electrical and optical properties of metals, insulators and semiconductors. *PH 651 prerequisite: PH 336 or equivalent. PH 652 prerequisite: PH 651.*

### PH 663 Statistical Mechanics I

2½:0:0:3

Equilibrium distributions. Relationships to laws of thermodynamics. Quantum effects. Maxwell-Boltzmann, Fermi-Dirac, Bose-Einstein distributions. Applications to bulk properties of phenomena using Boltzmann transport equation. **Also listed under EL 651.**

### PH 664 Statistical Mechanics II

2½:0:0:3

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 663 and PH 667 or equivalents. Also listed under EL 652.*

### PH 667-668† Quantum Mechanics I, II

each 2½:0:0:3

Quantum mechanics with applications to atomic systems. The use of Schrodinger's equations. Angular momentum and spin. Problems and approximation methods. Semiclassical theory of field-matter interaction. **Also listed under EL 655-656.**

### PH 669-670 Quantum Mechanics III, IV

each 2½:0:0:3

Theory of measurement and connection with classical dynamics. The Dirac formulation, transformation theory, scattering theory and introduction to the theory of radiation. *PH 669 Prerequisite: PH 616, PH 624 and PH 667-668. PH 670 prerequisite: PH 669.*

**PH 751-752 Theory of Solids I, II\***  
each 2½:0:0:3

Quantum and statistical mechanics of the band theory of solids as applied to electrical, thermal and optical properties of metals, semiconductors and insulators. *PH 751 Prerequisite: PH 664 and PH 668. PH 752 prerequisite: PH 751.*

**PH 753-754 Crystal Dynamics I, II\***  
each 2½:0:0:3

Particular physical properties of crystals arising from anisotropy of matter constants. Thermal, electrical, optical and elastic properties and effects arising from coupling of these properties. Interpretations of these material constants according to modern solid state theory and principles of crystal symmetry. *PH 753 Prerequisite: PH 616 and PH 624. PH 754 Prerequisite: PH 668 and PH 753.*

**PH 761-762 Relativistic Quantum Mechanics and Field Theory I, II\***  
each 2½:0:0:3

Dirac theory of the electron and positron, application of Dirac equation for discussion of electron spin and fine structure of hydrogen atom spectrum. Scattering of relativistic particles. Brief review of Lagrangian formalism of classical fields. Quantization of fields, scattering and the S-matrix theory. Feynman diagrams and renormalization theory. Applications of dispersion relations to strong interactions. *PH 761 prerequisite: PH 670. PH 762 prerequisite: PH 761.*

**PH 763-764 Nuclear Theory I, II\***  
each 2½:0:0:3

Fundamental properties of nuclei. Advanced quantum mechanical treatment of nuclear forces, nuclear reactions, nuclear structures, nuclear radiation and the theory of beta-decay. Models of nuclear structure and nuclear reactions. *Prerequisite: PH 670 or equivalent.*

**PH 765-766 High Energy Physics and Elementary Particle Theory I, II\***  
each 2½:0:0:3

Basic properties of particles, their interactions and invariance laws of particle physics. Fundamental properties and quantum numbers of the elementary particles, classification of interactions, invariance under space reflections, time reversal, charge conjugation, isotopic spin. Calculation of cross-sections, branching ratios, lifetimes. Higher symmetry schemes of SU (3), SU (6), etc. Field theory and second quantization. *PH 765 prerequisite: PH 670. PH 766 prerequisite: PH 765.*

**PH 780 Special and General Theory of Relativity\***  
2½:0:0:3

Einstein's theory of relativity, Minkowski geometry, relativistic mechanics and electrodynamics, applications of theory with special reference to high-energy physics; gravitation and principle of equivalence, Riemannian geometry, curvature tensor; equations of Einstein's theory of gravitation, approximate and rigorous solutions, observational tests of the theory, theory of ponderomotive equations. *Prerequisite: PH 616 and PH 624 or equivalents.*

**PH 801-802 Selected Topics in Advanced Physics I, II\***  
each 2½:0:0:3

Current or advanced topics of particular interest to graduate students. Subject matter determined each year by students and faculty. May be given in more than one section. Consult department office for current offerings.

**PH 901-902 Physics Colloquium I, II**  
each 2:0:0:0

Topical subjects of experimental and theoretical physics by the staff and outside lectures. Fee required. Required of all master's and doctoral candidates.

**PH 953-954 Graduate Seminar I, II**  
each 1:0:0:1½

Presentations by participating students and discussion of topics in physics of current interest and from the literature.

**PH 955-956 Reading in Physics I, II**  
each 2½:0:0:3

Selected papers and current literature in a specialized field of physics guided by a faculty member. *Prerequisite: graduate adviser's and supervising faculty member's consent.*

**PH 999 Research in Physics**  
each 3 units

An original investigation in some branch of physics or chemical physics, which may serve as basis for the degree of master of science or doctor of philosophy, to be 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. *Prerequisite: degree status and graduate adviser's and research director's consent.*

\* Not offered every year.

† May be taken for either undergraduate or graduate credit.

# PART III

## SPECIAL PROGRAMS



# COOPERATIVE EDUCATION PROGRAM

The Cooperative Education (Co-op) Program provides students with paid work experience in industry, government and public service agencies. This experience contributes to the student's career decision-making ability, motivates academic performance and provides a competitive advantage in the job market. Students can also earn a substantial salary while employed in a Co-op position.

Co-op at Polytechnic is an optional, noncredit program. It is a partnership involving the student, the employer and the Co-op Office. Students may opt to participate in the alternating or parallel programs:

## Full-time (alternating co-op)

Students alternate semesters of full-time co-op employment. Students work for a full semester (fall or spring) and return to school to continue their courses. Students who have a full-time co-op position and are not attending classes do not pay a tuition fee for the semester.

## Part-time (parallel co-op)

Students work on a part-time basis (15-20 hours a week) while they are enrolled full-time in classes. No fee.

At the end of each co-op assignment, students complete an evaluation provided by the Co-op Office. Their co-op assignment is recorded on their transcript and is graded pass/fail.

A student may participate in the program for up to seven work periods (semesters) and may require a five-year undergraduate program, depending on the number of semesters spent working. Each co-op student designs a co-op work-study program with the help of an academic adviser. Eligible students can begin the program in their sophomore year. Graduate students are not eligible for the Co-op Program.

Students accepted into the program start interviewing with participating co-op companies during the semester prior to their first scheduled work period. Companies select students based on their employment needs, and the process is competitive. Co-op students are given work directly related to their career goals and level of academic experience. Co-op students are paid salaries based on their experience and academic level.

## ELIGIBILITY

### Before applying for the initial co-op work assignment, students must:

- Be enrolled as a full-time undergraduate,
- Complete two full-time semesters at Polytechnic,
- Achieve and maintain a 2.5 grade-point average,
- Have sophomore status (28+ credits) with no course deficiencies,
- Complete at least one technical course in their major as determined by their academic department,
- Successfully complete CP 101, Career Development Seminar,
- Obtain adviser approval for program participation (work-study plan signed by adviser).

### Transfer Students are required to:

- Complete one semester of full-time study at Polytechnic University before beginning their first work period,
- Successfully complete CP 101, Career Development Seminar,
- Achieve a 2.5 grade-point average at Polytechnic University,
- Obtain departmental approval for program participation (work-study plan signed by adviser).

## CO-OP SEMINARS

The Co-op Career Development Seminar (CP 101) prepares students for entry into professional environments and is a prerequisite to participation in the work experience sequence.

CP 101 includes self assessment, techniques of resume writing, interviewing, making contact with prospective employers, and other topics that foster students' successful adjustment in the workplace. Students may also have an opportunity to meet co-op employers and co-op students who have been out working.

Students entering work assignments after the sophomore year can complete up to seven field experience courses, CP 201 through CP 501. Types, complexities and challenges of field assignments vary depending on the student's academic preparation, ability and interest. The initial field experience (CP 201) usually serves as an introduction to the technical work environment. Students are assigned work under supervisors, who are usually senior staff professionals. As students progress through subsequent field assignments, more complex tasks and duties are added.

## COOPERATIVE EDUCATION PROGRAM

### COURSES

**CP 101 Cooperative Education Seminar I** 1:0:NC

**CP 201 First Co-op Field Assignment** 0:0:NC

*Prerequisite: CP 101 and departmental approval.*

**CP 202 Second Co-op Field Assignment** 0:0:NC

*Prerequisite: CP 201 and departmental approval.*

**CP 301 Third Co-op Field Assignment** 0:0:NC  
*Prerequisite: CP 202 and departmental approval.*

**CP 302 Fourth Co-op Field Assignment** 0:0:NC

*Prerequisite: CP 301 and departmental approval.*

**CP 401 Fifth Co-op Field Assignment** 0:0:NC

*Prerequisite: CP 302 and departmental approval.*

**CP 402 Sixth Co-op Field Assignment** 0:0:NC

*Prerequisite: CP 401 and departmental approval.*

**CP 501 Seventh Co-op Field Assignment** 0:0:NC

*Prerequisite: CP 402 and departmental approval.*

Grades of P (pass) or F (fail) are recorded upon completion of each course. Courses will not be computed to the grade-point average. These grades are based upon final reports and work evaluations written by students and evaluations submitted by supervisors.

### COORDINATORS

#### BROOKLYN CAMPUS

**David J. Gillette**, Director  
MS, Florida State University

**Robin Ponsolle**, Assistant Director  
MS, Long Island University

**Michele Ayne**, Cooperative Education Coordinator  
MS, Long Island University

**Dorothy Adams**, Executive Scholars Coordinator  
MS, Polytechnic University

**JoAnn B. McDonald**, Recruiting Coordinator

#### LONG ISLAND CAMPUS

**James L. Giordano**, Placement Director  
MS, State University of New York, Fort Schuyler

**Maxine Cohen**, Executive Scholars Coordinator  
MS, Syracuse University



# HEOP

The Higher Education Opportunity Program (HEOP) is a New York State-funded program. It is designed to provide broad and varied educational experiences to capable students who, due to academic underpreparation and limited financial resources, might otherwise not have an opportunity to pursue a college education at Polytechnic University. HEOP assists its students by providing academic support services, counseling and financial aid to enable them to successfully complete their programs of study at Polytechnic. HEOP's goal is to retain and graduate nontraditional students from professional career areas in engineering, where these students have been traditionally underrepresented.

## ADMISSION

To qualify for the program, applicants must be residents of New York State and demonstrate both academic and economic needs. Applicants are either referred by an admissions counselor, or may indicate on their application that they are interested in being considered for HEOP. Economic eligibility is determined on the basis of income guidelines issued by the State Education Department.

Because SAT scores may not thoroughly reflect students' potential for success at Polytechnic, a personal 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 on what to expect at Polytechnic.

Potential HEOP students come from the public and private high schools in the five boroughs of New York City and Long Island. Students may apply for admission to either the Brooklyn or Farmingdale program.

## TRANSFERS

Students wishing to transfer into HEOP at Polytechnic must have been in an opportunity program (HEOP, EOP, SEEK, etc.) at their previous institution. Each applicant must also complete the regular transfer application. Transfer applicants are reviewed based on individual circumstances, and the reasons for transfer. College transcript(s) and recommendations from counselors or professors are reviewed by the HEOP director, and a recommendation is sent to the Office of Admissions.

## ACADEMIC SUPPORT SERVICES

As a retention effort, HEOP provides freshmen and continuing students with academic support services.

These services include:

- A prefreshman summer program, including courses in precalculus, chemistry, physics and study skills.
- Exam review sessions.
- Study skills courses.
- Individual and group tutoring sessions.

## COUNSELING

In order to meet the needs of the student, one-to-one, personal, academic, financial, and career counseling are provided for program students. Group and individual counseling sessions are scheduled to assist students in making the transition to college.

## FINANCIAL AID

Students who are eligible for HEOP are packaged to full financial need. It is important that all students complete the Free Application for Student Aid (FAFSA) and Tuition Assistance Program (TAP) application early to enable the University to determine their financial need. Students are required to supplement their financial aid packages with minimal student loans.

## APPLICATION PROCEDURES

Students apply for HEOP by completing the regular application for admission. They should indicate on the application their interest in being considered for HEOP. Students who meet the educational and economic qualifications are then required to have a personal interview and take a math skills assessment test.

## HIGHER EDUCATION OPPORTUNITY PROGRAM

### COURSES

#### **CM 000 Precollege Chemistry**

6:0:NC

Mole concept and stoichiometry; gaseous molecular behavior and gas law; equilibrium and Le Chatelier's principle.

#### **HE 000 Study Skills**

2:0:NC

A workshop which includes a close examination of a student's expectations and survival skills; notetaking and textbook use; reevaluation of goals and career objectives.

#### **MA 000 Precollege Math**

6:0:NC

Review of trigonometry, quadratic and absolute value questions and inequalities, limits and differentiation of both algebraic and trigonometric functions.

#### **PH 000 Precollege Physics**

6:0:NC

One-dimensional motion, vectors, two-dimensional motion, Newton's Force Laws, work and energy, momentum, rotations and static equilibrium.

### OFFICES

#### **Brooklyn**

Jacobs Building  
Room 355  
718/260-3370  
e-mail:heop@duke.poly.edu

#### **Farmingdale**

Bassett Building  
Room 104  
516/755-4252  
e-mail:heop@duke.poly.edu

### PROFESSIONAL STAFF

**Teresina W. F. Tam**, Director  
MS, Wilfrid Laurier University

**Patricia J. Baron**, Associate Director  
Farmingdale Campus  
MS, St. John's University

**Jacqueline Bell**, Assistant Director  
MS, University at Albany

**Saralda Ortiz**, Counselor  
BA, Fordham University

# PHYSICAL EDUCATION AND ATHLETICS

The major goal of the Physical Education and Athletics program is to offer a wide range of physical activities for the benefit and enjoyment of the student body. With guidance from their instructors, students can develop skill and success in a chosen activity while having fun and experiencing optimum physical fitness in terms of strength, agility, endurance and tension relaxation.

## INTERCOLLEGIATE ATHLETICS

All full-time undergraduate students who are in good academic standing are eligible for team membership and are encouraged to participate and win their varsity letter.

Polytechnic is a member of the NCAA, ECAC, and the NECVA; fields varsity teams in men's basketball, baseball, cross country, judo, soccer, tennis and volleyball as well as women's cross country, judo, tennis and volleyball.

## INTRAMURALS

The University offers the following intramural events for those who want to participate in an athletic event but can't devote as much time as needed for a course or a varsity team. These events are held during club hours on both campuses as well as evenings at the Farmingdale campus. These events change from semester to semester depending on the student's interest. Events presently offered are basketball, darts, football, handball, hockey, soccer, volleyball, table tennis, mini-marathons, fitness contests, ultimate frisbee and tug of war.

## PHYSICAL EDUCATION COURSES

The University and all of its degree granting departments strongly recommend and encourage all undergraduates to register for a minimum of two semesters of physical education.

Courses may be selected in any sequence. A student may elect to take the same course for more than one semester.

### PE 102 Weight Training 0:1:0

Individualized weight training programs to suit the individual needs can be arranged. Universal and free weights are available along with aerobic equipment. Stretching area also available for warm-up and free exercises including heavy-bag workout. (Offered at Brooklyn and Farmingdale campuses.)

### PE 103 Aerobics 0:1:0

Basic aerobic steps, dance steps and conditioning to music. Class consists of warm-up, stretching, low impact aerobics and more strenuous workout if asked for. Floor exercises are also included with stomach, legs and buttocks stressed along with some strength exercises. (Offered at Brooklyn campus.)

### PE 105 Martial Arts: Judo and Karate 0:1½:0

Fundamental principles and basic karate techniques including katas, self defense techniques and light sparring. Judo includes basic throwing and mat work techniques. Can be practiced for exercise, self defense purposes or competition. Rank can be awarded up to Brown Belt in Judo. (Offered at Brooklyn campus.)

## FACULTY

**Maureen Braziel**, Associate Director of Athletics and Director of Intramurals  
MS, Hunter College

**Nick Russo**, Sports Information Director

## VARSITY COACHING STAFF

**Laddy Baldwin**, Head Basketball Coach

**Arty Williams**, Assistant Basketball Coach

**Roger Perez**, Head Baseball Coach

**Phil Procker**, Assistant Baseball Coach

**Rich Lucian**, Men's and Women's Cross Country Coach

**Nick Russo**, Assistant Cross Country Coach

**Maureen Braziel**, Men's and Women's Judo Coach

**Louis Zinser**, Soccer Coach

**Steve Wen**, Men's and Women's Tennis Coach

**James Zeng**, Men's Volleyball Coach

**Klavdia Kreig**, Women's Volleyball Coach

# THE YES CENTER

The mission of Polytechnic's Center for Youth in Engineering and Science (YES) is to promote activities that sensitize high school students to career opportunities in engineering and science, nurture their interest, develop their scientific curiosity and encourage them to pursue appropriate study. The YES Center addresses these needs through a variety of high school outreach programs designed to interest precollege students in technological careers based upon an understanding of and fascination with technology. Special attention is paid to attracting the interest of students from populations underrepresented in engineering and science careers, specifically women and minorities. The center sponsors a number of outreach programs, including the Summer Research Institute, the College Preview Program, Introduction to Engineering, BASIS/STRIDE Program, University Tours, Special Seminars and Events, tutorial programs in math and science, special competitions, (science fairs, Jets competitions) and Professional Enrichment Seminars for High School Teachers. Students may enroll in a YES Center program at either the Brooklyn or Long Island campus.

## RESEARCH

The Summer Research Institute is a six-week full-time summer effort focused on the conduct of an independent research project with a faculty member. Students are paid a stipend for this period of time. Students are expected to make a full-time commitment to the program. Seminars will be held regularly throughout the program on a scheduled basis, and all participants are required to attend.

The student will undertake a research effort, either individually or as part of a group, focused on a problem formulated by the student in conjunction with his/her faculty mentor. If the student so desires, the effort may be geared toward submission of results to the International Science

and Engineering Fair, Intel Science Talent Search and/or other prestigious science competitions.

## SEMINARS

An instructional component specially designed to supplement the research experiences of student participants is an integral part of the institute's program. Sessions are devoted to drafting preliminary essays, learning the appropriate format for a science paper, compiling the data profile for a Westinghouse Talent Search submission, presenting research results and sharing experiences. Several seminars will involve outside speakers and role models from the University and from industry. Appropriate field trips will be arranged to enhance students' research experiences.

Students are expected to attend any preparatory seminars needed to allow them to conduct their research effectively during the six-week summer session. Such preparatory sessions are arranged for students' convenience during after-school hours. Students wishing to continue their research beyond the summer period may make individual arrangements to do so.

## QUALIFICATIONS

Admission to the program is competitive and will be determined by the student's scholastic ability, scientific/technology background and interest and recommendations from high school teachers, principals or counselors. Students should be high school juniors who will begin their senior year after completing the program. Outstanding sophomores will also be considered for enrollment.

## EXPENSES

Students, depending upon individual schedules, will need lunch money and transportation to and from the University.

## COLLEGE PREVIEW PROGRAM

Introductory college courses at Polytechnic are offered to outstanding high school students. Interested students must complete an application and obtain a recommendation from their guidance counselor or principal. Polytechnic waives regular tuition, but charges a nonrefundable \$150 registration fee per course. Students earn college credits for satisfactorily completed course work, and a transcript is produced. Courses include beginning courses in college mathematics, computer science, physics, chemistry and selected courses in the humanities and social sciences. Application for fall courses must be submitted during the first week of September; for spring courses, applications are required in mid-January. Applications are available at your high school or from the YES Center.

### **INTRODUCTION TO ENGINEERING (EG 101)**

Introduction to Engineering is a course geared toward ninth and 10th grade high school students. The purpose of this course is to give potential engineering students the opportunity to develop teamwork skills, work with other disciplines and develop writing and oral skills. This course will provide knowledge and experience of:

- What engineers do
- How they do it
- The tools and technology they use
- The engineering design process
- Design and construction skills

After successful completion of this course, students will receive 3 Polytechnic University college credits. The cost for this course is \$150.

### **BASIS/STRIDE (BROOKLYN AND STATEN ISLAND SCHOOLS/SCIENCE TECHNOLOGY & RESEARCH USING INDIVIDUAL DISCOVERY & EXPLORATION)**

The BASIS/STRIDE Program is conducted in collaboration with the New York City Board of Education. Its purpose is to provide students who have completed 10th grade with instructional and cocurricular activities to enhance their interest and excitement about mathematics, science and technology through exploration and discovery. Students will utilize the state-of-the-art resources at Polytechnic University. Experiences will include:

- Problem-solving classroom experiences
- Independent and group projects
- Guided research techniques and skills
- Field trips to science and corporate centers

By the end of the session, students will complete a project, illustration/construction (e.g., model, scrapbook, diagram or drawing, current events) of a scientific or technological concept accompanied by a written explanation of the work. Upon successful completion of this course, students will receive 1 high school credit.

### **UNIVERSITY TOURS**

The University regularly sponsors tours of its laboratories and facilities. Also included are demonstrations, lectures on careers in engineering and science, and presentations on college planning and financial aid. Any interested high school can arrange for such a tour by calling the YES Center.

### **PROGRAMS FOR HIGH SCHOOL STAFF MEMBERS**

Speakers, workshop facilitators and specialists may be obtained from the University to conduct special staff development/training workshops for high school teachers. Polytechnic also offers a special 50% tuition discount for full-time teachers taking courses at Polytechnic. Documentation from the home school is required.

### **SPECIAL COMPETITIONS (SCIENCE FAIRS, JETS COMPETITIONS)**

We will inform participants in the YES program of special science competitions, such as the International Science Fair and the Jets (Juniors in Engineering Technical Society) Competition. Polytechnic University is the host of the Mathematics, Science and Technology Fair. Winners of this fair go on to participate in the International Science Fair. The Jets Competition is held at Polytechnic each year. This competition promotes the advancement of high school students in math, science and technology. Students from around New York City and Long Island participate in this competition.

### **SPECIAL SEMINAR PROGRAMS**

Polytechnic sponsors seminars, conferences and lectures in science, technology, engineering, social science, mathematics and computer science. High school students and faculty members are invited to participate. Several programs each year are specifically aimed at high school students and faculty, and relevant information regarding these programs is distributed to high schools. Any high school interested in a seminar on a particular topic may inquire with the YES Center.

### **TUTORIALS**

Polytechnic University students are willing to serve as tutors of mathematics and science to high school students. High school students interested in participating should contact the YES office.

### **SCHOLARSHIPS**

Students from high schools participating in center-sponsored activities are eligible for special PROMISE Scholarships earmarked for such students, should they choose to attend Polytechnic University.

# THE DAVID PACKARD CENTER FOR TECHNOLOGY AND EDUCATIONAL ALLIANCES

*Director:* Noel N. Kriftcher

Created in September 1996, the David Packard Center for Technology and Educational Alliances develops opportunities connecting Polytechnic with educational, business and community organizations to enhance and disseminate information on electronically mediated learning, and to encourage advanced studies in mathematics, science and technology.

The Packard Center serves to extend the University's commitment to precollege populations by providing a contact point for learning initiatives. Polytechnic University students and staff serve as mentors, interns and instructors; secondary teachers form cohorts with Polytechnic faculty; and professional development programs yield long-term advantages for high school and college learners.

The center's goals seek to:

- ensure equity of availability, opportunity and access for women and underrepresented minorities in the use of computers, information-age technology and the study of mathematics and science.
- build alliances of stakeholders in the impact of information-age technology on the learning process, and on social, economic and educational institutions.
- communicate findings to influence learning in urban school systems.

- utilize technology as a tool to assist learning, and disseminate what we discover through publications, multimedia communications, symposia and lectures.
- serves as a resource to help define the local, regional and national agenda relating to the impact of information-age technology on instruction and new educational paradigms.

High school students earn college credit upon satisfactorily completing advanced science, mathematics and computer science courses that are offered at their own high schools. These courses are taught by associate faculty, selected by Polytechnic University, utilizing approved curricula and evaluation instruments. Polytechnic waives tuition, charging only a registration fee, provides the salary for the instructor and issues a transcript to certify that college credits have been earned.

A variety of instructional enrichment activities bring high school students onto the Poly campus to participate in scientific research competitions and exhibitions, meet noted scientists and engineers, and enrich learning through academic symposia and information exchanges. Among these programs and events are the Principal's Scholars Dinner Symposia; the Future City Regional Competition; the New York City Mathematics, Science and Technology Fair, which qualifies students for the International Science and Engineering Fair; and the New York City Science/Technology Forum.

Polytechnic University's alliance with United Neighborhood Houses Inc. joins the University to New York City's settlement houses, which serve economically disadvantaged populations, to introduce young people to new communications technologies. Through salaried internships, Poly undergraduates visit the settlement houses to work with children, including local high school students who serve as mentors to young children, to provide access to the Internet and electronic mail, to encourage the development of research and writing skills, and explore college and career choices.

High school teachers attend specially designed workshops, courses and conferences at Polytechnic University to learn how to utilize information-age technology in their classrooms through conceptual exploration and practice with applications. A companion program seeks to develop varied teaching strategies in science and mathematics that emphasize hands-on learning experiences.

A unique 6-credit graduate course commissioned by the New York City Board of Education introduces teachers of mathematics, science and technology to the writing process and technology that supports writing improvement. Participating teachers learn to improve their own writing and also student writing to meet the new learning standards through varied instructional strategies.

# **PART IV**

## **THE CORPORATION THE ADMINISTRATION THE FACULTY**



# THE CORPORATION

## Chairman

Arthur C. Martinez, *Chairman & CEO, Sears, Roebuck & Co.*

## Deputy Chairman

R. William Murray, *Chairman (retired), Philip Morris Cos.*

## Vice Chairman

Clifford H. Goldsmith, *Principal, The Prendel Company*

## Vice Chairman

Henry J. Singer, *President, Reg-Nis LLC*

## Secretary/Treasurer

Michael R. Corey, *Treasurer, J. P. Morgan & Co. Inc.*

## Trustees

David C. Chang, *President, Polytechnic University*

Joseph J. Jacobs, *Lifetime Trustee, Chairman Emeritus; Chairman, Jacobs Engineering Group Inc.*

Franklin H. Blecher, *Executive Director (retired), Technical Info. Sys. Div. AT&T Bell Labs*

George Campbell Jr., *President & CEO, National Action Council for Minorities in Engineering Inc.*

Robert D. Dalziel, *Vice President (retired), AT&T Global Networks*

David Dibner, *Chairman (retired), Burndy Corp.*

Herman Fialkov, *Partner, Newlight Management LLC*

Richard W. Foxen, *Senior Vice President (retired), Rockwell Int'l Corp.*

Rachelle Friedman, *Co-Founder and Secretary, J&R Music World & Computer World*

William L. Friend, *Executive Vice President and Director (retired), Bechtel Group Inc.*

Peter Georgescu, *Chairman & CEO, Young & Rubicam Inc.*

Leila Heckman, *Managing Director, Global Asset Allocation Research, Salomon Smith Barney*

Michael Hora, *Vice President, A. T. Kearney*

Linda K. Jacobs, *President, Middle East Tech. Assistance*

Peter M. Lehrer, *Vice Chairman, Bovis Construction Group*

Jeffrey H. Lynford, *Chairman, Wellsford Real Properties Inc.*

Craig G. Matthews, *President & COO, KeySpan Energy*

William C. W. Mow, *Chairman & CEO, Bugle Boy Industries Inc.*

Stewart G. Nagler, *Vice Chairman of the Board & CFO, Metropolitan Life Insurance Co.*

Tsuneo Nakahara, *Executive Advisor to the Chairman, Sumitomo Electric Industries Ltd.*

John G. Puente, *Chairman, Telogy Networks Inc.*

Steven M. Rittvo, *President, Urban Systems Associates Inc.*

Leonard J. Shustek, *Director, Network Associates Inc.*

Casimir Skrzypczak, *Corporate Vice President & Group President, Professional Services, Bell Communications Research*

Paul Soros, *Private Investor, Paul Soros Investments*

Won Bong Sull, *Chairman & CEO, TS Corporation*

Jerome Swartz, *Chairman & CEO, Symbol Technologies Inc.*

Robert H. C. Tsao, *Chairman & CEO, United Microelectronics Corp.*

Harry C. Wechsler, *President, Farboil Company*

## Emeritus Trustees

William F. May, *President, Statue of Liberty/Ellis Island Foundation*

John S. Mayo, *President, Emeritus Lucent Technologies*

Louis N. Rowley Jr., *Consulting Editor, Power and Electric World McGraw-Hill Publications*

George L. Wilcox, *Vice Chairman, (retired) Westinghouse Electric*

## Advisory Trustees

Donald M. Alstadt, *Chairman, Lord Corp.*

Henry Bachman, *Vice President, Hazeltine Corp.*

Edward T. Barron, *EAB Enterprises Inc.*

Vincent A. Calarco, *Chairman, President & CEO, Crompton & Knowles Corp.*

Ralph W. Casazzone, *President, First National Oil Brokers*

Donald M. Cox, *Director (retired), Exxon Corp.*

Fred Heinzelman Jr., *President, Fred Heinzelman & Sons*

Charles Hinkaty, *President, Del Pharmaceuticals Inc.*

Eugene Kleiner, *Consulting Partner, Kleiner Perkins Caulfield & Byers*

Richard Laster, *Management Consultant*  
Hans Mark, *Director of Defense Research & Engineering, Department of Defense*

Charles Strang, *Chairman & CEO (retired), Outboard Marine Corp.*

Jerry M. Sudarsky, *Chairman & CEO, Alexandria Real Estate Equities Inc.*

Steven J. Wallach, *Advisor, Center Point Ventures*



# THE ADMINISTRATION

## ADMINISTRATIVE OFFICERS

David C. Chang, PhD  
*President*

George Bugliarello, ScD  
*Chancellor*

Ivan T. Frisch, PhD  
*Executive Vice President and Provost*

Ellen F. Hartigan, MA  
*Vice President, Student Affairs*

William R. McShane, PhD, PE  
*Vice President and Dean of Engineering and Applied Sciences*

Gregory D. Smith, MPhil  
*Vice President, Finance and Administration*

Richard S. Thorsen, PhD  
*Vice President, Development and University Relations*

## ACADEMIC ADMINISTRATION

Ivan T. Frisch, PhD  
*Executive Vice President and Provost*

William R. McShane, PhD, PE  
*Vice President and Dean of Engineering and Applied Sciences*

Nancy M. Tooney, PhD  
*Associate Dean of Engineering and Applied Sciences*

David Doucette, PhD, PE  
*Associate Dean of the Long Island Campus*

Deborah Cassetta, MPhil  
*Director of Academic Operations and Budgets*

LaVerne M. Clark, MS  
*Director of Operations of the Westchester Graduate Center*

Joanne Ingham, EdD  
*Director of Institutional Assessment and Retention*

Jose Ulerio, MS  
*Deputy Director of Research Operations*

## ACADEMIC DEPARTMENTS AND RESEARCH CENTERS

Kalle Levon, PhD, Department Head/Chair  
*Chemical Engineering, Chemistry and Material Science/Physics Task Team*

John Falcocchio, PhD, PE, Department Head  
*Civil and Environmental Engineering*  
David Goodman, PhD, Department Head  
*Electrical Engineering*

Mel Horwitch, PhD, Department Chair  
*Management*

Sunil Kumar, PhD, Department Head  
*Mechanical Engineering/Aerospace Engineering/Manufacturing Engineering*

Erwin Lutwak, PhD, Department Head  
*Mathematics*

Neil Mahoney, BS, Department Head  
*General Engineering*

Stuart Steele, PhD, Department Head  
*Computer and Information Science*

Richard Wener, PhD, Department Head  
*Humanities and Social Sciences*

Henry Bertoni, PhD, Director  
*Weber Research Institute (WRI)*

Ifay Chang, PhD, Executive Director  
*Polytechnic Research Institute for Development and Enterprise (PRIDE)*

John Falcocchio, PhD, PE, Director  
*Transportation Research Institute (TRI)*

Mel Horwitch, PhD, Director  
*Institute for Technology and Enterprise (ITE)*

Ilan Juran, PhD, Executive Director  
*Urban Infrastructure Institute*

Kalle Levon, PhD, Director  
*Polymer Research Institute (PRI)*

Shivendra Panwar, PhD, Director  
*Center for Advanced Technology in Telecommunications (CATT)*

Arnost Reiser, PhD, Director  
*Institute of Imaging Sciences (IIS)*

## THE ADMINISTRATION

### DEVELOPMENT AND UNIVERSITY RELATIONS

Richard S. Thorsen, PhD  
*Vice President, Development and University Relations*

Audrey Andrews, MS  
*Director, Alumni Relations and Individual Giving*

Thomas Daly, MS  
*Director, Planned Giving*

Stuart Dim, BS  
*Executive Director, Communications and External Affairs*

Michael Gillespie, PhD  
*Director, Communications*

Michael Mainiero, MEd  
*Director, Institutional Research*

Rodney Miller, MA  
*Executive Director, Development and Alumni Relations*

Mary Ann Scafia, MA  
*Director, Special Events/Projects*

Peter West, BA  
*Director, Media Relations and Campaign Communications*

### FINANCE AND ADMINISTRATION

Gregory D. Smith, MPhil  
*Vice President, Finance and Administration*

Rosemarie Barnickel, CPA/BBA  
*Assistant Vice President, Financial Operations Controller*

Christopher Kilcommons, MPA  
*Director, Human Resources*

June McGriskin, MBA  
*Executive Director, Planning and Budget*

Kevin O'Rourke, BT  
*Manager, Facilities Management*

Mary Pollard  
*Manager, Mailroom and Printing Services*

### OFFICERS OF THE POLYTECHNIC ALUMNI

Edward T. Barron '56  
*President*

Demir (Dick) Eden '73  
*Executive Vice President*

Stephen Garone '73  
*Treasurer*

George Likourezos '92  
*Secretary*

Dr. Bernard Meyers '58  
*Vice President*

### STUDENT AFFAIRS

Ellen F. Hartigan, MA  
*Vice President, Student Affairs*

Maureen Braziel, MS  
*Director, Athletics*

Haang Fung, MS  
*Director, Special Services*

David Gillette, MS  
*Director, Career Services/  
Cooperative Education/Brooklyn Campus*

James L. Giordano, MS  
*Placement Director, Career Services/Long Island Campus*

Beverly Johnson, BA  
*Director, Youth in Engineering & Science  
(YES Center)*

John Steven Kerge, MS  
*Dean, University Admissions*

Noel N. Kriftcher, EdD  
*Director, David Packard Center for  
Technology and Educational Alliances*

Veronica Lukas, MBA  
*Director, Financial Aid/Student Services*

Cheryl McNear, BS  
*Director, Student Development*

Teresina Tam, MS  
*Director, Higher Education Opportunity Program  
(HEOP)*

Christine Tigar, BS  
*Director, Student Accounts*

# THE FACULTY

**Arnold, Stephen**, Thomas Potts Professor of Physics and University Professor  
PhD, City University of New York

**Aronov, Boris**, Associate Professor of Computer Science  
PhD, New York University

**Assmus, Alexi**, Assistant Professor of History of Science and Technology  
PhD, Harvard University

**Bain, Jonathan**, Assistant Professor of Philosophy and Science  
PhD, University of Pittsburgh

**Ball, Keith**, Professor of Mathematics  
PhD, Cambridge University

**Balsara, Nitash P.**, Professor of Chemical Engineering  
PhD, Rensselaer Polytechnic Institute

**Bartlett, Charles**, Industry Professor and Director of Manufacturing Program  
PhD, Massachusetts Institute of Technology

**Bentson, James**, Industry Professor of Mechanical and Aerospace Engineering  
PhD, Polytechnic Institute of Brooklyn

**Bertoni, Henry L.**, Professor of Electrophysics  
PhD, Polytechnic Institute of Brooklyn

**Blecherman, Barry S.**, Assistant Professor of Management and Academic Professor of MSM Extension in Israel  
PhD, Wharton School, University of Pennsylvania

**Boorstyn, Robert R.**, Professor of Electrical Engineering  
PhD, Polytechnic Institute of Brooklyn

**Boukli, Mokhtar**, Assistant Industry Professor of Electrical Engineering  
PhD, Polytechnic University

**Bugliarello, George**, Professor of Civil Engineering and Chancellor  
ScD, Massachusetts Institute of Technology

**Cassara, Frank A.**, Professor of Electrical Engineering  
PhD, Polytechnic Institute of Brooklyn

**Chang, Ifay**, Industry Professor of Computer Science and Executive Director of Polytechnic Research Institute for Development and Enterprise  
PhD, University of Rhode Island

**Chang, David C.**, Professor of Electrical Engineering and President  
PhD, Harvard University

**Chao, H. Jonathan**, Professor of Electrical Engineering  
PhD, Ohio State University

**Chesla, Elizabeth**, Instructor of English and Coordinator of Technical Communication Program  
MA, Columbia University

**Cheung, Tak Ip**, Instructor in Computer Science  
MS, Polytechnic University

**Chiang, Yi Jen**, Assistant Professor of Computer Science  
PhD, Brown University

**Choe, Wolhee**, Professor of English  
PhD, City University of New York

**Christodoulou, Symeon**, Assistant Professor of Civil Engineering  
PhD, University of California at Berkeley

**Chudnovsky, David V.**, Distinguished Industry Professor of Mathematics  
PhD, Institute of Mathematics, Ukrainian Academy of Science

**Chudnovsky, Gregory V.**, Distinguished Industry Professor of Mathematics  
PhD, Institute of Mathematics, Ukrainian Academy of Science

**Cowman, Mary K.**, Associate Professor of Biochemistry  
PhD, Case Western Reserve University

**Czarkowski, Dariusz**, Assistant Professor of Electrical Engineering  
PhD, University of Florida

**Das, Nirod K.**, Associate Professor of Electrical Engineering  
PhD, University of Massachusetts

**Delis, Alex**, Assistant Professor of Computer Science  
PhD, University of Maryland at College Park

**DiBartolo, John**, Instructor of Physics  
PhD, University of Virginia

**Doucette, David R.**, Industry Professor of Computer Science  
PhD, Polytechnic Institute of Brooklyn

**Eibschutz, Marcu**, Research Professor of Physics and Materials Science  
PhD, The Weizmann Institute of Science

**Eisenberg, Anne**, Professor of Humanities and Communications  
PhD, New York University

**Epstein, Jerome**, Instructor of Mathematics  
PhD, New York University

**Falcocchio, John C.**, P.E., Professor of Transportation and Department Head and Executive Director of Transportation Research Institute  
PhD., Polytechnic Institute of Brooklyn

**Fasullo, Eugene**, PE, Distinguished Industry Professor of Civil Engineering and Director of Exec21 Program  
MS, University of Illinois

**Fayngold, Moses**, Research Assistant Professor of Physics  
PhD, Nuclear Research Institute

**Feddersen, Ronald**, Instructor in Computer Science  
MS, Polytechnic University

**Feroli, Teresa**, Assistant Professor of English  
PhD, Cornell University

## THE FACULTY

**Flynn, Robert J.**, Industry Professor of Computer Science  
PhD, Polytechnic Institute of Brooklyn

**Folan, Lorcan M.**, Associate Professor of Physics  
PhD, Polytechnic University

**Frankl, Phyllis G.**, Associate Professor of Computer Science  
PhD, New York University

**Frisch, Ivan T.**, Professor of Electrical Engineering and  
Computer Science and Executive Vice President and Provost  
PhD, Columbia University

**Gallagher, Evan**, Instructor in Computer Science  
MS, New York University

**Gallagher, Jean**, Assistant Professor of English  
PhD, City University of New York Graduate Center

**Garetz, Bruce A.**, Professor of Physical Chemistry  
PhD, Massachusetts Institute of Technology

**Goodman, David**, Professor of Electrical Engineering and  
Department Head  
PhD, Imperial College, University of London

**Green, Mark M.**, Professor of Organic Chemistry  
PhD, Princeton University

**Grieco, Linda Anne**, Industry Associate Professor  
PhD, Rutgers University

**Gross, Richard**, Herman F. Mark Professor of Polymer  
Science  
PhD, Polytechnic University

**Guleryuz, Onur**, Assistant Professor of Electrical  
Engineering  
PhD, University of Illinois at Urbana-Champaign

**Hadimioglu, Haldun**, Industry Associate Professor of  
Electrical Engineering and Computer Science  
PhD, Polytechnic University

**Hass, Zygmunt**, Associate Professor of Electrical  
Engineering  
PhD, Stanford University

**Hellerstein, Lisa**, Associate Professor of Computer Science  
PhD, University of California at Berkeley

**Hoover, Charles W. Jr.**, Distinguished Industry Professor  
of Manufacturing Engineering  
PhD, Yale University

**Horwitch, Mel**, Professor of Management and Department  
Chair and Director of Institute for Technology and Enterprise  
DBA, Harvard University

**Howley, Eamon**, Instructor in Computer Science  
BS, State University of New York at Binghamton

**Iskander, Magued**, PE, Assistant Professor of Civil  
Engineering  
PhD, University of Texas at Austin

**Ivanchenko, Yuli M.**, Research Professor of Physics  
PhD, University of Donetsk

**Jiang, Zhong-Ping**, Assistant Professor of Electrical  
Engineering  
PhD, Ecole des Mines de Paris

**Jones, Barry**, Industry Associate Professor of Electrical  
Engineering and Computer Science  
MS, Marist College

**Juran, Ilan**, Professor of Civil Engineering  
PhD, DSc, University of Paris VI, Ecole Nationale des Ponts  
et Chaussées

**Juretschke, Hellmut J.**, Professor of Physics  
PhD, Harvard University

**Kadik, Abdelhamid**, Instructor of Mathematics  
MS, Polytechnic University

**Kalkhoran, Iraj M.**, Associate Professor of Aerospace  
Engineering  
PhD, University of Texas at Arlington

**Kapila, Vikram**, Assistant Professor of Aerospace  
Engineering  
PhD, Georgia Institute of Technology

**Karri, Ramesh**, Associate Professor of Electrical Engineering  
PhD, University of California at San Diego

**Kaufman, Harold G.**, Professor of Management and  
Academic Director, Organizational Behavior Program and  
Academic Director, MSM Extension in Israel  
PhD, New York University

**Kershenbaum, Aaron**, Professor of Computer Science  
PhD, Polytechnic Institute of Brooklyn

**Khan, Eakalak**, Assistant Professor of Civil Engineering  
PhD, University of California at Los Angeles

**Khorrami, Farshad**, Associate Professor of Electrical  
Engineering  
PhD, Ohio State University

**Klosner, Jerome M.**, PE, Professor of Mechanical and  
Aerospace Engineering  
PhD, Polytechnic Institute of Brooklyn

**Kozol, Lauren**, Instructor of English  
MA, City University of New York

**Kouar, Mohammed**, Associate Industry Professor of  
Electrical Engineering  
PhD, Polytechnic University

**Kriftcher, Noel N.**, Industry Professor and Director of David  
Packard Center for Technology and Educational Alliances  
EdD, Hofstra University

**Kuiken, Kathryn**, Associate Professor of Mathematics  
PhD, Polytechnic Institute of New York

**Kumar, Sunil**, Associate Professor of Mechanical  
Engineering and Department Head  
PhD, University of California at Berkeley

**Kuo, Szu-Ping**, Professor of Electrical Engineering and  
Electrophysics  
PhD, Polytechnic Institute of New York

**Kwei, T.K.**, Research Professor of Polymer Chemistry  
PhD, Polytechnic Institute of Brooklyn

**Landau, Gad M.**, Research Professor of Computer Science  
PhD, Tel-Aviv University

**Lane, Victor Hugo IV**, Assistant Professor of History  
PhD, University of Michigan

**Lash, Alan**, Instructor of Mathematics  
BS, Polytechnic University

**Lehman, Sheila**, Research Associate Professor of  
Psychology  
MA, Columbia University

**Leiber, Frank**, Industry Associate Professor of Management and Financial Engineering and Academic Director of Management of Technology Program  
PhD, HEI Geneva

**Leung, K. Ming**, Professor of Physics  
PhD, University of Wisconsin

**Levine, Nathan**, Industry Professor of Mechanical Engineering  
PhD, University of Illinois

**Levon, Kalle**, Professor of Chemistry and Department Head and Director of the Polymer Research Institute  
Dr. Agr., University of Tokyo

**Lieberman, Burton**, Professor of Mathematics  
PhD, New York University

**Lin, Feng-Bao**, PE, Associate Professor of Civil Engineering  
PhD, Northwestern University

**Lu, I-Tai**, Associate Professor of Electrical Engineering  
PhD, Polytechnic Institute of New York

**Lutwak, Erwin**, Professor of Mathematics and Head of Department of Mathematics  
PhD, Polytechnic Institute of Brooklyn

**Mahoney, Neil**, Industry Professor and Director of General Engineering  
BS, Manhattan College

**Marks, Sylvia Kasey**, Associate Professor of English  
PhD, Princeton University

**Martcheva, Maya**, Instructor of Mathematics  
PhD, Purdue University

**McShane, William R.**, Professor of Mechanical and Systems Engineering and Dean of Engineering and Applied Sciences  
PhD, Polytechnic Institute of Brooklyn

**Memon, Nasir**, Associate Professor of Computer Science  
PhD, University of Nebraska

**Mermelstein, David**, Professor of Economics  
PhD, Columbia University

**Mijovic, Jovan**, Professor of Chemical Engineering  
PhD, University of Wisconsin

**Miller, Edward Y.**, Professor of Mathematics  
PhD, Harvard University

**Molof, Alan H.**, Associate Professor of Environmental Engineering  
PhD, University of Michigan

**Morgillio, Cira**, Instructor of Computer Science  
MS, Polytechnic University

**Motzkin, Shirley M.**, Professor of Biology  
PhD, New York University

**Mulcahy, F. David**, Associate Professor of Anthropology  
PhD, University of Massachusetts

**Myerson, Allan S.**, Joseph J. and Violet J. Jacobs Professor of Chemical Engineering  
PhD, University of Virginia

**Nourbakhsh, Said**, Professor of Materials Science  
PhD, Leeds University

**Novomestky, Fredrick**, Industry Associate Professor of Management and Academic Director of Financial Engineering Program and Director of Center for Finance and Technology  
PhD, Polytechnic University

**Okamoto, Yoshiyuki**, Research Professor of Organic and Polymer Chemistry  
PhD, Purdue University

**Otugen, M. Volkan**, Associate Professor of Mechanical Engineering  
PhD, Drexel University

**Pannaparayil, Thomas M.**, Industry Professor of Physics  
PhD, Fordham University

**Panwar, Shivendra S.**, Associate Professor of Electrical Engineering  
PhD, University of Massachusetts

**Parikh, Mihir**, Assistant Professor of Management  
PhD, Georgia State University

**Pearce, Eli M.**, University Professor  
PhD, Polytechnic Institute of Brooklyn

**Petrucci, Sergio**, Research Professor of Physical Chemistry  
PhD, University of Rome

**Phillips, Donald**, Instructor of Psychology  
BS, Polytechnic Institute of New York

**Pickel, Paul F.**, Professor of Computer Science  
PhD, Rice University

**Pillai, S., Unnikrishna**, Professor of Electrical Engineering  
PhD, University of Pennsylvania

**Prassas, Elena S.**, Assistant Professor of Transportation Engineering  
PhD, Polytechnic Institute of New York

**Protopapas, Angelos L.**, PE, Industry Assistant Professor of Civil Engineering  
PhD, Massachusetts Institute of Technology

**Rao, Bharat**, Assistant Professor of Management  
PhD, University of Georgia

**Reiser, Arnost**, Research Professor of Chemistry and Director of Institute Imaging Sciences  
DrIng, University of Prague

**Riseborough, Peter S.**, Professor of Physics  
PhD, Imperial College

**Roess, Roger P.**, Professor of Transportation Engineering  
PhD, Polytechnic Institute of Brooklyn

**Rogers, Joel**, Associate Professor of Mathematics  
PhD, Massachusetts Institute of Technology

**Roy, Dipak**, PE, Professor of Environmental Engineering  
PhD, University of Illinois

**Rusnaek, Robert**, Assistant Director of General Engineering  
BS, Pennsylvania State University

**Saltman, Bethany**, Instructor of English  
MFA, Brooklyn College

**Scheiner, Lowell L.**, Associate Professor of Humanities and Communications  
MS, Columbia University Graduate School of Journalism

**Selesnick, Ivan**, Assistant Professor of Electrical Engineering  
PhD, Rice University

**Shah, Chandni**, Lecturer of Mathematics and Director of Freshman Mathematics  
PhD, University of Texas at Austin

**Shaw, Leonard G.**, Professor of Electrical Engineering  
PhD, Stanford University

## THE FACULTY

**Sheverev, Valery A.**, Industry Assistant Professor of Physics  
PhD, St. Petersburg University

**Shnidmen, Yitzhek**, Assistant Professor of Chemistry  
PhD, The Weizmann Institute

**Sibner, Lesley**, Professor of Mathematics  
PhD, New York University

**Sjursen, Harold**, Industry Professor of Philosophy and  
Director of Philosophy and Technology Studies Center  
PhD, New School for Social Research

**Snyder, Joel B.**, PE, Senior Industry Professor of Electrical  
Engineering and Computer Science  
MEE, Polytechnic Institute of Brooklyn

**Soffer, Jonathan**, Assistant Professor of History  
PhD, Columbia University

**Steele, Stuart**, Industry Professor of Computer Science and  
Department Head  
PhD, Pennsylvania State University

**Stiel, Leonard I.**, Associate Professor of Chemical  
Engineering  
PhD, Northwestern University

**Strauss, Fred**, Industry Associate Professor of Computer  
Science  
MS, Polytechnic University

**Suel, Torsten**, Assistant Professor of Computer Science  
PhD, University of Texas

**Sviedrys, Romualdas**, Associate Professor of History of  
Technology  
PhD, Johns Hopkins University

**Teng, Hualiang**, Assistant Professor of Transportation  
Engineering  
PhD, Purdue University

**Teraoka, Iwao**, Associate Professor of Polymer Chemistry  
PhD, University of Tokyo

**Thorsen, Richard S.**, Associate Professor of Mechanical  
Engineering and Vice President of Development and  
University Relations  
PhD, New York University

**Tooney, Nancy M.**, Associate Professor of Biochemistry and  
Associate Dean of Engineering and Applied Sciences  
PhD, Brandeis University

**Tsifrinovich, Vladimir I.**, Research Assistant Professor of  
Physics  
PhD, Kirensky Institute of Physics

**Tsotras, Vassilis J.**, Associate Professor of Electrical  
Engineering and Computer Science  
PhD, Columbia University

**Tzes, Anthony P.**, Associate Professor of Mechanical  
Engineering  
PhD, Ohio State University

**Ulerio, Jose M.**, EIT Instructor of Transportation  
Engineering and Special Assistant to Dean of Engineering  
MS, Polytechnic Institute of New York

**Ulman, Abraham**, Alstadt-Lord-Mark Professor of  
Chemistry  
PhD, The Weizmann Institute

**Ulman, Hanna**, Instructor of Mathematics  
MA, Tel-Aviv University

**Umanskiy, Vladimir**, Instructor of Mathematics  
PhD, Azerbaijan Institute of Mathematics and Mechanics

**Vafakos, William P.**, PE, Professor of Mechanical  
Engineering  
PhD, Polytechnic Institute of Brooklyn

**Van Slyke, Richard**, Professor of Electrical Engineering and  
Computer Science  
PhD, University of California at Berkeley

**Van Wagenen, Lindsey**, Instructor of Mathematics  
PhD, Columbia University

**Veeraraghaven, Malathi**, Associate Professor of Electrical  
Engineering  
PhD, Duke University

**Voltz, Peter**, Associate Professor of Electrical Engineering  
PhD, Polytechnic Institute of New York

**Vradis, George C.**, Associate Professor of Mechanical  
Engineering  
JD, Brooklyn Law School  
PhD, Polytechnic University

**Wang, Yao**, Associate Professor of Electrical Engineering  
PhD, University of California at Santa Barbara

**Wein, Joel**, Associate Professor of Computer Science  
PhD, Massachusetts Institute of Technology

**Wener, Richard E.**, Associate Professor of Psychology and  
Department Head  
PhD, University of Illinois at Chicago

**Whang, Sung H.**, Professor of Materials Science  
DEngSc, Columbia University

**Wolf, Edward L.**, Professor of Physics  
PhD, Cornell University

**Wong, Edward K.**, Associate Professor of Computer Science  
PhD, Purdue University

**Yang, Deane**, Professor of Mathematics  
PhD, Harvard University

**Yang, Yisong**, Professor of Mathematics  
PhD, University of Massachusetts at Amherst

**Zabar, Zivan**, Professor of Electrical Engineering  
ScD, Technion

**Zauderer, Erich**, Professor of Mathematics  
PhD, New York University

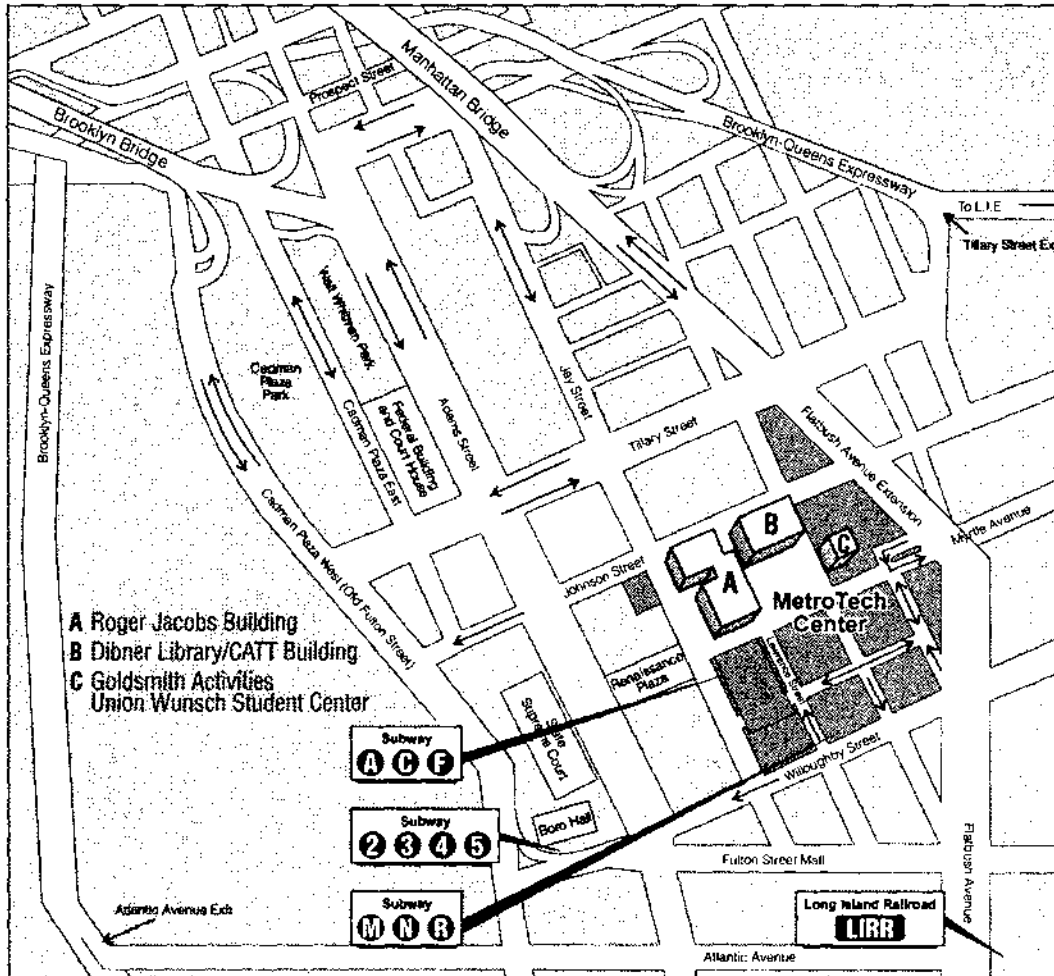
**Zhang, Gaoyong**, Assistant Professor of Mathematics  
PhD, Temple University

**Ziegler, Edward N.**, Associate Professor of Chemical  
Engineering  
PhD, Northwestern University

**Ziv, Nina D.**, Industry Associate Professor of Management and  
Co-director of Executive Management Master's Programs  
PhD, New York University

**Zurawsky, Walter P.**, Associate Professor of Chemical  
Engineering  
PhD, University of Illinois

**BROOKLYN CAMPUS**



**From Manhattan**

By Subway—A, C or F train to Jay St.-Borough Hall; or the 2, 3, 4 or 5 subway to Borough Hall (walk to Fulton and make a left onto Jay) or the R or M to Lawrence St.

By Car—Take the FDR Drive to the Brooklyn Bridge, make the first left after the bridge onto Tillary and a right onto Flatbush.

\*From Flatbush go right onto Myrtle and the second left onto Bridge St. Public parking is available on the lower levels of the SIAC and Brooklyn Union buildings.

**From Queens or the Bronx**

By Car—Take the Brooklyn-Queens Expwy. to Tillary St. and then left onto Flatbush Ave. Continue from \*.

**From Staten Island**

By Car—Take the Verrazano Narrows Bridge to the Brooklyn-Queens Expwy. to the Tillary St. exit. Make a left onto Flatbush Ave. Continue from \*.

**From New Jersey**

By Car—From the George Washington Bridge take the Harlem River Drive to the FDR Drive or Holland Tunnel to Brooklyn Bridge. (Continue as from Manhattan).

**From Brooklyn or Long Island**

By Train—Take the Long Island Railroad to Flatbush Ave. Then take a taxi, bus #B67 to MetroTech on Jay St., or the R or M subway to Lawrence St. 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 St.

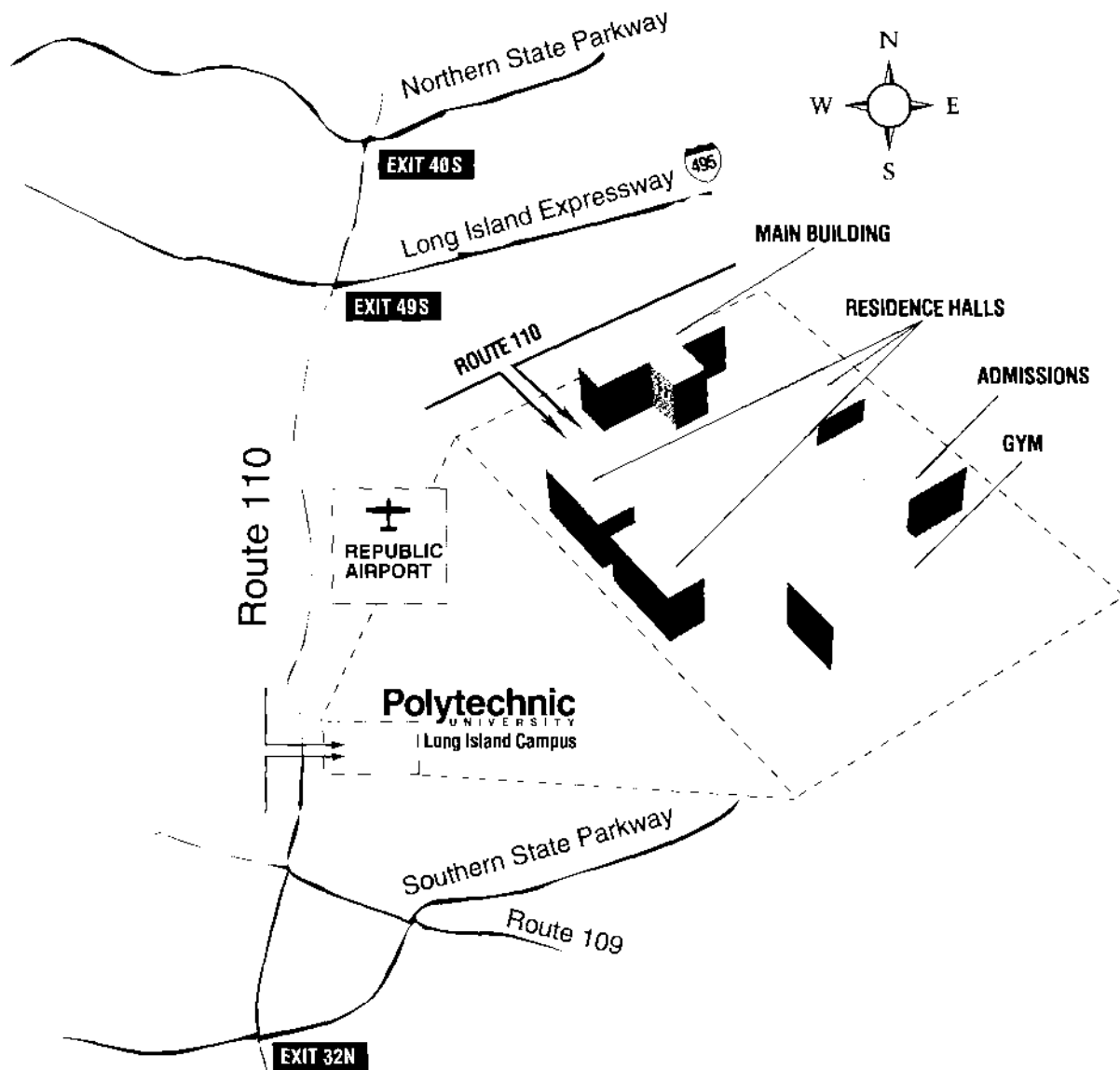
By Car—Brooklyn-Queens Expwy. to the Tillary St. exit. Go left onto Flatbush, continue from \*.

**From Westchester**

By Car—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 Flatbush Ave., continue from \*.

## ROUTES TO POLYTECHNIC

### LONG ISLAND CAMPUS AT FARMINGDALE



#### From New York City

**By Train**—Take the Long Island Rail Road (LIRR) to the Amityville station—taxi or buses available.

**By Car**—Take the Long Island Expressway to Exit 49S. South on Route 110 four miles to campus on left. Or, Northern State Parkway to Exit 40S, then south on Route 110 for five miles to campus on left. Southern State Parkway to Exit 32N, then north on Route 110 for one mile; campus is on the right.

#### From New Jersey

**By Train**—Penn Central, or Commuter Lines to Penn Station, the LIRR as above.

**By Car**—Same directions as from New York City.

#### From Westchester

**By Train**—To Grand Central, taxi or Shuttle (S) train to Penn Station, LIRR as above.

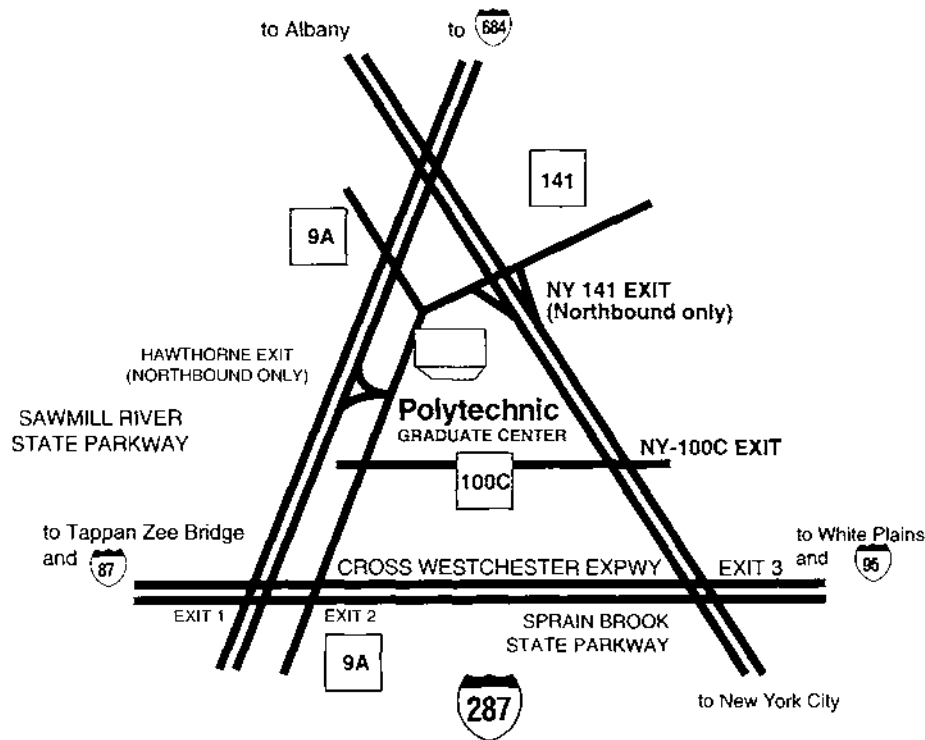
**By Car**—Whitestone or Throgs Neck Bridge to Cross Island Pkwy. (South) to Long Island Expressway East or Northern State Parkway East (then same as from NYC).

#### From Eastern Long Island

**By Car**—Long Island Expressway to Exit 49S which is Route 110; the campus is four miles on the left. Or, Southern State Parkway to 32 North, (Route 110) for one mile; campus is on the right.



**WESTCHESTER GRADUATE CENTER**



**BY CAR**

**From New York City:** NY-9A West Side Highway to Saw Mill River Parkway NORTH. Or I-278 to Triboro 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 interchange for I-287 to the exit for Hawthorne (Route 9A). Turn left at light on to Route 9A northbound. Polytechnic is on the right side of road.

**From New Jersey and Downstate New York:** Take I-87 SOUTH (New York State Thruway) to Tappan Zee Bridge. After bridge, take I-287 EAST to Saw Mill River Parkway NORTH (Exit 1). Travel north 3 miles to exit 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 on to 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:** I-95 to I-287 WEST (Cross Westchester Expressway) to Route 9A (Exit 2) NORTH. Travel north 3 miles; Polytechnic is on the right.

# INDEX

## A

- Academic administration, 285
- Academic Affairs, Office of. 6, 22, 27
- Academic calendar, 10
- Academic departments, 12
  - administration, 285
  - degrees offered, 48
- Academic policies, 18–24
  - academic standing and probation, 21–23
  - continuation of studies (MS to PhD), 21
  - credits and units, 18–20
  - Family Educational Rights and Privacy Act (FERPA, Buckley Amendment), 24
  - grading and grades, 20–21
  - intellectual property, 24
  - leaves of absence and readmission, 23–24
  - outcomes assessment, 18
  - transcripts, 24
  - withdrawal from university, 23
- Academic probation
  - graduate, 23
  - undergraduate, 22
- Academic programs, 11
  - program areas, 17–18
  - selection of major, 18
  - selection of minor, 18
- Academic Skills Seminar (SL 102), 51
- Academic standing, 21–23
- Academic warning, 22
- Accelerated Honors Programs, 52
- Accident insurance, 28
- Adjustment of Degree Requirements form (“blue sheet”), 51
- Administration
  - officers, 285–286
  - offices, 6–9
- Admissions, 31–34
  - graduate, 31–32
    - early, 32
    - examinations, 31
    - international applicants, 31
    - procedures, 31
    - readmission, 23–24, 32
    - status, 31–32
  - offices, 6, 31, 32
    - undergraduate, 32–34
      - with advanced standing, 33
    - application process, 32
    - early admission plan, 32
    - examinations, 32
    - as freshman, 32–33
    - under Higher Education Opportunity Program (HEOP), 33
    - as international student, 33
    - interviews and campus tours, 33
    - as part-time student, 34
    - preferred high school course of study, 32–33
    - readmission, 34
    - special and visiting students, 34
    - timetables, 32
    - transfer agreements, 33–34
      - as transfer student, 33
- Advanced computer architecture concentration (computer engineering), 134
- Advanced standing, freshman admission with, 33
- Advisement
  - for registration, 42
- Advisers
  - graduate, 27
  - undergraduate, 27
- Aerospace engineering, 233, 236
  - class of 1998 job placement, 45
  - department. *See* Department of Mechanical, Aerospace and Manufacturing Engineering
  - graduate program, 236
    - courses, 239–240
    - MS requirements, 238
    - PhD requirements, 238
    - project, thesis and dissertation, 240
  - undergraduate program, 236
    - courses, 238–239
    - typical program of study, 237
- Affirmative action policy, 309
- Aid for Part-Time Study (APTS), 37
- Alcohol policy, 27
- Alumni, 11, 14
  - officers, 286
- Alumni Relations offices, 6
- Analytical chemistry course
  - graduate, 74

- Anthropology  
 concentration (social sciences), 186  
 courses, 189–190
- Appeals  
 financial aid ineligibility, 44  
 refund, 44
- Application for degree, 53
- APTS. *See* Aid for Part-Time Study
- Artificial intelligence and expert systems concentration (computer engineering), 134
- Associations, 28–29, 192–193
- Athletics, 28, 279  
 intercollegiate and intramural, 279  
 offices, 6  
 varsity coaching staff, 279
- Atmospheric physics, program including (electrical engineering), 141
- Auditing courses, 21
- Automatic withdrawal, 23
- B**
- Bachelor of Science (BS)  
 basic degree requirements, 49  
 BS/MS Accelerated Honors Programs, 52  
 core curriculum for engineering majors, 50–51  
 course substitutions, 51  
 degrees offered, 47, 48  
 degrees with honors, 51  
 dual degrees, 52  
 dual majors, 52  
 freshman seminar (SL 101), 26, 51  
 graduation checklist, 51  
 modifications to curricula, 51  
 placement examinations, 49  
 senior honor students, 51  
 theses, 54
- Basic science core  
 for engineering majors, 50
- BASIS/STRIDE Program, 280, 281
- Bassett Building, 15
- Behavioral sciences  
 BS program (accelerated honors program with MS in organizational behavior), 186, 217  
 concentration including (social sciences), 186  
 courses, 189–190
- Biochemistry courses  
 graduate, 75
- Biology courses, 75–76
- Biomaterials option (chemistry), 70, 71
- Biomedical sciences option (chemistry), 67, 69
- “Blue sheet” (Adjustment of Degree Requirements form), 51
- Board of Trustees Scholarships, 38
- Bookstores, 7
- Brooklyn and Staten Island Schools/Science Technology & Research Using Individual Discovery & Exploration (BASIS/STRIDE), 281
- Brooklyn campus, 14–15  
 administrative offices, 6–9  
 campus housing, 30  
 degrees offered, 47  
 library, 15–16  
 map and directions, 294
- BS degree. *See* Bachelor of Science
- BS/MS Accelerated Honors Programs, 52
- Buckley Amendment (Family Rights and Privacy Act, FERPA), 24
- Budget Office, 7
- Bursar, 8
- C**
- Cable*, 14
- CAD. *See* Computer-aided design
- Cafeterias, 7
- Calendar, 10
- Campus housing, 29–30
- Campus life, 25–30
- Campus tours  
 for high school students, 281  
 for prospective students, 33
- Campuses, 14–15
- Career development services, 25–26
- Career Services and Cooperative Education, Office of, 7, 25–26
- Catalog, 5, 309
- Center for Advanced Technology in Telecommunications (CATT), 12, 14, 128
- Center for Finance and Technology (CFT), 12, 193
- Center for Youth in Engineering. *See* YES Center
- Certificate programs, graduate, 53
- CFT. *See* Center for Finance and Technology
- Chancellor, Office of the, 6
- Change, management of, concentration (organizational behavior), 217
- Chase Manhattan Bank facilities, 14
- Chemical engineering, 61  
 class of 1998 job placement, 45  
 department. *See* Department of Chemical Engineering,

## INDEX

- Chemistry and Materials Science  
graduate programs, 61, 63  
courses, 65, 66  
MS requirements, 63  
PhD requirements, 63  
polymer science and engineering option, 63  
projects, theses and seminars, 66  
undergraduate program, 61  
courses, 64  
typical course of study, 62
- Chemistry, 67  
department. *See* Department of Chemical Engineering, Chemistry and Materials Science  
graduate program, 71–72  
courses, 73, 74–75, 76  
MS requirements, 71  
PhD minors, 72  
PhD requirements, 71–72  
undergraduate programs, 67–71  
biomaterials option, 70, 71  
biomedical sciences option, 67, 69  
courses, 72–73, 75–76  
curricula, 68, 69, 70  
life sciences courses, 75–76  
materials chemistry option, 67  
polymer chemistry option, 71  
requirements, 67–71
- Civil engineering  
class of 1998 job placement, 45  
department. *See* Department of Civil and Environmental Engineering  
Executive Construction Management Program (Exec 21)  
courses, 96  
graduate program, 87–88  
additional courses given in specialty areas, 87  
courses, 87, 89, 92–96  
graduate student manual, 88  
MS requirements, 87  
PhD requirements, 88  
requirements without specialization, 87  
specialization requirements, 87  
undergraduate program, 84–85  
accreditation, 84  
courses, 90–91  
curriculum, 85  
part-time students, 85  
philosophy and background, 84  
transfer credits, 84  
typical course of study, 86  
*Undergraduate Manual*, 85
- Class standing, 20  
Clifford H. Goldsmith Student Activities Union, 15  
Cocurricular student activities, 28–29  
Code of Conduct, University, 30  
College preview program (YES Center), 280–281  
College Work Study, 36, 41, 44  
Communication. *See also* Technical and professional communication program; Technical communication  
courses, 170–171  
Communications and information transmission courses, 144–145  
Community college teachers  
reduced tuition program, 35  
Comparative religion courses, 171–172  
Computer and information science, 17, 107. *See also* Department of Computer and Information Science  
Computer architecture, advanced, concentration (computer engineering), 134  
Computer engineering, 131  
class of 1998 job placement, 45  
laboratories (electrical engineering), 145–148  
MS program, 135, 142  
undergraduate program, 107, 131–135  
BS/MS accelerated honors program, 135  
computer-aided design (CAD), 134  
concentrations, 134  
courses, 135  
curriculum, 131–134  
guidance, 135  
information announcements, 135  
part-time, 134  
senior honor students, 135  
transfer students, 134–135  
Computer graphics concentration (computer engineering), 134  
Computer placements, 49  
Computer science, 17, 107  
class of 1998 job placement, 45  
core curriculum for engineering majors, 50–51  
department. *See* Department of Computer and Information Science  
graduate program  
certificate in software engineering, 114–115  
courses, 117–120  
MS requirements, 112–114  
PhD requirements, 114  
project and thesis, 120  
preparatory courses, 117  
undergraduate program, 107, 110–112  
courses, 115–117

curriculum, 110–111, 113  
 departmental standards, probations and I grade, 111–112  
 electives list, 112  
 honors program, 111  
 information announcements, 112  
 transfer students, 111  
*Computer Science Graduate Mailing*, 117  
 Computer-aided design (CAD), 134  
 Computing facilities, 16  
 Conditional status applicant, 31  
 Conolly Hall, 30  
 Construction management  
   concentration (management program), 205  
   courses, 94–95, 96  
   Executive Construction Management Program (Exec 21), 96  
 Contact information, 2  
 Continuation of studies, from MS to PhD, 21  
 Control and instrumentation courses, 144  
 Control and robotics  
   concentration (computer engineering), 134  
   courses, 261  
   lab, 128  
 Control systems courses, 149, 150–151  
 Co-op Career Development Seminar (CP 101), 275  
 Cooperative Education, Office of, 7, 25–26  
 Cooperative Education Program, 26, 39, 275–276  
 Cooperative programs, 33–34. *See also* Cooperative Education Program  
 Core curriculum, for engineering majors, 50–51  
 Corporate scholarships, 38–39  
 Corporation, 284  
 Counseling services, 26  
 Course auditing, 21  
 Course changes  
   additions/deletions, 42  
   substitutions, 51  
 Course descriptions  
   guide to, 57  
 Course repetition, 21  
 Course withdrawal, 21  
 CP 101 (Co-op Career Development Seminar), 275  
 Credits, 18  
   calculating, 22  
   for courses taken elsewhere (transfer), 19, 33  
   by examination, 19–20  
   maximum, and registration status, 20  
   minimum, by semester of full-time study, 22  
   validation, 20  
 CS 200 (Programming Methodology), 49  
 Cultural organizations, 29

## D

Data communications concentration  
 (computer engineering), 134  
 David Packard Center for Technology and Educational Alliances, 7, 282  
 Dean of Engineering Scholarships, 38  
 Dean's List, 23  
 DeGaeta, Albert and Edythe, 40  
 Degree requirements, 49–54  
   application for degree, 53  
   Bachelor of Science, 49–52  
   Doctor of Philosophy, 53  
   graduate certificate programs, 53  
   Master of Science, 52–53  
   theses and dissertations, 54  
 Degrees  
   dual undergraduate, 52  
   offered, by department, 47  
   simultaneous BS/MS, 52  
 Department of Chemical Engineering, Chemistry and Materials Science, 58  
   chemical engineering program, 61–66  
   chemistry program, 67–76  
   degrees offered, 48  
   environmental science program, 77–78  
   faculty, 59–60  
   graduate programs, 59  
   polymer science and engineering program, 79–80  
   undergraduate programs, 58–59  
 Department of Civil and Environmental Engineering, 81  
   civil engineering program, 84–96  
   degrees offered, 48, 81  
   environmental engineering and environmental science programs, 97–100  
   faculty, 81–83  
   *Graduate Student Manual*, 88  
   transportation program, 101–106  
   *Undergraduate Manual*, 85  
 Department of Computer and Information Science, 107  
   computer engineering program, 107  
   computer science program, 107, 110–120  
   degrees offered, 48  
   faculty, 108–109  
   graduate programs, 107–108  
   information management program, 107, 121–123  
   information systems engineering program, 124–125  
   telecommunication networks program, 126  
   undergraduate programs, 107

## INDEX

- Department of Electrical Engineering, 127  
CATT, 128  
computer engineering program, 131–135  
degrees offered, 48, 127  
*EE Department Graduate Student Manual*, 141, 142  
electrical engineering program, 136–157  
electrophysics program, 158  
faculty, 128–130  
phone numbers, 128  
specialty labs, 127–128  
systems engineering program, 159  
telecommunication networks program, 160
- Department of Humanities and Social Sciences, 161  
degrees offered, 48, 161–162  
dual undergraduate degrees, 161  
environment-behavior studies program, 164–166  
faculty, 162–163  
history of science program, 167–168  
humanities program, 169–172  
instructional labs, 162  
minors, 161  
research centers, 162  
social sciences program, 184–191  
technical and professional communication program, 173–183  
writing placement exam, 161
- Department of Management, 18, 192  
administration, 193  
Center for Finance and Technology (CFT), 12, 193  
corporate advisory board, 195–196  
degrees offered, 48, 192  
faculty, 193–195  
financial engineering program, 192, 197–202  
graduate degree and certificate programs, 192  
information management program, 107, 121–123  
Institute for Technology and Enterprise (ITE), 12, 193  
Management of Technology (MOT) Executive Program, 211–215  
management program, 192, 203–210  
    extension in Israel, 193  
organizational behavior program, 186, 192, 216–217  
program administration and professional staff, 196  
research and development, 192  
student professional organizations, 192–193  
Telecommunications and Information Management (TIM) Executive Program, 218–222
- Department of Mathematics, 223  
degrees offered, 48  
faculty, 223–224  
mathematics program, 225–232
- Department of Mechanical, Aerospace and Manufacturing Engineering, 233  
aerospace engineering program, 236–240  
degrees offered, 48, 234  
faculty, 234–235  
general engineering program, 263–264  
industrial engineering program, 241–244  
manufacturing engineering program, 245–248  
materials science program, 249–252  
mechanical engineering program, 233–234, 253–262
- Department of Student Development, 9
- Departmental societies, 28–29
- Development and University Relations  
    Office of, 6  
    officers, 286
- Dibner Library, 14, 15–16
- Directory information, 24
- Disabilities, students with, 27
- Disqualification  
    graduate, 23  
    undergraduate, 22
- Dissertations, 54
- Doctor of Philosophy  
    continuation of studies (from MS), 21  
    degree requirements, 53  
    degrees offered, 47, 48  
    dissertations, 54
- Documentation, 173–174
- Documentation, Training and New Media specialization (technical and professional communication), 173–174, 176
- Dropping of course, 42
- Drug policy, 27
- Dual majors, 52
- Dual undergraduate degrees, 52
- E**
- Early admissions, 32
- Economics  
    concentration (social sciences program), 185  
    courses, 190
- Education records, student rights concerning, 24
- Edythe and Albert DeGaeta Scholars Loan Program, 40
- EE Department Graduate Student Manual*, 141, 142
- EG 101 (Introduction to Engineering), 281

- Electric power courses, 145
- Electrical engineering, 136–138  
 class of 1998 job placement, 45  
 concentrations (computer engineering), 134  
 department. *See* Department of Electrical Engineering  
 graduate program, 141–143  
 courses, 148–157  
 MS in computer engineering, 135, 142  
 MS requirements, 141–142  
 PhD requirements, 142–143  
 program areas, 141  
 undergraduate program, 138–140  
 BS/MS accelerated honors program, 140  
 computer-aided design facilities and programs, 139  
 courses, 143–148  
 curriculum, 137, 138–139  
 guidance in, 140  
 information announcements, 140  
 part-time, 140  
 senior honor students, 140  
 senior laboratory and senior design projects, 146  
 transfer students, 140
- Electrical laboratories, 145–146
- Electrodynamic and wave phenomena courses, 149, 156–157
- Electromagnetic fields courses, 145
- Electronic business concentration (management certificate), 204
- Electronic circuit analysis and design courses, 144
- Electronic devices, circuits and systems courses, 149, 153–154
- Electronic materials courses, 145
- Electronics and VLSI program (electrical engineering), 141
- Electronics option (physics), 268
- Electro-optics courses, 149, 154–155
- Electrophysics program, 158
- Energy conversion, program including (electrical engineering), 141
- Engineering, 17. *See also specific areas of engineering*  
 core curriculum for majors, 50–51  
 courses  
 general, 263–264  
 for high school students, 281
- Engineering and computer science core, 50–51
- Enrollment statistics, 46
- Entrepreneurship concentration (management certificate), 204
- Environmental engineering, 97  
 courses, 93–94, 99–100  
 department. *See* Department of Civil and Environmental Engineering
- Environmental engineering and environmental science programs, 97–100  
 courses, 99–100  
 hazardous waste management certificate, 98  
 MS requirements, 98  
 PhD requirements, 98
- Environmental science, 77, 97  
 courses, 99–100  
 graduate program. *See* Environmental engineering and environmental science program  
 undergraduate program, 77–78  
 typical course of study, 78
- Environment-behavior studies program, 164–166  
 certificate in human-computer interaction, 164  
 certificate program, 164  
 courses, 165–166  
 faculty, 166  
 MS requirements, 164
- Examinations  
 for establishing credit, 19–20  
 freshman admissions, 32  
 graduate admissions, 31  
 international student admissions, 31  
 placement, for BS, 49
- Executive Construction Management Program (Exec 21)  
 courses, 96
- Executive offices, 6
- Executive Scholars Program, 26
- Expert systems  
 concentration including (computer engineering), 134
- F**
- Facilities, 7
- Faculty, 11, 13, 287–290
- Family Educational Rights and Privacy Act (FERPA), 24
- Farmingdale campus. *See* Long Island campus
- Federal financial aid programs  
 undergraduate, 36–37
- Federal Pell Grants, 37
- Federal Perkins Loans, 36
- Federal Subsidized Stafford Loans  
 graduate, 36  
 undergraduate, 39–40
- Federal Supplemental Education Opportunity Grant (SEOG), 36
- Federal Unsubsidized Stafford Loan  
 graduate, 36  
 undergraduate, 40
- Federal Work-Study Program, 36, 41, 44

## INDEX

- Fees, 43–44
- Fellowships, graduate, 35
- FERPA. *See* Family Educational Rights and Privacy Act
- Fields and waves program (electrical engineering), 141
- Final probation, 22
- Final registration, 42
- Finance and Administration
  - Office of, 6
  - officers, 286
- Financial aid, 35–41
  - graduate, 35–36
  - offices, 7
  - policies, 41
  - and tuition refunds upon withdrawal, 44
  - types of, 35–41
  - undergraduate, 36–41
    - application for, 36
    - renewal of, 36
- Financial engineering program, 192, 197–202
  - Advanced Certificate, 197, 198–199
  - certificate, 197, 198–199
  - courses, 199–202
  - MS, 197–198
    - admission, 197–198
    - curriculum, 198
- Financial Engineering Student Association, 193
- Financial Operations office, 8
- Financial services track (Management of Technology Executive Program), 212
- Fine arts courses, 172
- Fluid sciences courses, 259–260
- Fraternalities, 29
- Freshman
  - admission as, 32–33
- Freshman seminar (SL 101), 26, 51
- Full-time status, 20
  
- G**
- Geiger/Fialkov Scholarships, 38
- General engineering program, 263–264
  - courses, 263–264
  - faculty, 264
  - objectives, 263
- Geotechnical and geo-environmental engineering courses, 94
- GMAT. *See* Graduate Management Admission Test
- Goldsmith Student Activities Union, 15
- Grade-point average
  - computing, 20–21
  - required
    - graduate, 23
    - undergraduate, 22
- Grades
  - in calculating credits, 22
  - I (Incomplete), 21
  - for repeated courses, 21
  - W (Withdrawal), 21
- Grading policies, 20–21
- Graduate Admissions, Office of, 6, 31
- Graduate certificate programs, 53
- Graduate Management Admission Test (GMAT), 31
- Graduate Record Examination (GRE), 31
- Graduate research projects, 54
- Graduate students
  - academic standing and probation, 23
  - admissions, 31–32
    - early, 32
    - examinations, 31
    - international applicants, 31
    - procedures, 31
    - readmission, 23–24, 32
    - status, 31–32
  - advisers, 27
  - auditing courses, 21
  - computing grade-point average, 21
  - continuation of studies (from MS to PhD), 21
  - credit by examination, 20
  - deferred payment plan, 43
  - financial aid, 35–36
  - leaves of absence, 23–24
  - registration status, 20
  - repeating courses, 21
  - tuition and fees, 43
  - units, 18–19
    - for courses taken elsewhere, 19
- Graduation checklist, 51
- Graduation rate, 28
- Grants
  - undergraduate, 36, 37–39
- GRE. *See* Graduate Record Examination
- GSL. *See* Federal Subsidized Stafford Loans
- Gymnasium (Long Island campus), 15
  
- H**
- Hazardous waste management, certificate in, 98
- HEGIS Codes, 47
- HEOP. *See* Higher Education Opportunity Program
- Herman F. Mark Polymer Research Institute, 58
- High school students
  - Packard Center courses and programs for, 282
  - YES Center courses and programs for, 280–281



- High school teachers  
 reduced tuition program, 35  
 seminars and staff development/training  
 workshops for, 281, 282
- Higher Education Opportunity Program (HEOP), 33, 37, 277–278
- Highway construction, materials and engineering courses, 95
- History  
 concentration (social sciences), 185  
 courses, 187–189  
 of Polytechnic University, 11
- History of science  
 courses, 167–168, 187–189  
 history and philosophy of science and technology  
 concentration (social sciences), 185  
 MS program, 167–168
- History of technology. *See* History of science
- Home equity loan/line of credit, 40
- Honor societies, 29
- Honor students, 51
- Honors, degrees with, 51
- Honors programs  
 BS/MS Accelerated, 52
- Housing  
 campus, 29–30  
 charges for, 43  
 off-campus, 30
- Human resource management concentration  
 in management program, 205  
 in organizational behavior program, 217
- Human Resources office, 8
- Human-computer interaction  
 certificate in, 164
- Humanistic studies concentration (humanities), 169–170
- Humanities, 18  
 department. *See* Department of Humanities and Social Sciences  
 undergraduate program, 169–172  
 concentrations, 169–170  
 courses, 170–172  
 degree requirements, 169
- I**
- I (Incomplete) grade, 21
- I-CARE system, 13
- Identification  
 student, 42
- IIS. *See* Institute of Imaging Sciences
- Immunizations, required, 27
- Individually sponsored scholarships, 38–39
- Industrial engineering program, 241–244  
 certificate program, 242  
 courses  
 graduate, 243–244  
 undergraduate, 244  
 MS requirements, 241–242
- Information management. *See also* Telecommunications and Information Management (TIM) Executive Program  
 concentration (management certificate), 204  
 undergraduate program, 107, 121–123  
 requirements, 123  
 standards, probations and I grade, 123  
 typical course of study, 122
- Information science. *See* Computer and information science department. *See* Department of Computer and Information Science
- Information Systems Engineering (ISE)  
 Executive Degree Program, 124–125  
 admission requirements, 124  
 courses, 125  
 degree requirements and curriculum, 124
- Inorganic chemistry courses  
 graduate, 74
- Institute for Technology and Enterprise (ITE), 12, 193
- Institute of Imaging Sciences (IIS), 12
- Insurance, accident and sickness, 28
- Intellectual property, 24
- Intelligent Transportation Systems (ITS)  
 certificate in, 104  
 courses, 106  
 research on, 13
- International Student Office, 8
- International students, 27  
 admissions  
 graduate, 31  
 undergraduate, 32, 33  
 registration status, 20
- Intersessions, 20
- Interviews, prospective student, 33
- Introduction to Engineering (EG 101), 281
- Involuntary withdrawal, 23
- ISE. *See* Information Systems Engineering
- Israel, MSM extension in, 193
- ITE. *See* Institute for Technology and Enterprise
- ITS. *See* Intelligent Transportation Systems

## INDEX

### J

- Jacobs Building, 14
- Jets Competition, 281
- Job placement
  - class of 1998, 45
  - services, 25–26
- Joseph W. and Samuel Wunsch Student Center Building, 15
- Journalism, specialized, MS in, 173, 176
- Journalism and Technical Writing, BS in, 173, 174–176
  - sample schedule, 175

### K

- KeySpan Energy office, 14

### L

- Laster Library, 16
- Late registration, 42
- Law and technology concentration (social sciences), 184–185
- The Learning Center, 25
- Leaves of absence, 23–24
- Liberal arts, 18. *See also* Department of Humanities and Social Science
  - core curriculum for engineering majors, 50
- Libraries, 8, 15–16
- Life sciences courses, 75–76
- Linear systems and networks courses, 149
- Literature concentration (humanities), 169–170
- Loans
  - graduate, 36
  - undergraduate, 36, 39–40
- Local Area Networks Lab, 127
- Long Island campus, 15
  - administrative offices, 6–9
  - campus housing, 15, 30
  - degrees offered, 47
  - library, 16
  - map and directions, 295

### M

- Machinery Lab, 128
- Mailrooms, 8
- Main building (Long Island campus), 15
- Major
  - dual, 52
  - selection of, 18

- Management, 18, 192
  - certificate programs, 203
  - courses
    - graduate, 206–210
    - undergraduate, 205–206
  - department. *See* Department of Management
  - MSM (Master of Science in Management), 203–205
    - admission and degree requirements, 203
    - concentrations, 204–205
    - curriculum, 204
    - extension in Israel, 193
  - Management of change concentration (organizational behavior), 217
  - Management of Technology (MOT). *See also* Technology management
    - Executive Program, 211–215
      - admissions, 211–212
      - courses, 213–215
      - degree requirements and curriculum, 212
      - MOTIFS track, 212
    - Management of Technology and Innovation in Financial Services (MOTIFS), 212
    - Management of Technology and the Telecommunications and Information Management Executive Programs Alumni Association, 192
  - Manufacturing engineering, 233, 245
    - certificate program, 246
    - courses
      - graduate, 247–248
      - undergraduate, 245, 248
    - department. *See* Department of Mechanical, Aerospace and Manufacturing Engineering
    - laboratory facilities, 246
    - MS program, 245–246
      - laboratory and project work, 246
      - master's report (MS Report), 246
      - requirements, 245–246
- Mark, Herman, 12
- Mark Polymer Research Institute, 58
- Master of Science (MS)
  - BS/MS Accelerated Honors Programs, 52
  - continuation of studies (to PhD), 21
  - degree requirements, 52–53
  - degrees offered, 47, 48
  - projects and theses, 54
- Materials chemistry option (chemistry), 67
- Materials option (physics), 268

- Materials science, 58, 249  
 courses, 149, 154–155, 250–252  
 department. *See* Department of Chemical Engineering, Chemistry and Materials Science; Department of Mechanical, Aerospace and Manufacturing Engineering  
 graduate program, 249–252  
 admissions requirements, 252  
 courses, 250–252  
 degree requirements, 249  
 degrees offered, 249  
 fellowships/assistantships, 252
- Mathematics, 17, 225  
 core curriculum for engineering majors, 50  
 department. *See* Department of Mathematics  
 graduate program, 227  
 courses, 229–232  
 MS requirements, 227  
 PhD requirements, 227  
 option (physics), 268  
 undergraduate program, 225–227  
 courses, 227–228  
 dual major with physics, 225, 268  
 minor, 227  
 requirements, 225  
 typical course of study, 226
- Mathematics Placement Examination, 49
- Mayor's Graduate Scholarship Program, 35
- Mechanical analysis and design courses, 260–261
- Mechanical engineering, 233, 253  
 class of 1998 job placement, 45  
 department. *See* Department of Mechanical, Aerospace and Manufacturing Engineering  
 graduate program, 254–256  
 courses, 259–262  
 MS requirements, 254–256  
 PhD requirements, 256  
 undergraduate program, 233–234, 253–254  
 courses, 256–259  
 requirements, 254  
 transfer students, 254  
 typical program of study, 254, 255
- Media organizations, 29
- Mentoring  
 of children and high school students, 282
- Metro Caf., 7
- MetroTech Center, 14
- Microcontroller Systems and Interfaces, concentration (computer engineering), 134
- Microwave Lab, 128
- Minor, selection of, 18
- MOT. *See* Management of technology
- MOTIFS, 212
- MS degree. *See* Master of Science
- MSM program. *See* Management, MSM
- Multimedia Lab, 127
- Music courses, 172
- N**
- National Society of Professional Engineers Scholarship (NSPE), 38
- Networking  
 courses, 149, 151–152  
 program including (electrical engineering), 141
- New media, 174  
 specialization including, 173–174, 176
- New student orientation, 26
- New York University  
 dual degree program in transportation, 102–103
- Nondegree status  
 undergraduate, 34
- Non-New York State residents  
 grant aid to, 39
- NSPE. *See* National Society of Professional Engineers Scholarship
- O**
- Off-campus housing, 30
- Operations concentration (management), 205
- Organic chemistry courses  
 graduate, 74–75
- Organizational behavior program, 192, 216–217  
 certificate, 216–217  
 concentrations, 217  
 curriculum, 216–217  
 MS, 216  
 admission and degree requirements, 216  
 with BS in behavioral sciences, 186, 217
- Organizations, student, 28–29  
 management-related, 192–193
- Orientation, new student, 26
- Outcomes assessment, 18
- Outstanding Transfer Scholarships, 38

## INDEX

- P**
- Packard Center, 7, 282
  - Parents
    - loans to, 40
  - Part-time status, 20
  - Part-time students, undergraduate
    - admission as, 34
    - financial aid program for, 37
  - Payment
    - plans/options, 40, 43
    - policies, 43
  - Pell Grants, 37, 41, 44
  - Perkins Loans, 36, 41
  - PhD degree. *See* Doctor of Philosophy
  - Philosophy
    - concentration (humanities), 169
    - courses, 171–172
    - of science and technology, concentration including (humanities), 185
  - Philosophy and Technology Studies Center, 162
  - Physical chemistry courses, graduate, 74
  - Physical Education and Athletics Program, 279
    - courses, 279
    - faculty, 279
    - varsity coaching staff, 279
  - Physics, 265
    - atmospheric, program including (electrical engineering), 141
    - degrees offered, 48
    - dual major with mathematics, 225, 268
    - electrophysics program, 158
    - faculty, 265
    - graduate program, 265, 268–269
      - courses, 271–273
      - MS requirements, 269
      - PhD requirements, 269
    - undergraduate program, 265, 266–268
      - courses, 269–271
      - options, 268
      - requirements, 266–268
      - typical course of study, 267
  - Placement examinations
    - for BS, 49
  - Placement statistics, 45
  - Plasma and atmospheric physics program (electrical engineering), 141
  - Policies. *See also* Academic policies
    - financial aid, 41
    - payment, 43
  - Polymer chemistry
    - graduate courses, 74
    - option (chemistry), 71
  - Polymer Research Institute (PRI), 12–13
  - Polymer science and engineering program, 79–80
    - admissions requirements, 79
    - courses, 79–80
    - MS requirements, 79
    - projects, theses and seminars, 80
  - Polytechnic Alumni, 14
  - Polytechnic National Society of Professional Engineers Scholarship (NSPE), 38
  - Polytechnic University, profile of, 11
  - Polytechnic University Catalog, 5, 297
  - Power engineering courses, 149, 155–156
  - Power systems and energy conversion program (electrical engineering), 141
  - Pre-law
    - concentration (social sciences), 184–185
    - courses, 187
  - President, Office of the, 6
  - PRI. *See* Polymer Research Institute
  - PRIDE, 13
  - Principal's Scholarships, 38
  - Printing Services, 8
  - Privacy rights, 24
  - Pro rata refunds, 44
  - Probation
    - graduate, 23
    - undergraduate, 22
  - Professional communication program. *See* Technical and professional communication program
  - Professional societies, 28–29, 192–193
  - Program adjustments, 42
  - Programming Methodology (CS 200), 49
  - Programs. *See also* Academic programs
    - research, 12–13
    - special, 275–282
  - PROMISE Scholarships, 38, 281
  - Prospective students
    - campus tours and interviews, 33
    - financial aid application, 41
  - Provisional status applicant, 31
  - Provost, Office of the, 6
  - Psychology and behavioral sciences
    - concentration (social sciences), 186
    - courses, 189–190
  - Publication of doctoral dissertations, 54
  - Publications, student, 29

- Q**  
 Quantum electronics courses, 149, 154–155
- R**  
 Racial/ethnic status, enrollment by, 46  
 Readmission  
   graduate, 23–24, 32  
   undergraduate, 23, 34  
 Reduced tuition program  
   for high school and two-year community college teachers, 35  
 Reduction of liability, 44  
 Refund of tuition, 44  
 Registrar, 9  
 Registration, 42  
   for theses and dissertations, 54  
 Registration status, 20  
 Regular status applicant, 31  
 Religion courses, 171–172  
 Religious observances, guidelines on, 28  
 Religious organizations, 29  
 Repeating courses, 21  
 Request for Continuation of Studies form, 21  
 Research fellowships, 35  
 Research programs and centers, 12–13  
   administration, 285  
 Residence halls (Long Island campus), 15, 30  
 Residence Life office, 8  
 Residency requirements, 19, 33  
 Residential life, 29–30  
 Retention, 28  
 Richard L. Conolly Hall, 30  
 Richard Laster Library, 16  
 Risk management  
   Advanced Certificate Program, 197, 198–199  
 Robotics  
   concentration including (computer engineering), 134  
   Control/Robotics Lab, 128  
   courses, 261  
 Rogers Hall, 14  
 ROTC scholarships, 39
- S**  
*Schedule of Classes*, 5  
 Scholarships  
   graduate, 35  
   undergraduate, 36, 37–39  
   renewability, 41  
 Science, 17  
   history of. *See* History of science  
   Science competitions/fairs, 281  
 Securities Industry Automation Corporation (SIAC), 14  
 Security, 8  
 Senior honor students, 51  
 SEOG. *See* Supplemental Education Opportunity Grant  
 Settlement houses, 282  
 SHRM. *See* Society for Human Resources Management  
 SIAC. *See* Securities Industry Automation Corporation  
 Sickness insurance, 28  
 Signal processing  
   courses, 149–150  
   program (electrical engineering), 141  
 SL 101 (Freshman seminar), 26, 51  
 SL 102 (Academic Skills Seminar), 51  
 Social organizations, 29  
 Social sciences, 18  
   BS/MS accelerated honors program in behavioral sciences and organizational behavior, 186, 216  
   department. *See* Department of Humanities and Social Sciences  
   undergraduate program, 184–181  
     concentrations, 184–186  
     courses, 187–191  
 Society for Human Resources Management (SHRM)  
   student chapter, 192  
 Sociology  
   concentration (social sciences), 186  
   courses, 189–190  
 Software engineering  
   graduate certificate in, 114–115  
 Sororities, 29  
 Special fellowships, 35  
 Special programs, 275–282  
 Special Services  
   Office of, 8, 25, 26  
 Special student status  
   graduate, 31–32  
   undergraduate, 34  
 Specialized journalism, MS in, 173, 176  
 Stafford Student Loans  
   graduate, 36  
   undergraduate, 39–40, 41  
 State-sponsored financial aid programs  
   undergraduate, 37  
 Status  
   graduate admissions, 31–32  
 Structural materials and engineering courses, 92–93  
 Student Accounts/Bursar offices, 8  
 Student activities  
   cocurricular, 28–29  
   offices, 9

## INDEX

- Student Affairs
    - Office of, 6, 9
    - officers, 286
  - Student associations, 28–29
  - Student body statistics, 46
  - Student center (Brooklyn campus), 15
  - Student Development, Department of, 9, 25
  - Student government, 28
  - Student identification, 42
  - Student information, disclosure of, 24
  - Student organizations, 28–29
    - management-related, 192–193
  - Student population, 11
  - Student publications, 29
  - Student Records/Registrar offices, 9
  - Student religious observances, guidelines on, 28
  - Student retention, 28
  - Students with disabilities, 27
  - Summer Research Institute (YES center), 280
  - Summer sessions, 20
  - Supplemental Education Opportunity Grant (SEOG), 36, 41, 44
  - Support services, 25–30
  - Systems, control and robotics courses, 261
  - Systems and control program (electrical engineering), 141
  - Systems engineering program, 159
- T**
- TAP. *See* Tuition Assistance Program
  - Technical communication, certificate in, 176
  - Technical and professional communication program, 173–183
    - graduate, 176–177
      - certificate in technical communication, 176
      - courses, 179–183
      - MS in specialized journalism, 176
      - specialization courses, 177
    - specializations, 173–174
      - recommended courses, 174–176, 177
    - undergraduate, 174–175
      - BS in journalism and technical writing, 174–176
      - BS/MS accelerated honors program, 176
      - courses, 177–179
      - specialization courses, 174–176
  - Technology
    - history and philosophy of. *See* History of science
  - Technology management. *See also* Management of technology
    - concentration (management certificate), 204
  - Telecommunication networks program, 126, 160
  - Telecommunications and Information Management (TIM) Executive Program, 218–222
    - admissions, 219
    - courses, 219–222
    - curriculum, 219
  - Telecommunications and networking
    - courses, 149, 151–152
    - program (electrical engineering), 141
  - Telecommunications Management concentration (management), 205
  - Test of English as a Foreign Language (TOEFL), 31
  - Test of Spoken English (TSE), 31
  - Thermal and fluid sciences courses, 259–260
  - Theses, 54
  - TIM program. *See* Telecommunications and Information Management (TIM) Executive Program
  - Time needed to complete degrees, 28
  - Title IV Aid, 41
    - and refunds upon withdrawal, 44
  - TOEFL. *See* Test of English as a Foreign Language
  - Traffic engineering
    - certificate in, 103–104
    - courses, 105
  - Training, 174
    - specialization including (technical and professional communication), 173–174, 176
  - Training and development concentration (organizational behavior), 217
  - Transcripts, 24
  - Transfer agreements, 19, 33–34
  - Transfer credits, 19, 33
    - for international courses, 33
  - Transfer students
    - admission of, 33
    - scholarship for, 38
  - Transportation
    - certificate programs, 103–104
    - courses
      - graduate, 104–106
      - undergraduate, 104
    - MS program, 101–102
      - dual degree, with NYU, 102–103
      - requirements, 102
      - transfer credits, 102
      - transportation management, 102
      - transportation planning and engineering, 102
    - PhD program, 101–102, 103
    - program requirements, general, 101–102

- Transportation management
    - dual degree program, 102–103
    - MS in, 102
  - Transportation management and economics
    - certificate in, 104
  - Transportation management and facility operations
    - courses, 105
  - Transportation planning, analysis and evaluation
    - courses, 104–105
  - Transportation planning and engineering
    - certificate in, 104
    - dual degree program in, 102–103
    - MS in, 102
    - PhD concentration in (civil engineering), 103
  - Transportation Research Institute (TRI), 13
  - Trustees, 284
  - TSE. *See* Test of Spoken English
  - Tuition, 43
    - refunds, 44
  - Tuition Assistance Program (TAP)
    - graduate, 35
    - undergraduate, 37
  - Tutoring services
    - for high school students, 281
    - for university students, 25
  - Two-year community college teachers
    - reduced tuition program, 35
- U**
- Undergraduate Admissions, Office of, 6, 32
  - Undergraduate students. *See also* Bachelor of Science
    - academic standing and probation, 21–23
    - admissions, 32–34
      - application process, 32
      - early admission plan, 32
      - as freshman, 32–33
      - under Higher Education Opportunity Program, 33
      - as international student, 32, 33
      - as part-time student, 34
      - readmission, 23, 34
      - special and visiting students, 34
      - transfer agreements, 33–34
      - as transfer student, 33
    - advisers, 27
    - class standing, 20
    - computing grade-point average, 20–21
    - credit by examination, 18–19
    - credits, 18
    - financial aid, 36–41
      - application for, 36
      - policies, 41
      - renewal of, 36
      - types of, 36–41
    - leaves of absence, 23
    - registration status, 20
    - repeating courses, 21
    - selection of major, 18
    - selection of minor, 18
    - transfer credits, 19
    - tuition and fees, 43
  - Undergraduate theses, 54
  - Undergraduate Waiver of Admissions Credentials Plan, 33
  - United Neighborhood Houses Inc., 282
  - Units, 18–19
    - for courses taken elsewhere, 19
    - maximum, and registration status, 20
  - University Code of Conduct, 30
  - University Scholars, 35
  - University tours
    - for high school students, 281
    - for prospective students, 33
  - Urban Infrastructure Institute, 13
  - Urban ITS Center, 13
  - Urban Utilities Center, 13
- V**
- Validation credits, 20
  - Veterans Administration (VA) educational benefits, 39
  - Vietnam Veterans Tuition Award Supplement (VVTA), 37
  - Visiting student status, 34
  - VLSI
    - design, concentration (computer engineering), 134
    - program including (electrical engineering), 141
    - specialty labs, 127–128
  - Voluntary withdrawal, 23
  - VVTA. *See* Vietnam Veterans Tuition Award Supplement
- W**
- W (Withdrawal) grade, 21
  - Water resources engineering courses, 93
  - Waves
    - courses, 149, 156–157
    - program including (electrical engineering), 141
  - Weber Research Institute (WRI), 13
  - Weeping Willow Cafeteria, 7

## INDEX

- Westchester Graduate Center, 15  
administrative offices, 6–9  
degrees offered, 47  
library, 16  
map and directions, 296
- Wireless Lab, 127
- Withdrawal  
from course, 21  
international students, 20  
grade (W), 21  
and tuition refund, 44  
from university, 23
- Work-study, federal program, 36, 41, 44
- World Wide Web site address, 2, 16
- WRI. *See* Weber Research Institute
- Writing  
course(s), 170  
for high school teachers, 282  
placement examination, 49, 161  
technical, BS in journalism and, 174–176
- Writing about Medicine, Science and Technology specialization (technical and professional communication), 173, 174
- Writing and humanities courses, 170
- “Writing and speaking across the curriculum” program, 51
- Writing Center, 162
- Writing for Business specialization (technical and professional communication), 173, 174
- Wunsch Student Center Building, 15

## Y

- YES Center, 9, 280–281  
college preview program, 280–281  
and PROMISE Scholarships, 38, 281  
Summer Research Institute, 280





It is the policy of Polytechnic University to comply 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 University will conduct its business and practices in a manner that fully complies with and supports Presidential Executive Order 11246, as amended. Our compliance with Executive Order 11246 is calculated to eliminate discrimination against employees or applicants for employment on account of race, color, religion, sex, age, national origin, sexual orientation, liability for service in the Armed forces of the United States, veteran status or disability.

Inquiries about the above policies may be directed to the Affirmative Action Office, Polytechnic University, Six Metrotech Center, Brooklyn, New York 11201.

The University is authorized under federal law to enroll non-immigrant alien students.

This catalog is not intended to be, and should not be regarded as, a contract between Polytechnic University and any student or other person.

NOTES

**NOTES**