Drexel University Graduate Catalog

2003 - 2004

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For queries regarding historical course descriptions, contact the Office of the Registrar at Curtis Hall, Room 261 3141 Chestnut Street, Philadelphia, PA 19104.

For questions about admissions or to request an application, contact the Office of Admissions, Drexel University, 3141 Chestnut Street, Philadelphia PA. 1.800.2.DREXEL enroll@drexel.edu

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About the University

Yesterday, Today, and Tomorrow

In 1891, near the end of a long and prosperous life, Philadelphia financier and philanthropist Anthony J. Drexel founded the Drexel Institute of Art, Science and Industry. As society's need for technically proficient leaders grew, so did Mr. Drexel's institution, first becoming the Drexel Institute of Technology in 1936, and then Drexel University in 1970.

Today, more than 11,500 undergraduate and 4,500 graduate students attend Drexel's eight colleges and three schools:

- The College of Arts and Sciences, which grants bachelor's, master's, and Ph.D. degrees
- The Bennett S. LeBow College of Business, which grants bachelor's, master's, and Ph.D. degrees
- The College of Engineering, which grants bachelor's, master's, and Ph.D. degrees
- The College of Information Science and Technology, which grants bachelor's, master's, and Ph.D. degrees
- The College of Media Arts and Design, which grants bachelor's and master's degrees
- The Goodwin College of Professional Studies, which grants interdisciplinary bachelor's degrees, provides academic and professional support for all part-time undergraduate students, and offers continuing professional education courses
- The School of Biomedical Engineering, Science, and Health Systems, which grants bachelor's, master's, and Ph.D. degrees
- The School of Education, which grants bachelor's, master's, and Ph.D. degrees, and recommends issuance of Pennsylvania instructional and teaching certificates
- The College of Nursing and Health Professions, which grants bachelor's, master's, and Ph.D. degrees
- The Drexel University College of Medicine, which grants M.D., master's and Ph.D. degrees
- The School of Public Health, which grants master's and Ph.D. degrees

One of the first schools in the nation to adopt mandatory co-operative education programs, Drexel now administers one of the largest, with more than 4,800 students taking part in co-op/internships on an annual basis. Agreements

with 1,500 business, industrial, governmental, and other institutions located in 27 states and 11 foreign countries enable Drexel students to acquire practical experience related to college studies through periods of paid internships.

Located on 49 acres in Philadelphia's University City neighborhood, just minutes from Center City, Drexel is ideally situated for its valuable co-operative relationships with business and industry. The 45-building campus, which includes seven residence halls housing more than 2,500 students, is a vibrant mix of neoclassical architecture, such as the grand Main Building at 32nd and Chestnut Streets, and innovative classrooms and laboratories, such as those found in the Leonard Pearlstein Business Learning Center, completed in 2002. The University's educational programs are enhanced by the industrial, commercial, professional, and cultural activities of the nation's fifth-largest metropolitan area.

A unique academic niche is filled by the Drexel University College of Medicine, the nation's largest private medical school, which combines more than a century of excellence in medical education with Drexel's technological focus. Drexel also includes an outstanding college for nursing and the health professions and one of only two public health schools in Pennsylvania.

Drexel University is privately controlled, nonsectarian, and coeducational.

Accreditation

Drexel's educational program is accredited by the Middle States Association of Colleges and Secondary Schools.

Accreditation was last reaffirmed in 2001.

The following programs are accredited, approved, or certified by the associations noted:

- Architecture is one of the few part-time evening programs accredited by the National Architectural Accrediting Board.
- Chemistry (College of Arts and Sciences) is certified by the American Chemical Society.
- Clinical dietetics (College of Arts and Sciences) is approved by the American Dietetics Association.
- The clinical psychology Ph.D. program (College of Arts and Sciences) is accredited by the American Psychological Association.
- The computer science B.S. degree program (College of Arts and Sciences) is accredited by the Computing Sciences Accreditation Board.

- All engineering curricula, except the program in industrial engineering, are accredited or currently under review by the Accreditation Board for Engineering and Technology, the final authority on educational standards of the engineering profession.
- Hospitality management is accredited by the Accrediting Commission for Programs in Hospitality Administration.
- The library and information science M.S. degree program (College of Information Science and Technology) is accredited by the American Library Association.
- Interior design (College of Media Arts and Design) is accredited by the Foundation for Interior Design Education Research.

Any student or prospective student may request a copy of the documents describing the institution's accreditation. This information is available in the Provost's Office and in the Financial Aid Office, both located in the Main Building.

Technology
Technology is integrated into every aspect of the Drexel educational experience, marking the university as a leader in educational innovation.

Drexel made history in 1983 when it became the first university to mandate that all students must have personal access to a microcomputer. This tradition of leadership in integrating state-of-the-art technologies into a Drexel education continued when Drexel in early 1998 inaugurated the first totally wireless library in the nation. In 2000, Drexel again made history by becoming the nation's first major university to offer completely wireless Internet access across the entire campus.

And in 2002 the University launched DrexelOne Mobile, a Web portal that allows students to retrieve personalized information via any Web-enabled handheld device.

Our students are able to access the Internet and Drexel's comprehensive system of information networks from anywhere on campus using a laptop computer in a fully wireless environment. Drexel students are the first in the U.S. to enjoy the best of both worlds—a campus network ranked by *Yahoo! Internet Life* magazine's "most wired" survey as number one in Philadelphia and number six nationwide, and an all-wireless environment where it's easy to access the network at anytime and from anyplace on campus.

Drexel Co-op
One of the nation's most established and successful experiential programs, Drexel Co-op: The Ultimate Internship® provides students with a unique combination of academic and professional problem-solving skills.

Quality Faculty
Dedicated to teaching and learning, Drexel faculty have reached the highest level of recognition for their research and scholarship.

GRADUATE PROGRAMS

The College of Arts and Sciences

The College of Arts and Sciences is young—founded in 1990—but its roots go back to Drexel's earliest days. In February 1892, when the Drexel Institute welcomed 300 students to its first class, 173 of them took courses in cooking, dressmaking, millinery, and chemistry. Business and arts courses began a few weeks later; 80 students enrolled in art. Among the institute's charter divisions were the Art Department, the Scientific Department, and the Department of Lecture and Evening Classes.

The College has grown quickly and has taken a preeminent place at Drexel. It has the largest number of faculty of any of the University's colleges, and it offers about 490 percent of the courses scheduled each quarter. With flourishing programs in many fields, the college is also a haven for scholarship and research.

The College offers the following graduate programs in Arts and Sciences:

Bioscience and Biotechnology
Chemistry
Communication
Environmental Policy
Environmental Science
Mathematics
Nutrition and Food Science
Physics
Psychology
Publication Management
Science, Technology, and Society

Biology

M.S. in Biological Sciences
Forty-five credits are required for the M.S. in Biological Sciences. Soon after matriculation the student completes a

plan of study with the advisor, outlining his or her specific program. Both thesis and non-thesis options are available, although some formal research activity is recommended for all M.S. degree candidates.

Students wishing to pursue Ph.D. candidacy are encouraged to elect the M.S. with thesis. After all other requirements are completed, the M.S. student defends the thesis at a final oral examination. The non-thesis student takes a comprehensive examination. The M.S. candidate may simultaneously obtain secondary education certification by including specified required courses. The minimum number of credits for this M.S. degree is 48.

Ph.D. in Biological Sciences

The Doctor of Philosophy in Biological Sciences is conferred in recognition of breadth of scholarship and scientific attainment plus demonstrated ability to complete original research. A minimum of 90 credits is required beyond the bachelor's degree. In addition to a qualifying examination, the Ph.D. student must pass a candidacy examination and an oral defense of his or her dissertation, which demonstrates the capacity to perform independent research. Both examinations are administered by the student's examining committee.

Chemistry

The Chemistry Department offers graduate programs in analytical chemistry, inorganic chemistry, organic chemistry, physical chemistry, and polymer chemistry. The department also encourages interdisciplinary activities. Faculty members are active participants in the environmental engineering and science and biomedical science and engineering programs; others work with physicists and biologists in areas such as atmospheric science, biochemistry, and biophysical chemistry.

The chemistry faculty wants graduate students to understand the purpose of, and need for, fundamental research while working on problems of practical interest and application to the challenges facing mankind in the modern world. Areas of research include the use of digital electronic methods to analyze trace constituents of air and water, a study of the molecules of living systems, the effects of toxic chemicals and carcinogens, synthesis and characterization of compounds of medicinal and industrial interest, methods for studying macromolecules, and characterization of transient species using lasers.

The Chemistry Department strives to maintain a community of research scholars (faculty, postdoctoral fellows, and graduate and undergraduate students) that is large enough to provide a variety of experiences within chemistry, yet small enough to give each student individual attention. Both full- and part-time study are available.

M.S. in Chemistry

The M.S. degree is awarded after satisfactory completion of a minimum of 45 credit hours in chemistry and related fields, at least 30 credits of which must be taken at Drexel. Both thesis and nonthesis options are available.

Course Requirements

The course requirements for both thesis and nonthesis options are one complete sequence in the major area of interest; one of the sequence courses from each of analytical, organic, polymer, and inorganic chemistry; and two courses in physical chemistry. The remaining credits may be chosen from graduate courses within the department or from other departments offering courses related to the student's major areas.

Major sequence (choose one of the following): 9.0 Credits

CHEM 521 Inorganic Chemistry I 3.0
CHEM 522 Inorganic Chemistry II 3.0
CHEM 523 Inorganic Chemistry III 3.0
or
CHEM 530 Analytical Chemistry I 3.0
CHEM 531 Analytical Chemistry II 3.0
CHEM 532 Analytical Chemistry III 3.0
or
CHEM 541 Organic Chemistry I 3.0
CHEM 542 Organic Chemistry II 3.0
CHEM 543 Organic Chemistry III 3.0
or
CHEM 557 Physical Chemistry I 3.0
CHEM 558 Physical Chemistry II 3.0
CHEM 659 Physical Chemistry III 3.0
or
CHEM 561 Polymer Chemistry I 3.0
CHEM 562 Polymer Chemistry II 3.0
CHEM 563 Polymer Chemistry III 3.0

Additional sequence courses* 15.0
Electives 21.0

***One of which must be chosen from the following: CHEM 555 (Quantum Chemistry of Molecules I), CHEM 557 (Physical Chemistry I), CHEM 561 (Polymer Chemistry I), CHEM 562 (Polymer Chemistry II), or CHEM 563 (Polymer Chemistry III).**

Thesis Option

Up to 9 credits of coursework may be replaced by either CHEM 997 or by sections of CHEM 680 involving laboratory research. No later than the spring term of the first year of coursework, a student should choose a research advisor with whom to work in carrying out an original investigation in chemistry. The results will be written up in thesis form and submitted to an M.S. thesis

committee consisting of the research advisor and two other departmental faculty appointed by the advisor. The acceptance by this committee of the M.S. thesis completes the thesis option requirements for the M.S. degree. Students in the M.S. program receiving financial aid from the department must elect the thesis option if they do not pursue the Ph.D. program at Drexel.

Ph.D. in Chemistry

The Ph.D. degree is awarded in any of five main areas of chemistry: analytical, inorganic, organic, physical, or polymer chemistry. The degree recipient must demonstrate scholastic breadth in chemistry and contribute significantly to scientific advancement in a chosen major area. Requirements of the program include coursework, candidacy examinations, a chemical information retrieval or technical writing course, and successful completion of a publishable Ph.D. thesis.

Course Requirements
Ninety credits of graduate-level work must be completed for the Ph.D. degree. The Chemistry Department requires 30 credits of coursework in chemistry (outlined above in the Course Requirements section of the M.S. program). The balance can be made up of more advanced special topics courses and research credits.

Candidacy Requirements
To become a candidate for the Ph.D. in chemistry at Drexel, a student must pass a prescribed set of cumulative examinations and present and successfully defend a research proposal in an area not directly related to his or her Ph.D. thesis research.

Cumulative Examinations
Written examinations designed to test a student's background in his or her major area are given monthly during the academic year and occasionally during the summer at the discretion of the faculty. Students should begin taking these examinations after having completed three courses in the major area (usually the main sequence courses). Full-time students normally begin taking these examinations in the fall term of their second year.

Research Proposal
The research proposal is an attempt to confront the student early on with the problem of defining and evaluating a worthwhile research program. The examination at which the research proposal is defended is held no later than 90 days after the notification of a student's completion of the cumulative examination requirement. A written proposal is submitted to the committee no later than two weeks before the examination. A passing grade on this examination admits the student to Ph.D. candidacy.

Thesis
A Ph.D. thesis — the heart of the Ph.D. degree — must be written, accepted by the research supervisor, presented to a Ph.D. Thesis Examining Committee, and defended orally. It is the responsibility of the student, not the research supervisor, to submit an acceptable thesis.

Communication

Master of Science in Communication

Drexel's Master of Science in communication prepares students for careers in a wide range of professional activities. The program specializes in three areas: technical communication, science communication, and public communication. Technical communication is for those seeking employment as technical writers, computer documentation specialists, and training specialists. Science communication has much to offer those who aspire to medical, science, and pharmaceutical writing. A concentration in public communication leads to careers in journalism and public relations. In addition, the program provides a strong foundation in theoretical approaches to communication. This theoretical basis is designed to ensure that, as the field changes, students will continue to have an intellectual framework for evaluating and implementing new technology and changing media.

Students can attend full time or part time, they can begin the program in any academic quarter, and they can complete all coursework in the evening. The program emphasizes flexibility, encouraging each student, in consultation with a faculty advisor, to fashion a particular course of study.

The program accommodates students from widely varying educational backgrounds: Many have backgrounds in science and mathematics; an equal number come from humanities-related areas. Some students pursue their degrees while already at work at demanding jobs in technical or scientific fields; others are new to the field. For students without previous work experience, the program requires a paid internship).

M.S. in Communication

The M.S. degree requires 45 credits of coursework, a professional portfolio of three to five items developed by the student, and six months of paid internship for those who lack significant experience in technical or science communication.

As a final graduation requirement, each student must submit a professional exit portfolio. Based on coursework and professional assignments, the portfolio undergoes a rigorous process of review by faculty members and by a professional outside the university.

Curriculum
Students may use electives to increase communication skills, to broaden theoretical backgrounds, or to develop areas of specialization. Any appropriate graduate course offered in the University can serve as an elective if the student has sufficient background to take the course. In addition, the program offers its own elective courses as special topics (COM 690). Qualified students may also pursue independent study for elective credit in special cases.

Core Courses
COM 500 Persuasive Writing and Reading in Communication 3.0
COM 610 Theories of Communication and Persuasion 3.0

Concentrations
Technical Communication
COM 510 Technical Writing 3.0
COM 570 Technical and Science Editing 3.0
COM 620 Message Design and Evaluation 3.0
COM 630 Developing Software Documentation 3.0
COM 875 Ethics in Technical and Science Communication 3.0
Electives 24.0

Science Communication
COM 520 Science Writing 3.0
COM 570 Technical and Science Editing 3.0
COM 620 Message Design and Evaluation 3.0
COM 660 Investigative Journalism 3.0
COM 875 Ethics in Technical and Science Communication 3.0
Electives 24.0

Public Communication
COM 635 Writing for the World Wide Web 3.0
COM 650 Telecommunications Policy 3.0
COM 660 Investigative Journalism 3.0
COM 680 Public Relations Strategies 3.0
COM 880 Seminar: Ethics for Public Communication 3.0
Electives 24.0

Psychology

Graduate degrees in clinical psychology train clinical psychologists in the scientist-practitioner model. This model places equal emphasis on clinical research and the application of scientific principles. This education includes training in intervention and assessment, as well as an introduction to the science and practice of clinical psychology. The program is accredited by the American Psychological Association.

M.S. Degree in Clinical Psychology

The master's degree program in the Department of Clinical and Health Psychology is a full-time program encompassing two years of study. It provides graduate students with a strong foundation in cognitive-behavioral psychological theory, experience in the practice of psychological assessment and intervention, and experience in the conduct of basic and applied research relevant to clinical psychology.

General Requirements
The general requirements for earning the master's degree in clinical psychology are as follows:

- Completion of all required coursework with a minimum grade point average of 3.0, with no grade lower than a B in any required (non-elective) course and no more than two course grades of C or lower.
- Successful completion of a minimum of 49 credits.
- Successful completion of practicum.
- Completion of a thesis in clinical psychology

Required courses
PSY 610 Data Analysis 3.0
PSY 721 Principles of Psychotherapy 3.0
PSY 722 Psychotherapy Techniques 3.0
PSY 514 Learning Foundations of Behavioral Assessment 3.0
PSY 515 Behavioral Assessment II 3.0
PSY 630 Psychopathology of Adults 3.0
PSY 522 Intellectual Assessment 3.0
PSY 516 Developmental Psychology 3.0
or
PSY 512 Cognitive Psychology 3.0
PSY 524 Ethics & Professional Issues 3.0
Research Design 3.0
Advanced Statistics 3.0
Clinical Practicum Seminar 1.0
Thesis 6.0
Electives 9.0

Ph.D. in Clinical Psychology

Drexel University offers the Ph.D. degree in clinical psychology with the primary goal of training clinical psychologists in the scientist-practitioner model. This model places equal emphasis on clinical research and the application of scientific principles. Students receive an appropriate, broad education in preparation for entry-level practice in professional psychology. This education includes training in intervention and assessment, as well as an introduction to the science and practice of clinical psychology. The program is accredited by the American Psychological Association.

Curriculum
The Drexel Ph.D. in Psychology curriculum follows the scientist-practitioner model and APA guidelines on

accreditation of doctoral clinical psychology programs. It also considers state licensing guidelines and various publications that have been written on the topic of doctoral education, training, and credentialing in clinical psychology, as well as the specialty areas of forensic psychology, health psychology, and neuropsychology.

The following section outlines the courses required for graduation for entering Bachelor's-level students. The Ph.D. program curriculum requires the student to earn a minimum of 90 credits. Typically, students enroll in 27 credits during the first year, 22 credits during the second and third years, 12 credits in the fourth year, and 8 credits during the fifth/final internship year. Drexel University operates on a calendar of four eleven-week terms. Students in the program do not take courses during Summer Term in order to complete research projects and continue clinical practicum training.

All coursework can be divided into two major components: (1) Foundations of Psychology, which is the evolving body of knowledge in the discipline of psychology, and (2) Clinical and Professional Training, which focuses on the application of theory and empirical research to the practice of psychology. Listed below are all required and elective courses offered within the Drexel psychology curriculum followed by specific requirements for each concentration. Credit levels listed are set at the minimum required.

Foundations of Psychology
History and Systems
PSY 712 History and Systems of Psychology 3.0

Statistics/Research Methods
PSY 510 Research Methods in Psychology 3.0
PSY 610 Data Analysis in Psychology 3.0
PSY 710 Multivariate Methods in Psychology 3.0
PSY 711 Data Analysis III: Advanced Topics 3.0
PSY 898 Thesis in Psychology 3.0
PSY 998 Dissertation in Psychology 4.0
Electives
PSY 511 Research Methods in Psychology I 3.0

Biological Bases of Behavior
PSY 530 Principles of Neuroscience 3.0
PSY 630 Psychopharmacology 3.0
Electives
PSY 812 Cognitive Neuroscience 3.0

Cognitive/Affective Bases of Behavior
PSY 512 Cognitive Psychology 3.0
PSY 514 Learning Foundations of Behavioral Assessment 3.0

At least one of the following:
PSY 516 Developmental Psychology 3.0
PSY 612 Psychology of Human-Computer Interaction 3.0
PSY 614 Problem-Solving and Creativity 3.0
PSY 616 Empirical Foundations of Unconscious Processes 3.0
PSY 840 Models of Memory 3.0

Social Bases of Behavior
PSY 550 Multicultural Perspectives on Client Populations 3.0
At least one of the following:
PSY 517 Social Cognition in Clinical Psychology 3.0
PSY 518 Social Psychology 3.0
PSY 618 Psychology of Loss and Bereavement 3.0

Clinical and Professional Training
General Foundations of Practice
PSY 520 Psychopathology 3.0
PSY 524 Professional Issues and Ethics 3.0

Foundations of Psychological Evaluation/Measurement
PSY 522 Psychological and Intellectual Assessment 3.0
PSY 542 Neuropsychological Assessment 3.0
PSY 620 Personality Assessment 3.0
PSY 514 Learning Foundations of Behavioral Assessment 3.0
PSY 515 Behavioral Assessment II 3.0
Electives 3.0

PSY 543 Neuropsychological Assessment 3.0
PSY 642 Neuropsychological Case Analysis/Integration 3.0
PSY 648 Forensic Psychology/Forensic Assessment I 3.0
PSY 649 Forensic Assessment II 3.0

Foundations of Intervention
PSY 721 Principles of Psychotherapy 3.0
PSY 722 Psychotherapeutic Techniques 3.0
PSY 899 Practicum 2.0
PSY 999 Internship 4.0
At least one of the following :
PSY 540 Principles of Neuropsychology 3.0
PSY 648 Forensic Psychology/Forensic Assessment I 3.0
PSY 819 Health Psychology 3.0
PSY 820 Cognitive-Behavior Therapy 3.0

Advanced Professional Training
Elective Courses 12.0 Credits
PSY 730 Criminal Law and Psychology (Villanova) 4.5
PSY 732 Law and Mental Health (Villanova) 4.5
PSY 734 Social Science Applications to the Law (Villanova) 4.5
PSY 746 Neuropsych. Evaluation: Children and Adolescents 3.0
PSY 821 Family and Group Therapy 3.0
PSY 822 Pediatric Psychology 3.0
PSY 823 Substance Abuse 3.0
PSY 824 Psychotherapy with Children and Adolescents 3.0
PSY 825 Seminar in Mind/Body Studies 3.0
PSY 826 Behavioral Stress Management 3.0
PSY 840 Models of Memory 3.0
PSY 845 Neuropsych. Evaluation/Intervention: The Elderly 3.0
PSY 854 Psychology of Rehabilitation 3.0

Specific Concentration Requirements

General Clinical Concentration

The general clinical concentration is designed to provide an overview of clinical psychology while permitting the student to tailor an individualized area of specialized study through elective courses, research experiences including thesis and dissertation topics, and clinical practica. The

empirical foundations of psychology are emphasized, and clinical training is based on the scientist-practitioner model.

In addition to the core curriculum:

- Required class: Cognitive-Behavior Therapy
- Elective courses, specific practica, research experience, and thesis and dissertation topics should be selected in close consultation with the student's mentor

Clinical Neuropsychology Concentration
The clinical neuropsychology concentration includes courses, research, and clinical experiences designed to train the students for professional practice in neuropsychology. Clinical neuropsychology involves the application of psychological assessment and intervention to the problems encountered by people with brain injury or illness. The knowledge of brain-behavior functioning and the incorporation of neuropsychological conceptualizations with traditional clinical conceptualizations of functioning are aimed at providing the student with a wider perspective regarding the range of human functioning and disability. The student is able to pursue specific interests in geriatrics, pediatrics, traumatic brain injury, and rehabilitation.

In addition to the core curriculum:

- One neuropsychology practicum (800 hours)
- A neuropsychology-focused thesis and dissertation
- Required classes: Principles of Neuropsychology, Principles of Neuroscience, Neuropsychological Assessment I and II, Case Analysis and Integration
- At least two neuropsychology electives: Models of Memory, Rehabilitation
- Psychology, Advanced Neuropsychology Assessment and Intervention:
- Children and Adolescents, Advanced Neuropsychology Assessment and Intervention: The Elderly.

Forensic Psychology Concentration
Forensic psychology involves the application of assessment and intervention techniques to informing legal decision-makers and attorneys on questions in criminal, civil, and family law. Those who concentrate in forensic psychology will be trained in relevant law, behavioral science research, and assessment and intervention approaches with a particular focus on juvenile and criminal issues.

In addition to the core curriculum:

- One forensic psychology practicum (800 hours)
- A forensic psychology-focused thesis and dissertation
- At least two years of research in an area related to forensic psychology
- Required classes: Forensic Assessment I and II, Law and Mental Health (at Villanova), and Principles of Neuropsychology
- At least two forensic psychology electives: Criminal Law and Psychology
- (Villanova), Children and the Law (Villanova), Substance Abuse

Health Psychology Concentration
Health psychology adopts a broad-based, biopsychosocial perspective in order to: (1) better understand the interplay among behavioral, emotional, cognitive, social, and biological factors regarding health, wellness, and physical disease; (2) promote and maintain wellness and positive physical health; (3) prevent, treat, and rehabilitate illness and disability, and (4) improve the health care delivery system. The health psychology concentration aims to provide specialty training in order to prepare graduate students for academic and/or clinical positions where the primary focus is on physical health problems.

In addition to the core curriculum:

- One health psychology practicum (800 hours)
- A health psychology-focused thesis and dissertation
- Required classes: Medical Psychology, Behavioral Stress Management (taken in second year with Personality assessment taken in third year)
- At least two Health Psychology electives: Seminar in Mind/Body Studies, Pediatric Psychology, Eating and Its Disorders, Substance Abuse

For more information on the Ph.D. program requirements, consult the Ph.D. Program Handbook available from the Department of Psychology's web site.

Joint J.D./Ph.D. Law-Psychology Program

Drexel University and Villanova University Law School offer a joint and integrated program in law and psychology leading to the Juris Doctor (J.D.) in law from Villanova and the Doctor of Philosophy (Ph.D.) in clinical psychology from Drexel. The psychology component is housed in Drexel's Department of Psychology and is fully accredited by the American Psychological Association.

Visit the Department of Psychology web site to access a copy of the Joint J.D./Ph.D. Law-Psychology Program brochure.

Curriculum
Law and psychology are related in many significant ways, yet few people are trained and skilled to strengthen this relationship. Many institutions permit students to pursue both degrees in an informal, uncoordinated manner. By contrast, Drexel University and Villanova train students in a carefully developed, integrated, conceptually unified program so that they acquire a mature understanding of the interaction between the two disciplines.

Over the seven-year course of study, students maintain continuous contact with the faculties of both schools and the developments in both disciplines. As the following sample curriculum reveals, students are enrolled concurrently in both universities and are required to fulfill the requirements of the J.D. and Ph.D. degrees. Students take courses in both institutions for the first six years; the emphasis in the first year is in law and the emphasis in the second year is in psychology. Time is about evenly divided between the institutions in the third through the sixth years.

A t the end of the sixth year, students are awarded the J.D. degree from Villanova. During the seventh year, students undertake a full-time supervised psychology internship in an approved setting and complete their dissertation. Students then receive the Ph.D. degree from Drexel.

At the conclusion of the program, students are eligible for admission to the bar and, after completing the postdoctoral requirement for supervised experience in a given state, licensure as a psychologist.

The curriculum consists of five elements:

- The required core program in law and psychology at both institutions
- Interdisciplinary courses such as Introduction to Law and Psychology, Social Science Applications to Law, Law and Mental Health, Research in aw and Psychology, and Forensic Assessment
- Legal clinics and psychology practica and internships that combine knowledge from both fields in a practical setting
- Electives in both fields, such as Health Law, Medical Malpractice, Privacy, Behavior Therapy, and Clinical Decision Making
- Employment for at least one summer in a legal setting, such as a public-interest law firm, governmental agency, or private law firm.

First Year
LAW 0110 Civil Procedure 3
LAW 0120 Contracts 3
LAW 0150 Criminal Law and Procedure 2
LAW 0151 Introduction to Legal Research 1
LAW 0152 Introduction to Legal Writing 1
LAW 0154 Torts 3
PSYC 511 Psychopathology of Adults 3
PSYC 601 Theories of Learning 3
PSYC 730 Introduction to Law and Psychology 2

Second Year
LAW 0153 Property 2
LAW 1000 Constitutional Law I 3
PSYC 506 Introduction to Psychotherapy Skills 1
PSYC 525 Intellectual Assessment 3
PSYC 604 Behavioral Assessment 3
PSYC 625 Advanced Statistics 3
PSYC 710 Doctoral Research 6

Third Year
Required Category Case 3
PSYC 501 Social Cognition in Clinical Psychology 3
PSYC 502 Developmental Psychology 3
PSYC 605 Health Psychology 3
PSYC 622 Research Methods in Clinical Psychology 3
PSYC 631 Behavioral Therapy I 3
PSYC 640 Personality Assessment 3
PSYC 700 Clinical Practicum Seminar 2
PSYC 715 Law and Mental Health 3
PSYC 720 Forensic Assessment 3
PSYC 725 Seminar in Advanced Problems in Mental Health Law 3

Fourth Year
LAW 7024 Evidence 3
LAW 7025 Family Law* 3
LAW 7028 Health Law* 2
PSYC 650 Psychopharmacology 3
PSYC 655 Ethics and Professional Issues 3
PSYC 700 Clinical Practicum Seminar (Two-Day) 2
PSYC 705 Social Science Applications to the Law 3
PSYC 710 Doctoral Research 12

Fifth Year
LAW 6028 Legal Profession 2
LAW 7002 Administrative Law* 3
LAW 7004 Advanced Criminal Procedure* 3
LAW 7008 Children and the Law* 2
PSYC 611 Intro to Clinical Neuropsychology 3
PSYC 710 Doctoral Research in Law and Psychology 12

Sixth Year
LAW 7005 Advanced Legal Writing 3
LAW 7015 Dispute Resolution* 2
LAW 7026 Federal Courts/Federal Systems* 3
LAW 7050 Trial Practice or Legal Clinic 1
LAW 7057 Negotiation and Advanced Mediation* 3
PSYC 710 Doctoral Research in Law and Psychology 8
Electives to complete J.D. requirements 0**
Electives to complete coursework for Ph.D. 0**
Completion of dissertation proposal 0**

***These courses are recommended, not required.**
****Contact the department for specific information.**

Environmental Policy

M.S. in Environmental Policy

The graduate program in Environmental Policy prepares students for careers as policy analysts who have a strong commitment to environmental values, are scientifically and methodologically competent, and can work effectively in the democracy policy process with the various groups and institutions engaged in environmental issues.

To meet these requirements, students must complete a range of coursework designed to teach:

- knowledge of how policies are developed and implemented
- scientific and engineering basis of effective environmental policies
- an understanding of who the key players are in environmental politics, and how to work with them to accomplish environmental improvement.

Core Courses
ENVR 501 Chemistry of the Environment 3.0
ENVR 506 Biostatistics 3.0
ENVR 511 Evolutionary Ecology 3.0
or
ENVR 521 Environmental Health 3.0

Required Specialization Courses in Environmental Policy ENVR 522 Environmental Law 3.0
ENVR 523 Environmental Regulations 3.0
ENVR 760 Social Change & Environmental Movements 3.0
ENVR 771 Theory/Practice of Environmental Policy Analysis 3.0
ENVR 772 Methods of Environmental Policy Analysis 3.0
ENVR 773 Practicum in Environmental Policy Analysis 3.0
ENVR 865 Resource and Environmental Economics 3.0
ENVR 710 Environmental Cost Benefit Analysis Valuation 3.0
ENVR 774 Economic Analysis of Environmental Policy 3.0

Recommended Electives
ENVR 880 Environment and Society 3.0
ENVR 885 International Environmental Politics 3.0
ENVR 886 Methods of Resource & Environmental Econ Anal. 3.0
ENVR 727 Risk Assessment 3.0

Plan of Study
Within the first quarter of study, a student must meet with an assigned advisor and work out a plan of study. An example plan of study form can be viewed on the Master of Science in Environmental Policy web page.

Environmental Science

Environmental science is a multidisciplinary field in which we try to understand environmental problems and find solutions to them. This field requires understanding of a number of disciplines, including biology, chemistry, hydrology and climatology.

The environmental science program was created to focus on the need for scientists and engineers to aid in the development of local, national, and international environmental policy.

M.S. areas of concentration include: air pollution, water resources, and water and wastewater treatment, environmental assessment, environmental biotechnology, environmental chemistry, environmental health, ecology, and environmental policy. A student may alternatively craft a specialized plan of study outside of these strength areas under the guidance of an academic advisor.

The master's degree may be completed with either a thesis or non-thesis option. Those choosing to prepare a thesis must complete 45 credits (including 6 - 9 credits awarded for the thesis). Students choosing the non-thesis option must complete coursework totaling 48 credits. Students who receive an assistantship or other form of assistance for the University must complete a thesis. Most courses carry three credits.

Dr. Susan Kilham is the Graduate Advisor for Environmental Science. Dr. Kilham can be reached by telephone at 215-895-2628 or e-mail at kilhams@drexel.edu. Her office is located in Room 312 of Stratton Hall.

M.S. in Environmental Science

The requirements for the M.S.E.S. degree include two sets of courses. The first set includes three required core courses that form the basis for further specialization. The second set of seven to nine courses comprise the area(s) of specialization. The remainder of required credits (a total of 48 credits for nonthesis; 45 credits for thesis) are elective courses.

Within the first quarter of study, a student must meet with an assigned advisor and work out a plan of study. Plan of study forms can be downloaded by visiting the M.S. in Environmental Science web page. A student may, under the advise of a faculty member, develop a unique plan of study combining one or more areas of interest.

Core Courses
ENVR 501 Chemistry of the Environment 3.0
ENVR 506 Biostatistics 3.0
ENVR 511 Evolutionary Ecology 3.0
or
ENVR 521 Environmental Health* 3.0

Core requirements in area of specialization
21.0-27.0 Credits (depending on area)

Electives
48.0 Credits for nonthesis; 45.0 Credits for thesis.

Ph.D. in Environmental Science

A Ph.D. can be pursued in the fields of Environmental Science (including Environmental Policy) and Environmental Engineering in specialties consistent with interests of the Environmental Science-affiliated faculty.

To be awarded the Ph.D., students must complete a major research project publishable in a peer-reviewed journal. The degree requires a total of 90 credits; credits earned toward a master's degree may apply toward the 90. There is no prescribed coursework -- students must take courses needed to complete their research under guidance of an academic advisor. There is a one-year residency requirement. Students must successfully pass the qualifying examination, the candidacy examination, and a Ph.D. dissertation and oral defense.

Mathematics

M.S. in Mathematics

Students must complete a minimum of 45 graduate credits for the M.S. degree. Of these, at least 36 credits must be from 500-, 600-, and 700-level courses, including a core of 27 credits. Core requirements are specified below. Elective courses taken outside the department must receive prior departmental approval in order to be counted toward the degree. Students seeking a dual M.S. must satisfy core requirements for both degree programs.

During the first term of study, matriculated students are assigned an advisor to assist them in preparing a complete plan of study. The plan of study serves as the sole document for determining graduation requirements.

Students should note that some departmental courses, such as Advanced Engineering Mathematics, are foundation courses and do not contribute to the departmental requirements for the degree. They do count toward the University requirements for a degree.

Mathematics Core Requirements
In addition to the general requirements, a basic requirement for the M.S. in mathematics is the completion of a three-term sequence that involves linear algebra and/or analysis. Placement in these courses is determined before the beginning of the fall term, when a faculty advisor will help the student develop a complete plan of study. Specific requirements for areas of emphasis in mathematics are provided below.

Applied Mathematics
Core Requirements
MATH 507 Applied Mathematics I 3.0

Two terms of Analysis from the following:
MATH 680 Special Topics: Intermediate Analysis I 3.0
MATH 680 Special Topics Intermediate Analysis II 3.0
MATH 630 Complex Variables I 3.0
MATH 631 Complex Variables II 3.0
MATH 633 Real Variables I 3.0
MATH 634 Real Variables II 3.0

Series electives from the following: 18.0 Credits
MATH 623 Ordinary Differential Equations I 3.0
MATH 624 Ordinary Differential Equations II 3.0
MATH 625 Ordinary Differential Equations III 3.0
MATH 640 Functional Analysis I 3.0
MATH 641 Functional Analysis II 3.0
MATH 645 Transform Theory I 3.0
MATH 646 Transform Theory II 3.0
MATH 533 Abstract Algebra I 3.0
MATH 534 Abstract Algebra II 3.0
MATH 510 Applied Probability and Statistics I 3.0
MATH 511 Applied Probability and Statistics II 3.0
MATH 512 Applied Probability and Statistics III 3.0
MATH 520 Numerical Analysis I 3.0
MATH 521 Numerical Analysis II 3.0
MATH 670 Methods of Optimization I 3.0
MATH 671 Methods of Optimization II 3.0

Statistics and Operations Research
Core Requirements
MATH 510 Applied Probability and Statistics I 3.0
MATH 511 Applied Probability and Statistics II 3.0
MATH 512 Applied Probability and Statistics III 3.0

Two courses each from two of the following groups
MATH 523 Computer Simulation I 3.0
MATH 524 Computer Simulation II 3.0

MATH 610 Advanced Probability and Statistics I 3.0
MATH 611 Advanced Probability and Statistics II 3.0

MATH 613 Stochastic Processes I 3.0
MATH 614 Stochastic Processes II 3.0

MATH 670 Methods of Optimization I 3.0
MATH 671 Methods of Optimization II 3.0

Series electives from the following: 6.0 Credits

MATH 623 Ordinary Differential Equations I 3.0
MATH 624 Ordinary Differential Equations II 3.0
MATH 625 Ordinary Differential Equations III 3.0
MATH 640 Functional Analysis I 3.0
MATH 641 Functional Analysis II 3.0
MATH 645 Transform Theory I 3.0
MATH 646 Transform Theory II 3.0
MATH 533 Abstract Algebra I 3.0
MATH 534 Abstract Algebra II 3.0
MATH 510 Applied Probability and Statistics I 3.0
MATH 511 Applied Probability and Statistics II 3.0
MATH 512 Applied Probability and Statistics III 3.0

MATH 520 Numerical Analysis I 3.0
MATH 521 Numerical Analysis II 3.0

Scientific Computation

Courses Credits

CS 557 Data Structures and Algorithms I 3.0
CS 680 Special Topics: Applied Computer Algebra 3.0
CS 680 Special Topics: Computer Algebra I 3.0
CS 680 Special Topics: Computer Algebra II 3.0
MATH 520 Numerical Analysis I 3.0
MATH 521 Numerical Analysis II 3.0
MATH 523 Numerical Analysis III 3.0
Series electives from the following: 6.0 Credits

MATH 623 Ordinary Differential Equations I 3.0
MATH 624 Ordinary Differential Equations II 3.0
MATH 625 Ordinary Differential Equations III 3.0
MATH 640 Functional Analysis I 3.0
MATH 641 Functional Analysis II 3.0
MATH 645 Transform Theory I 3.0
MATH 646 Transform Theory II 3.0
MATH 533 Abstract Algebra I 3.0
MATH 534 Abstract Algebra II 3.0
MATH 510 Applied Probability and Statistics I 3.0
MATH 511 Applied Probability and Statistics II 3.0
MATH 512 Applied Probability and Statistics III 3.0
MATH 670 Methods of Optimization I 3.0
MATH 671 Methods of Optimization II 3.0

Ph.D. in Mathematics

The Doctor of Philosophy degree is conferred in recognition of breadth of scientific attainment, plus demonstrated ability to investigate scientific problems independently and efficiently. At least three years of full-time study beyond the bachelor's degree are normally required (the master's degree is not a prerequisite).

The minimum requirements for a Ph.D. degree are successful completion of candidacy examinations, a dissertation showing original research of sufficient quality to be published in refereed journals appropriate for the degree emphasis, and an oral dissertation defense. Further details about the doctoral program may be obtained by contacting the Department of Mathematics.

Nutrition and Food Science

The human nutrition major is concerned with normal and therapeutic nutrition for individuals and groups. This major also encompasses nutrition science, the application of the principles of biochemistry, physiology, and biology to human nutritional needs. Students who wish to pursue a clinical nutrition emphasis follow a modified version of the basic human nutrition curriculum. Current research in human nutrition includes food preference and nutrition, nutrition assessment, effectiveness of nutrition education (particularly by the use of multimedia) on health and eating habits, and dietetic professional development. Current research in nutrition science includes physiological and genetic determinants of obesity, lipid metabolism, neutraceuticals, and diet-endocrine interrelationships.

Food science is concerned with foods and food ingredients, and their physicochemical and biochemical interactions at the molecular, functional, and cellular levels. The food science major applies the principles of chemistry, biochemistry, microbiology, physics, and engineering to the production, safety, and quality of the food supply. Current research in food science includes physicochemical changes during deep-fat frying, lipid oxidation in foods, organoleptic evaluation of foods, food safety, and the effect of food processing on nutrients.

All specializations stress the interdisciplinary and scientific nature of nutrition and food and provide students with a base of theoretical knowledge and methodology enabling them to continue professional growth after graduation. Students strengthen professional status through in-depth study of current scientific concepts, engage in evaluation of new information, and develop and demonstrate a spirit of intellectual inquiry and constructive criticism. Students participate in the research enterprise by completing a research project or by designing and executing a thesis under faculty direction.

The program cooperates with nearby universities and research and medical institutions, enabling students to take courses at other institutions and to be involved in joint research projects. Information on these opportunities is available from faculty in the department.

M.S. in Nutrition and Food Science

All graduate students are expected to attend BIO 865 seminar presentations even if not registered for the course, unless specifically excused by the department head or graduate advisor. All thesis students should attend BIO 870 seminars.

Research
Students are invited to participate in research by systematically designing and completing a research project or thesis. All thesis students consult with a faculty advisor and prepare a research proposal. Students present their proposals to their thesis committee for approval and, at the prerogative of the faculty, complete the research and report on it in seminar presentations. Students may elect to work in ongoing research or in some cases may suggest a new research area of specific interest to them. Individual

guidance is necessary before research can commence, and there is periodic review during the course of the work. Students must submit a final written thesis to their thesis committee and defend the thesis at a final oral examination. Students in the thesis option may include up to six credits of NFS 997, Research in Nutrition and Food Sciences, among their electives.

Students selecting the nonthesis option are required to pass a written comprehensive examination. Students in the nonthesis option may include up to three credits of NFS 997, Research in Nutrition and Food Sciences, among their electives.

Core Curriculum
All graduate students must satisfy the following core course requirements:
BIO 680 Special Topics: Data Analysis in the Biosciences 3.0
NFS 501 Nutritional Biochemistry I 3.0
NFS 531 Micronutrient Metabolism 3.0
NFS 601 Research Methods in Applied Nutrition 3.0
NFS 865 Seminar in Nutrition and Food Sciences 2.0

Students select a major in human nutrition or food science.

Major in Human Nutrition
The human nutrition major applies the principles of normal, preventive, and therapeutic nutrition to nutrition education and clinical practice. Students may select courses to focus on preventive community nutrition, therapeutic clinical nutrition, or human nutrition science. Several courses are designed to provide specialized training for advanced practice in dietetics.

Required courses
NFS 554 Microbiology and Chemistry of Food Safety 3.0
or
NFS 558 Nutritional Impact of Food-Processing Methods 3.0

NFS 629 Readings in Nutrition Science* 3.0
or
NFS 649 Readings in Nutrition* 3.0

Five of the following human nutrition electives:
NFS 530 Macronutrient Metabolism 3.0
NFS 546 World Nutrition 3.0
NFS 634 Women's Issues in Nutrition 3.0
NFS 640 Nutrition of the Schoolchild 3.0
NFS 641 Nutrition in Later Maturity 3.0
NFS 690 Community Nutrition 3.0
NFS 696 Methods of Teaching Dietetics 3.0
NFS 750 Special topics: Drug-Nutrient Interactions 3.0

Two of the following professional electives:
BIO 670 Medical Microbiology 3.0
ENVR 621 Epidemiology 3.0
ENVR 636 Toxicology and Human Physiology 3.0
NFS 560 Advanced Food Chemistry 3.0
NFS 750 Special Topics: Food Analysis 3.0
NFS 997 Research in Nutrition and Food Sciences 3.0
Free electives can include any graduate course in the department or university for which the student has the prerequisites (excluding NFSCI 500,NFSCI 506,and NFSCI 508) 4.0

*** Prerequisite: At least 30 graduate credits, including 6 credits of human nutrition electives.**

Major in Human Nutrition (Clinical Emphasis)
The human nutrition major applies the principles of normal, preventive, and therapeutic nutrition to nutrition education and clinical practice. Students may select courses to focus on preventive community nutrition, therapeutic clinical nutrition, or human nutrition science. Several courses are designed to provide specialized training for advanced practice in dietetics.

Required courses
NFS 554 Microbiology and Chemistry of Food Safety 3.0
or
NFS 558 Nutritional Impact of Food-Processing Methods 3.0

NFS 735 Case Studies in Clinical Nutrition* 3.0
or
NFS 849 Readings in Therapeutic Nutrition* 3.0

Five of the following human nutrition electives:
NFS 634 Women's Issues in Nutrition 3.0
NFS 640 Nutrition of the Schoolchild 3.0
NFS 641 Nutrition in Later Maturity 3.0
NFS 690 Community Nutrition 3.0
NFS 730 Nutritional Assessment 3.0
NFS 732 Weight Management and Eating Disorders 3.0
NFS 750 Special Topics: Nutrition and Endocrinology 3.0
NFS 750 Special Topics: Metabolic Nutrition Support 3.0
NFS 750 Special Topics: Sports Nutrition 3.0

Two of the following professional electives:
BIO 670 Medical Microbiology 3.0
ENVR 621 Epidemiology 3.0
NFS 546 World Nutrition 3.0
NFS 630 Nutrition Counseling 3.0
NFS 696 Methods of Teaching Dietetics 3.0
NFS 750 Special Topics: Drug-Nutrient Interactions 3.0
NFS 750 Special Topics: Entrepreneurial Nutrition 3.0
NFS 997 Research in Nutrition and Food Sciences 3.0
Free electives can include any graduate course in the department or university for which the student has the prerequisites (excluding NFSCI 500,NFSCI 506,and NFSCI 508) 4.0

*** Prerequisite: At least 30 graduate credits, including 6 credits of human nutrition electives.**

Major in Food Science
The food science major is concerned with foods and food ingredients, and their physicochemical and biochemical interactions at the molecular and cellular levels. The food science major applies the principles of chemistry,

microbiology, physics, and engineering to the production, safety, and quality of the food supply.

Required courses
NFS 554 Microbiology and Chemistry of Food Safety 3.0
NFS 558 Nutritional Impact of Food-Processing Methods 3.0
NFS 560 Advanced Food Chemistry 3.0
NFS 669 Readings in Food Science 3.0
NFS 750 Special Topics: Advanced Food and Nutrient Analysis 3.0
NFS 750 Special Topics: Organoleptic Testing Methodology 3.0
NFS 750 Special Topics: Food Microbiology 3.0
Core courses 14.0
Professional electives* 10.0

***Professional electives are selected from departmental or related course offerings (excluding NFS 500, NFS 506, and NFS 508) in consultation with the student's graduate advisor. Possibilities include courses in various aspects of nutrition; special topics in food science such as lipids, proteins, carbohydrates, or packaging; microbial physiology; microbial genetics; recombinant DNA techniques; biophysical chemistry; analytical chemistry; biochemistry; bioengineering and process systems; epidemiology; and environmental sciences. Students electing the thesis option may include up to six credits of NFS 997 (Research in Nutrition and Food Sciences) among their electives.**

Ph.D. in Nutrition and Food Science

The Ph.D. degree requires a minimum of 90 credits beyond the bachelor's degree. Depending on the applicant's background, a qualifying examination may be required. Candidates must demonstrate appropriate scientific scholarship and the ability to conduct independent research representing a significant contribution to their chosen field. Ph.D. students must pass a candidacy examination and an oral defense of their dissertations. Applicants interested in the Ph.D. program should contact potential major professors for an appointment to discuss research interests.

Physics

Graduate students in Physics at Drexel have the opportunity to work closely with world-recognized faculty whose interests span virtually all fields of physics. These daily encounters with faculty and fellow students provides the stimulus of new ideas and a collegial environment. Since specialization does not occur until after the second year, first- and second-year students can see some of the contemporary issues of physics first-hand, which proves helpful to students who are undecided about the field they wish to pursue.

Both full- and part-time study are available. Students may also enroll under the co-operative education plan, which offers alternating periods of study and employment.

M.S. in Physics

Students who wish to complete only the master's degree are welcomed, and will find that the learning environment will allow them to broaden their professional understanding by exploring current topics and trends of physics in an interdisciplinary setting.

The requirement for the master's degree in physics is 45 graduate credits, with at least 30 credits taken in dynamics, mathematical physics, electricity and magnetism, quantum mechanics, and statistical mechanics. There are no thesis, language, or special examination requirements for the master's degree. Degrees are also available in collaboration with other departments and programs.

Ph.D. in Physics

The Doctor of Philosophy degree is conferred in recognition of breadth of scholarship and scientific attainment, plus demonstrated ability to investigate scientific problems independently and efficiently. Doctoral students are required to take a minimum of 45 credits of coursework and research work beyond the master's requirement of 45 credits.

The successful Ph.D. candidate must pass a candidacy examination, written and oral; satisfy a one-year residence requirement; and perform original research, write a satisfactory thesis describing that research, and defend the thesis in an oral examination. Involvement in the teaching activities of the Physics and Atmospheric Science Department is required of all Ph.D. applicants.

Publication Management

M.S. in Publication Management

Students enter the Publication Management program from diverse undergraduate backgrounds, including liberal arts, business administration, journalism, communications, technical writing, and information studies. The program builds on the individual's undergraduate content base by providing knowledge about the key elements of the publishing process needed by a publishing executive. The program also serves the needs of individuals already employed in the printing or publishing industry who are seeking to update or broaden their knowledge.

Students completing the program may find career opportunities in the management of traditional publishing companies as well as in corporate communication areas of a broad range of business and education. Entrepreneurial opportunities provide another area of career development.

All courses in the program are offered in the evening on a part-time or full-time basis. The curriculum comprises courses in technical and science writing and editing, product acquisition, design, production, and printing technology offered through the College of Arts and Sciences and business management and marketing courses offered through the LeBow College of Business.

Graduation from the program requires the successful completion of all program pre- and co-requisites and 47 credits of graduate coursework. The graduate coursework includes 36 credits of required courses and 11 credits of electives. Electives can be selected, with faculty advisement, from graduate courses in the student's interest that meet the objectives of the program. Independent study and additional credits in the independent project are available as elective options.

Curriculum
ACCT 602 Managerial Accounting 3.0
COM 510 Technical Writing 3.0
COM 570 Technical and Science Editing 3.0
MKTG 620 Marketing Strategy and Planning 3.0
MKTG 638 New Product Planning/Strategy/Development* 3.0
ORGB 622 Group & Interpersonal Behavior in Organizations 3.0
PMGT 630 The Publishing and Printing Industries 3.0
PMGT 631 Art and Illustration Reproduction 3.0
PMGT 635 Small Publication Production 3.0
PMGT 670 Book Production 3.0
PMGT 731 Computer Image Generation and Telecom. 3.0
PMGT 735 Publication Budgeting and Estimating 3.0
Electives 11.0

***MKTG 638 should be taken after MKTG 620 if possible.**

Science, Technology, and Society

M.S. in Science, Technology, and Society

The increasingly complex nature of modern life has steadily eroded the distinctions traditionally made between social and technical issues. Leaders among scientists, engineers, policy-makers, managers, investors, and educators must base their decisions on a diverse array of data, new tools for gathering and evaluating this data, integrated systems of information, and interdisciplinary approaches to problem-solving. In an era of expanding global investment and complex regulation, opportunities will accrue to those who can identify potential problems early and formulate multifaceted, long-term, and viable solutions.

The graduate program in Science, Technology, and Society (STS) targets this new leadership cadre. STS at Drexel integrates the study of history, science and technology, public policy, and contemporary social and political issues. It combines core courses in the history of science and technology with classes that focus on gender and race, democratic institutions, ethics, and future challenges to industry and government. The program also provides a unique international orientation, which recognizes the crucial context of globalization in the advancement of science and technology and the broad implications of scientific research and innovation in the politics and history of the modern world.

Prospective students for the M.S. in STS see this educational opportunity as an essential factor in their skill enhancement and career advancement. They are recent college graduates in the social sciences, humanities, natural sciences, and engineering; middle and high school teachers; and professionals in businesses, city and state government offices, and area hospitals. Students can attend full time or part time and complete all coursework in the evening.

The M.S. degree in STS requires 45 credits of coursework. At least 36 credits must be history/politics courses. Required courses total 27 credits (including a 3-credit seminar, a 3-credit practicum, and 6 credits of research and writing for the thesis, which may be tied to the practicum). Remaining credits are chosen from a list of electives.

Basic requirements 15.0 Credits

HIST 501 Introduction to Science, Technology, and Society 3.0
HIST 585 Technology in Historical Perspective 3.0
HIST 586 Gender and Technology 3.0
or
PSCI 573 Gender, Race, and Science 3.0
PSCI 555 International Political Economy 3.0
One of the following courses:
PSCI 571 Science and Technology Public Policy 3.0
PSCI 557 Globalization and Transition 3.0
PSCI 541 Technology in Developing Countries 3.0
PSCI 570 International Environmental Policy 3.0

Advanced requirements 12.0 Credits

HIST 587 Seminar in Science, Technology, and Society 3.0
or
PSCI 587 Seminar in Science, Technology, and Society 3.0
HIST 697 Practicum: Science and Technology in Action 3.0
HIST 599 M.S. Thesis 6.0
or
PSCI 599 M.S. Thesis 6.0

Suggested Electives (select at least three of the following) 9.0 Credits

HIST 541 Technology in Developing Countries 3.0
HIST 555 International Political Economy and Technology 3.0
HIST 557 Globalization and Transition 3.0
HIST 583 History of Medicine and Disease 3.0
HIST 586 Gender and Technology 3.0
HIST 590 Themes in the History of Science 3.0
HIST 591 Themes in the History of Technology 3.0
PSCI 541 Technology in Developing Countries 3.0
PSCI 555 International Political Economy 3.0
PSCI 557 Globalization and Transition 3.0
PSCI 570 International Environmental Policy 3.0
PSCI 573 Gender, Race, and Science 3.0
PSCI 574 Alternative Policy Perspectives 3.0
PSCI 575 Appropriate Technology and Development 3.0
COM 650 Telecommunications Policy 3.0
COM 690 Grant Writing 3.0
ENVR 880 Environment and Society 3.0
MGMT 602 Management and Technology 3.0
PSY 612 Human-Computer Interaction 3.0
Remaining electives 9.0 Credits

Any remaining electives may be taken in the Department of History and Politics or other departments and colleges in the university, chosen in consultation with the STS faculty.

The LeBow College of Business

Graduate business programs at Drexel University provide a high quality education which blends practice and theory. Designed to fill the needs of a diverse population, Drexel's graduate programs in business help students round out their educational requirements in a way that suits them. Students with substantial professional experience might need conceptual tools to complete their education, while others with significant course work may need on-the-job training.

Drexel's MBA program enrolls approximately 900 students representing diverse backgrounds, one-third of whom are enrolled full-time. Approximately sixty percent of the full-time students are international. These students hail from more than 40 countries in Asia, the Pacific Rim, Europe, South America and Canada.

The Bennett S. LeBow College of Business has an outstanding faculty. More than 95 percent hold the doctoral degree. With equally impressive backgrounds in business experience and scholarly publications, Drexel business faculty combine strengths in teaching and research. They also enjoy strong ties with the corporate community, serving as consultants for a range of corporations, government agencies and other organizations. Corporate and entrepreneurial leaders add to the full-time faculty by coming to campus as guest lecturers or adjunct professors.

The Bennett S. Lebow College of Business is among just 25 percent of business schools nationwide accredited by the American Assembly of Collegiate Schools of Business. This status has been granted in recognition of the College's academic standards and curricular quality, the stature of its faculty and the resources it offers.

MBA Program

Drexel University's innovative, high-quality MBA program is recognized for its excellence and for its preparation of students for successful professional careers.

The MBA program is designed to:

- Integrate the foundations of business, problem-solving, and decision-making skills; organization theory; and practical aspects of institutional management
- Prepare students for managerial positions in business and other institutions
- Offer specializations in various areas of management
- Capitalize on communication skills, people skills, global perspectives, technological competence, pragmatic emphasis, and ethical perspectives
- Offer students the opportunity to participate in the Career Integrated Education option, in which they hold a full-time management position for a six-month period once they have completed about half of their graduate program

Professional MBA

Curriculum

Enterprise Management Sequence
BUSN 501 Measuring and Maximizing Financial Performance 3.0
BUSN 502 Essentials of Economics 3.0
BUSN 503 The External Enviroment of Business 3.0

Functional Core Sequence
STAT 601 Business Statistics 3.0
ECON 601 Managerial Economics 3.0
FIN 601 Corporate Financial Management 3.0
MKTG 601 Marketing Strategy and Planning 3.0
POM 601 Operations Management 3.0
ACCT 601 Managerial Accounting 3.0

Technology Management Sequence
MGMT 602 Management and Technology Innovation 3.0
MIS 611 Management Information Systems 3.0
or

MIS 641 MIS Policy & Strategy
Leadership Sequence
ORGB 625 Leadership and Professional Development 3.0
ORGB 630 Leading Effective Organizations 3.0
MGMT 780 Strategic Management 3.0

Industry Perspectives Sequence
BUSN 701 Industry Management Perspectives 3.0

Electives/Second Concentration Credits

Elective #1 or Concentration Course #1 3.0
Elective #2 or Concentration Course #2 3.0
Concentration Course #3 (only for dual concentration) 3.0

Concentrations
Students select one of the following areas of concentration.

Accounting Concentration 9.0 Credits
Required course(s)
ACCT 790 Seminar in Accounting 3.0

Two of the following*
ACCT 620 Asset Valuation and Income Determination 3.0
ACCT 621 Liability and Equity Valuation 3.0
ACCT 622 Advanced Financial Accounting 3.0
ACCT 623 Financial Accounting Theory 3.0
ACCT 631 Advanced Managerial Accounting 3.0
ACCT 640 Auditing Theory and Philosophy 3.0
ACCT 650 Accounting Information Systems 3.0

Business electives
Students are encouraged to take 6.0 credits of business courses (accounting courses are acceptable) that will benefit career goals.

***Other M.S. accounting courses are acceptable, with permission of the student's advisor.**
Students with undergraduate degrees in accounting will choose two of the following
courses for their concentrations: ACCT 623, ACCT 631, or ACCT 650..
Economics Concentration
9.0 Credits
Required course(s)
ECON 614 Macroeconomics 3.0

Two of the following
ECON 616 Public Finance and Cost-Benefit Analysis 3.0
ECON 630 International Economics 3.0
ECON 650 Game Theory 3.0
ECON 661 Health Economics 3.0
ECON 662 Economic Analysis of Health Systems 3.0
INTB 632 Economic Analysis of Multinational Corporations 3.0
ECON 790 Seminar in Managerial Economics 3.0

Financial Management Concentration 9.0 Credits
Required Courses
FIN 628 Capital Budgeting 3.0
FIN 790 Seminar is Financial Management 3.0

One of the following
FIN 624 Risk Management 3.0
FIN 640 Mergers and Acquisitions 3.0
FIN 642 Business Conditions and Forecasting 3.0
FIN 648 International Financial Management 3.0

Health Care Systems Concentration 9.0 Credits
Required Courses
ECON 661 Health Economics 3.0
ECON 662 Economic Analysis of Health Systems 3.0
MGMT 698 Special Topics in Managed Care Systems 3.0

International Business Concentration 9.0 Credits

Chose any of the following courses
ECON 630 International Economics 3.0
INTB 620 International Business Management 3.0
INTB 790 Seminar in International Business 3.0
INTB 632 Economic Analysis of Multinational Corporations 3.0
ECON 790 Seminar in Managerial Economics 3.0
FIN 648 International Financial Management 3.0
MKTG 630 International Marketing 3.0

Investment Management Concentration 9.0 Credits
Required Courses
FIN 624 Risk Management 3.0
FIN 626 Investment Management 3.0

One of the following
FIN 622 Financial Institutions and Markets 3.0
FIN 642 Business Conditions and Forecasting 3.0
FIN 649 Comparative Financial Analysis 3.0
FIN 650 Financial Derivatives 3.0
FIN 794 Seminar in Investments 3.0

Management Information Systems Concentration 9.0 Credits

Three of the following courses
MIS 620 Telecommunications Management 3.0
MIS 624 e-commerce Systems I 3.0
MIS 628 e-commerce Systems II 3.0
MIS 632 Database Analysis and Design for Business 3.0
MIS 636 Decision Processes in MIS 3.0
MIS 640 Java Programming 3.0
MIS 698 Special Topics in MIS 3.0

Students also can take either MIS 611 (Introduction to MIS) or MIS 641 (MIS Policy and Strategy)
if they did not take that course to fulfill the requirement for the Technology Management
Sequence.
It is also recommended that all students pursuing an MIS concentration take MGMT 655
(Knowledge Management in a Global Economy) as a free elective.

Marketing Concentration 9.0 Credits

Required Courses*

MKTG 652 Marketing Information: Management and Research 3.0

Two of the following courses
MKTG 622 Buyer Behavior 3.0
MKTG 624 Channels of Distribution Management 3.0
MKTG 628 Logistics and Supply Chain Management 3.0
MKTG 630 International Marketing 3.0
MKTG 632 Sales Management Seminar 3.0
MKTG 634 Integrated Marketing Communications Management 3.0
MKTG 636 Business-to-Business Marketing 3.0
MKTG 638 New Product Planning, Strategy, and Development 3.0
MKTG 646 Services Marketing 3.0
MKTG 650 Marketing Management in the New Economy: Cases and Problems 3.0
MKTG 790 Seminar in Marketing 3.0

***It is also recommended that all students pursuing a Marketing concentration take**
MKTG 790 as a free elective.

Organization Management Concentration 9.0 Credits
Three of the following courses*
MGMT 640 Strategic Human Resource Management 3.0
MGMT 650 Corporate Venturing: Entrepreneurs in Organizations 3.0
MGMT 655 Knowledge Management in a Global Economy 3.0
MGMT 685 Implementing Strategies Using Project Teams 3.0

***It is also recommended that all students pursuing an Organization Management**
concentration take the remaining (fourth) course from the concentration area
as a free elective.

Production and Operations Management Concentration 12.0 Credits

Three of the following courses*
POM 620 Management of Manufacturing Firms 3.0
POM 622 Materials Management 3.0
POM 624 Management of Service Firms 3.0
POM 625 Advanced Supply Chain Management 3.0

One of the following courses
OPR 620 Operations Research I 3.0
OPR 622 Operations Research II 3.0
STAT 924 Multivariate Continuous Analysis 3.0
STAT 636 Experimental Design 3.0

***The remaining POM courses may also be used to fulfill the requirement. For example,**
taking all four of the above POM courses will be sufficient to earn the concentration.

Taxation Concentration 9.0 Credits
Required course(s)
TAX 611 Tax Research 3.0
TAX 790 Tax Policy Seminar 3.0
Plus any graduate-level (600) tax elective 3.0

M.S. Programs in Business

The M.S. degree requires the same number of credits as the MBA, and it includes the same foundation courses. The advanced course work generally consists of a common core, specialization courses, and related electives.

The foundation level courses provide an introduction to the functional areas of business study primarily for students who do not have an undergraduate business degree. This program segment traditionally consists of 10 courses. Students with a business degree, especially from an AACSB-accredited school, may qualify for a waiver of the foundation requirement.

Currently, Drexel offers M.S. degrees in the following areas:

M.S. Accounting
M.S. Finance
M.S. Taxation
For additional information about the programs visit the M.S. Programs in Business web site.

M.S. in Accounting

Accounting students must have a strong background in intermediate accounting and managerial accounting. The number of prerequisite courses required depends on the student's previous academic record, but all prerequisites must be completed before proceeding to courses at the 600 through 800 level. In addition to the first-year business courses, each M.S. candidate must complete 48 graduate credits in accounting and related business disciplines.

Curriculum
For first-year courses, see the MBA program.

Required accounting courses

ACCT 622 Advanced Financial Accounting 3.0
ACCT 623 Financial Accounting Theory 3.0
ACCT 631 Advanced Managerial Accounting 3.0
ACCT 640 Auditing Theory and Philosophy 3.0
ACCT 650 Accounting Information Systems 3.0
ACCT 790 Seminar in Accounting 3.0
TAX 620 Individual Taxation 3.0
TAX 630 Corporate Taxation 3.0

Required non-accounting courses
ECON 610 Microeconomics 3.0
FIN 620 Advanced Financial Management 3.0
MGMT 780 Business Policy 3.0
STAT 602 Decision Sciences I 3.0
Electives* 12.0

***At least one accounting elective must be selected. Accounting courses that may be taken as electives include ACCT 636 (International Accounting and Financial Statement Analysis) and**

ACCT 651 (Not-for-Profit Accounting). The other two electives may be any LeBow College of Business courses, including tax courses, approved by the program director.

M.S. in Finance

Requirements

In addition to the prerequisite first-year courses, each student must complete 48 credits as described below. The number of prerequisite courses required depends on the student's previous academic record, but all prerequisites must be completed before proceeding to courses at the 600 through 800 level.

Curriculum
For first-year courses, see the MBA program.

Required finance courses
Core program*
MGMT 602 Management and Technology 3.0
MGMT 780 Business Policy 3.0
STAT 602 Decision Sciences I 3.0
STAT 604 Decision Sciences II 3.0

Required finance courses
FIN 620 Advanced Financial Management 3.0
FIN 622 Financial Institutions and Markets 3.0
FIN 624 Risk Management 3.0
FIN 628 Capital Budgeting 3.0
FIN 642 Business Conditions and Forecasting 3.0
FIN 790 Seminar in Financial Management
or
FIN 794 Seminar in Investments 3.0

Electives (six of the following courses) 18.0**

ACCT 620 Asset Valuation and Income Determination
ACCT 621 Liability and Equity Valuation
ECON 610 Microeconomics
ECON 614 Macroeconomics
ECON 630 International Economics
ECON 650 Game Theory
FIN 626 Investment Management
FIN 631 Bank Management I
FIN 632 Bank Management II
FIN 640 Mergers and Acquisitions
FIN 648 International Financial Management
FIN 698 Special Topics
MIS 628 Microcomputers for Management
MIS 630 Interactive Decision Support Systems
OPR 626 System Simulation
POM 620 Management of Manufacturing Firms
POM 624 Management of Service Firms
STAT 622 Statistical Decision Theory I
STAT 628 Regression and Correlation Analysis
TAX 630 Corporate Taxation
TAX 660 Tax Basis for Decision-Making
or
TAX 620 Individual Taxation

***Upon consultation with the program director, students may substitute more advanced courses for those listed in the core.**

****Additional specialization can be achieved by concentrating the six electives in one of the following fields: banking, investments, or systems management. Also, FIN 698 (Special Topics: Comparative Financial Analysis or Special Topics: Derivatives) may be taken.**

M.S. in Taxation

After satisfaction of the first-year prerequisites, the M.S. candidate must complete 48 credits. A variety of substitutions may be made for the required courses, and non-tax courses may be taken as elective courses only with prior written approval of the program director. Substitutes must be selected from advanced courses offered by the LeBow College of Business to meet the minimum 48 graduate credits required for the degree.

Curriculum
For first-year courses, see the MBA program.

Required courses
TAX 611 Tax Research 3.0
TAX 615 Tax Practice and Procedure* 3.0
TAX 620 Individual Taxation 3.0**
TAX 630 Corporate Taxation 3.0**
TAX 640 Partnership Taxation* 3.0
TAX 650 Estate and Gift Taxation 3.0
TAX 790 Tax Policy Seminar 3.0

Non-tax electives 9.0
Tax electives (selected from the following courses) 12.0
ACCT 698 Special Topics***
TAX 622 Advanced Property Transactions
TAX 631 Advanced Corporate Taxation
TAX 651 Estate Planning****
TAX 652 Fiduciary Income Taxation
TAX 722 Tax Accounting
TAX 731 Taxation of S Corporations
TAX 771 State and Local Taxation
TAX 780 Tax Fraud and White-Collar Crime

Note: TAX 660 (Tax Basis for Decision-Making) is not an approved elective for students enrolled in the taxation program.

***Required in the corporate tax track.**

****An elective tax course may be substituted for either or both of these courses if the material was previously taken at the undergraduate level or acquired from prior tax experiences.**

*****A variety of courses is offered under ACCT 698 (Special Topics), generally in the winter and spring quarters. They could include, for example, Taxation of Retirement Income******, Taxation of Individual Retirement Accounts, or International Tax.**

****** Required in the financial planning track.**

Ph.D. Program in Business

Drexel's Ph.D. Program in Business is designed to prepare candidates for careers in research and teaching. The Drexel program is characterized by a healthy respect for the interrelations among the different branches of knowledge and a close, collaborative relationship between each Ph.D. candidate and the faculty. The newly revised program offers specializations in seven areas: accounting, decision sciences, economics, finance, management information systems,marketing, and organization and strategy.

Ph.D. students complete a minimum of 60 quarter credits beyond the master's degree. Students who enter the program without a master's degree must complete 90 credits beyond the bachelor's degree. The degree requirements describes the basic structure of the Drexel Ph.D. curriculum.

Time Requirements for Program Completion
Time requirements are placed on graduate programs of study to ensure that students receive instruction in, and graduate with, the most up-to-date, current knowledge available in their discipline. It is expected that all graduate students will be able to complete their degrees within the stated time requirements.

University policy provides that students who enter the Ph.D. program without a master's degree must complete their studies for their Ph.D. within seven years after initial graduate registration. Those who enter the Ph.D. program with a master's degree in hand are permitted five years after initial registration to complete the Ph.D. degree.

Students who find that these time requirements are inadequate due to special circumstances must discuss this with their specialization coordinator and the director of the Ph.D. program. Together they may request an extension prior to the end of the student's stated time limit (either seven or five years). All formal extension requests must give a reasonable time for completion with an accompanying revised plan of study. Should an extension be required, please be aware that all courses will be reviewed for timeliness; some earlier coursework may have to be repeated.

Extension requests must be forwarded, after approval

The College of Engineering

As Drexel moves into the 21st century, the College of Engineering remains the flagship college of the university, offering students a truly diverse academic learning and research environment, while continuing to build on its national reputation for excellence in engineering and research.

The College of Engineering offers graduate degree programs in the following disciplines:

Biochemical Engineering
Chemical Engineering
Civil Engineering
Computer Sciences
Electrical Engineering
Computer Engineering
Telecommunications Engineering
Engineering Management
Environmental Engineering
Master of Engineering
Materials Engineering
Mechanical Engineering and Mechanics
In addition, the College offers a multidisciplinary program in Software Engineering and Engineering Management in concert with other Drexel University colleges.

Biochemical Engineering

Graduate study in biochemical engineering is offered on a regular full-time basis. The core courses are designed for students with an undergraduate training in chemical engineering. However, students with a background in biological sciences can also enroll in those courses after completing the necessary basic engineering courses as prerequisites. Programs for such individuals will be determined after consultation with the departmental graduate adviser.

M.S. in Biochemical Engineering

In general, each program leading to the Master of Science degree with specialization in biochemical engineering must meet the following requirements: biochemical engineering, 18 credits; biological sciences, 12 credits; electives, 15 credits.

A thesis of at least 9 credits is required for all full-time students. (The 18 credits in biochemical engineering courses include 9 thesis credits and 9 credits in core courses.) The thesis subject may be either a fundamental or an applied problem of limited scope in the general area of biochemical engineering.

Electives may be chosen broadly from graduate course offerings with prior approval of the graduate advisor.

Curriculum

Required biochemical engineering courses Credits

CHE 560 Transport Phenomena in Biological Systems 3.0
CHE 562 Bioreactor Engineering 3.0
CHE 564 Unit Operations in Bioprocess Systems 3.0

Required biological sciences courses
BIO 500 Biochemistry I 3.0
BIO 610 Biochemistry II 3.0
BIO 520 Cell Physiology 3.0

Suggested electives include:
Biosciences
BIO 449 Recombinant DNA Laboratory 3.0
BIO 530 Techniques in Microbial Genetics 3.0
BIO 615 Experimental Biochemistry I 3.0
BIO 618 Experimental Biochemistry II 3.0
BIO 620 Biomembranes 3.0
BIO 635 Topics in Eucaryotic Genetics 3.0
BIO 660 Microbial Physiology 3.0
BIO 670 Medical Microbiology 3.0

Biomedical Engineering
BMES 501 Medical Sciences I 3.0
BMES 502 Medical Sciences II 3.0
BMES 503 Medical Sciences III 3.0
BMES 521 Principles of Bioengineering and Instrumentation I 3.0
BMES 522 Principles of Bioengineering and Instrumentation II 3.0
BMES 523 Principles of Bioengineering and Instrumentation III 3.0
BMES 681 Physics of Living Systems I 3.0
BMES 682 Physics of Living Systems II 3.0
BMES 683 Physics of Living Systems III 3.0

Ph.D. in Biochemical Engineering

Superior students with M.S. or B.S. degrees will be considered for the doctoral program in chemical engineering or biochemical engineering.

All students are expected to develop competence in their areas of specialization. All students are urged to select a thesis topic and supervisor early in the program. A student becomes a Ph.D. candidate upon passing the candidacy examination, which includes writing and defending a research proposal; a doctoral committee is formed to direct his or her research and other aspects of the program of study.

As the culmination of intensive study and independent research, the doctoral dissertation represents a major scholarly endeavor; accordingly, it is recognized as the most important requirement of the degree. All doctoral candidates must present an acceptable dissertation based on significant work. The dissertation must represent a unique contribution to chemical engineering or biochemical engineering knowledge. A final oral examination is conducted, in part, as a defense of the dissertation.

Chemical Engineering

The graduate program in chemical engineering integrates current chemical engineering science with the growing fields of engineering applications and processes. In emphasizing engineering design, as well as scientific analysis, the department intends to develop broadly educated individuals who are knowledgeable in modern theories, cognizant of the behavior of engineering systems, and aware of current mathematical and engineering tools that are useful for the solution of problems in complex processes and systems, especially those in the fields of chemical, environmental, biochemical, and materials process engineering.

Two major areas of specialization are available: chemical engineering and biochemical engineering.

Programs are arranged to meet the needs and interests of individual students. The plan of study is initially formulated in consultation with the departmental graduate advisor and subsequently guided by the thesis advisor.

Graduates have pursued a variety of careers, ranging from faculty positions in academia to research and development in industry, in the U.S. and overseas.

M.S. in Chemical Engineering

In general, each program leading to the Master of Science in Chemical Engineering must meet the following requirements: chemical engineering, 24 credits; area of concentration, 15 credits; electives, 6 credits.

A thesis of at least 9 credits is required of all full-time candidates. (For full-time students, the 24 credits in chemical engineering courses include the 9 thesis credits and 15 credits in the core course group described below.) The thesis may be based on either a theoretical or an experimental investigation, or both, of limited scope but involving a significant degree of originality. The nature of the research may involve multidisciplinary areas such as environmental engineering, biomedical engineering, ceramic processing, molten metals processing, and other topics.

Courses in an area of concentration enable students to develop expertise in a technology area closely related to chemical engineering, such as environmental engineering, biochemical engineering, and materials engineering. Those contemplating a career in management of technology may consider the area of concentration in engineering management. Concentration in computer science is

suggested for students interested in computer applications in chemical engineering. The courses listed under each area of concentration are recommended for students who have no prior exposure to that field. Students who have prior experience in a field should select courses in consultation with the graduate advisor.

Electives may be chosen from course offerings in chemical engineering, mathematics, science, and other engineering disciplines, subject to approval.

Full-time students usually take the core courses in the first year. Other courses may be substituted for the core courses, if equivalent courses are available and if the substitution is approved by the graduate advisor.

Seminars, attended by all full-time students and faculty, provide a forum for the discussion of original research problems and other topics of interest to chemical engineers.

Full-time students normally require a minimum of one calendar year to complete their study and research.

Some courses are offered in the late afternoon or evening for the convenience of part-time students. Programs are developed on an individual basis.

Non-chemical engineering electives, other than those listed above, require prior approval by the graduate advisor. The current schedule of evening courses and a brochure for part-time students are available upon request.

Curriculum
Five of the following courses:
CHE 502 Mathematical Methods in Chemical Engineering 3.0
CHE 513 Chemical Engineering Thermodynamics 3.0
CHE 525 Transport Phenomena I 3.0
CHE 543 Kinetics and Catalysis I 3.0
CHE 554 Process Systems Engineering 3.0
CHE 658 Advanced Process Design 3.0
Area of concentration 15.0
Thesis 9.0
Electives 6.0

Areas of Concentration
Biochemical Engineering
BIO 500 Biochemistry I 3.0
BIO 501 Biochemistry I Laboratory 2.0
BIO 610 Biochemistry II 3.0
CHE 560 Transport Phenomena in Biological Systems 3.0
CHE 562 Bioreactor Engineering 3.0
CHE 564 Unit Operations in Bioprocess Systems 3.0

Computer Science
CS 557 Data Structures 3.0
CS 558 Analysis of Algorithms 3.0
CS 559 Formal Language Theory 3.0
CS 720 Operating Systems I 3.0
CS 761 Compiler Construction I 3.0

Engineering Management
EGMT 501 Engineering Management I 3.0
EGMT 502 Engineering Management II 3.0
EGMT 504 Communications 3.0
EGMT 531 Economics for Engineering Management 3.0
EGMT 581 Problems in Human Relations 3.0

Environmental Engineering
ENVR 501 Chemistry of the Environment 3.0
ENVR 608 Fate of Pollutants in Air and Water 3.0
ENVE 661 Environmental Engineering Unit Operations — Chemical and Physical 3.0
ENVE 662 Environmental Engineering Unit Operations — Biological 3.0
ENVR 865 Special Topics: Environmental Engineering 3.0

Materials Engineering
MATE 500 Structure and Properties of Metals 3.0
MATE 501 Structure and Properties of Polymers 3.0
MATE 502 Structure/Properties Ceramic/Electronic Materials 3.0
MATE 505 Phase Equilibria 3.0
MATE 506 Diffusion 3.0

Ph.D. in Chemical Engineering

Superior students with M.S. or B.S. degrees will be considered for the doctoral program in chemical engineering or biochemical engineering.

All students are expected to develop competence in their areas of specialization. All students are urged to select a thesis topic and supervisor early in the program. A student becomes a Ph.D. candidate upon passing the candidacy examination, which includes writing and defending a research proposal; a doctoral committee is formed to direct his or her research and other aspects of the program of study.

As the culmination of intensive study and independent research, the doctoral dissertation represents a major scholarly endeavor; accordingly, it is recognized as the most important requirement of the degree. All doctoral candidates must present an acceptable dissertation based on significant work. The dissertation must represent a unique contribution to chemical engineering or biochemical engineering knowledge. A final oral examination is conducted, in part, as a defense of the dissertation.

Civil Engineering

Program Objectives
The graduate program in civil engineering offers students the opportunity to develop a more fundamental and

complete understanding of the principles that govern their field as well as current design methodology. Students are encouraged to be innovative and imaginative in their quest for recognizing, stating, analyzing, and solving engineering problems.

The goal of the master's program is to develop technical depth of expertise for a professional career in the planning, design, construction, and operation of large-scale infrastructure systems, built facilities, and water resources management. The goal of the Ph.D. program is to develop the abilities to discover, pursue, and apply basic knowledge. Ph.D. recipients are prepared to engage in teaching and research or in an industrial career in the development of new concepts and innovative systems.

General Information
The civil engineering programs comprise the following areas of specialization: building systems, geotechnical engineering, hydraulic and coastal engineering, structural engineering, and water resources.

M.S. in Civil Engineering

The programs of study at the master's level continue the specialization developed at the senior level of the undergraduate program or newly developed interests. The Master of Science in Civil Engineering degree may be elected by graduates of ABET-accredited undergraduate programs in civil engineering and related fields. Admission and prerequisites are determined on the basis of a student's undergraduate transcript.

Most M.S.C.E. graduates work as professional engineers in consulting firms, industry, or governmental agencies. A number of our graduates have started consulting and construction firms in the Philadelphia area and have been very successful. Other former students hold prominent positions in public utilities, local government agencies, and industry.

The full-time graduate academic program is closely associated with the research efforts of the faculty. Full-time master's degree candidates are encouraged to base their master's thesis on some aspect of faculty research. The one-to-one relationship between student and faculty member provides an invaluable learning experience. The General (Aptitude) Test of the Graduate Record Examination (GRE) is required for applicants pursuing full-time study.

The master's degree requires a total of 45 credits, of which 24 credits must be in the major field of interest and 6 credits are to fulfill math requirements. The remaining credits are taken as electives in related areas. The choice of core and elective courses is made in consultation with the student's graduate advisor.

Areas of concentration include:

Structural
Geotechnical/geoenvironmental
Water resources/coastal
Building systems/energy
Geosynthetics
Infrastructure materials

Dual graduate degrees are possible. Among the more popular programs are combining the M.S. in Civil Engineering with an M.S. in Environmental Engineering, or Engineering Management. The required credits must meet all civil engineering program requirements and will be determined on the basis of the student's proposed program of study.

Ph.D. in Civil Engineering

The Ph.D. degree is awarded for original research on a significant civil engineering problem. Graduate students who have completed their M.S. degrees work closely with individual faculty members (see Faculty Research Interests below). Ph.D. dissertation research is usually supported by a research grant from a government agency or an industrial contract.

Doctoral students normally take at least 45 credits, including research credits, beyond the master's degree requirements. Full-time residency for one continuous academic year is required for the Ph.D. degree to ensure students the opportunity for intellectual association with other scholars. Many doctoral students take two, three, or four years of full-time graduate study to complete their degrees. Involvement in the teaching activity of the Civil Engineering Department is required of all Ph.D. applicants.

After approximately one year of study beyond the master's degree, doctoral students take a qualifying examination, consisting of written and oral parts. Each Ph.D. candidate is supervised by a major professor and a doctoral committee chaired by the major professor.

Ph.D. candidates submit a detailed proposal for dissertation research to the doctoral committee. The students then take a candidacy examination; successful completion of this examination is required to become a Ph.D candidate. After approval of the proposal, the committee meets from time to time to review the progress of the research. The dissertation must be submitted to the doctoral committee at least 90 days before the graduation

date. The committee schedules and conducts a final oral examination before approval of the dissertation.

Computer Science

The Master of Science in Computer Science is designed to provide breadth of understanding in the core topics of computer science, in-depth advanced material, and a range of topics courses in the research areas of the faculty. A balance of theory and practice is presented preparing students to perform cutting edge research as well as training students to become practicing computational scientists, computer specialists or software engineers in business, industry or government. A thesis option is available to prepare students for doctoral studies or other research-oriented career paths.

M.S. in Computer Science

General Requirements
Students must complete a minimum of 45 graduate credits for the M.S. degree. All students are required to submit a plan of study form with the Graduate Advisor at the beginning of their studies. Significant changes to the plan of study should be discussed with the Graduate Advisor.

Precore Classes
Precore classes are graduate level courses, but are not considered graduate level CS courses. These courses only count towards the degree requirement for three "additional graduate level courses." These courses are intended for students without adequate CS background. The material in these courses is considered prerequisite knowledge for all other graduate CS courses.

CS 680 Foundations of Computer Science
CS 680 UNIX Programming Environment
Degree Requirements

Core Courses Credits

CS 557 Data Structures and Algorithms I 3.0
CS 558 Data Structures and Algorithms II 3.0
CS 559 Formal Language Theory 3.0
CS 560 Programming Languages 3.0
CS 720 Operating Systems I 3.0
CS 740 Computer Networks I 3.0

Students select three intermediate courses, from at least two areas, chosen from the following:

Algorithms and Theory
CS 759 Complexity Theory 3.0

Artificial Intelligence and Robotics
CS 590 Artificial Intelligence 3.0
CS 680 Special Topics: Advanced Artificial Intelligence 3.0
CS 680 Special Topics: Robot Building Lab 3.0
CS 771 Expert Systems 3.0

Computer Architecture
ECEC 621 High-performance Computer Architecture 3.0
ECEC 622 Parallel Computer Architectures 3.0

Human Computer Interaction and Computer Graphics
CS 585 Computer Graphics I 3.0
CS 680 Special Topics: HCII 3.0

Numeric and Symbolic Computation
CS 680 Special Topics: Applied Symbolic Computation 3.0
CS 680 Special Topics: Computer Algebra I 3.0
MATH 520 Numerical Analysis I 3.0
MATH 540 Numerical Methods 3.0

Programming Languages and Compilers
CS 761 Compiler Construction I 3.0
CS 762 Compiler Construction II 3.0

Software Engineering

CS 575 Software Design 3.0
CS 576 Dependable Software Systems 3.0
Systems

CS 721 Operating Systems II 3.0
CS 741 Computer Networks II 3.0
ECEC 632 Performance Analysis of Computer Networks 3.0
CS 750 Database Theory I 3.0

Students select one advanced course from the following:
CS 770 Topics in Artificial Intelligence 3.0
CS 771 Computer Graphics II 3.0
CS 725 Operating System Workshop 3.0
CS 730 Parallel Processing 3.0
CS 743 Network Security and Cryptography 3.0
CS 680 Special Topics: Topics in Algorithms 3.0
CS 680 Special Topics: Computer Algebra II 3.0
CS 680 Special Topics: Reverse Software Engineering 3.0
ECEC 623 Advanced Parallel Computer Architectures 3.0
ECEC 633 Advanced Topics in Computer Networks 3.0
MATH 521 Numerical Analysis II 3.0

Thesis Option
Usually students pursuing a Master's Thesis will first do 3 research credits (CS 897 or CS 997) to obtain background knowledge required by the thesis topic. It is the responsibility of the student to find a thesis supervisor.

CS 898 Master's Thesis 6.0

Non-thesis Option

The non-thesis option requires Two additional courses from either intermediate level or advanced level courses listed above.

Three additional graduate level courses are required: These courses may come from either intermediate or advanced courses. In addition, courses may be taken outside the department, may include CS 897 (Independent Study), CS 997 (Research in Computer Science), and precore Computer Science courses listed in requirement (0). Any course not explicitly listed above, including independent study and research courses, must be approved by the Graduate Advisor.

Other courses, such as special topics, the department offers may qualify for meeting intermediate or advanced requirements. Students must check with the department to see if this is the case. Any course offered by other departments not listed here must be approved by the Graduate Advisor, or they will not count towards the degree.

Computer Engineering

M.S. in Computer Engineering

The Master of Science in Computer Engineering degree requires a minimum of 45 approved credits chosen in accordance with a plan of study arranged in consultation with the student's advisor and the departmental graduate advisor. Up to but not exceeding 9 research/thesis credits may be taken by students who choose to write a Master's thesis. Students who elect a non-thesis option are also encouraged to engage in research, by registering for research credits (not exceeding 9 credits).

Core Requirements
The core requirement consists of two courses, ECEC 621 (High-Performance Computer Architecture) and ECEC 631 (Computer Network Design), which are the first courses of the computer architecture sequence and the networks sequence, respectively. Students must complete one of these two sequences. Because students need not have advanced knowledge beyond the undergraduate level to study either sequence, we plan to offer the sequences in alternating years. That will ensure a practical teaching load for the Computer Engineering faculty.

Sequence Requirement
A student’s plan of study must include at least one three-course sequence. At present, we have available five sequences in the areas of discrete mathematics in computer engineering, switching theory, computer architecture, networks, and embedded systems.

Credits Requirement
Students choosing the nonthesis option will be required to take 18 credits of computer engineering (ECEC) courses, 6 credits of electrical engineering (ECEE, ECES, ECEP) courses, 12 credits of engineering and/or mathematics and computer science courses, 6 credits of free ECE electives, and 3 credits of approved free electives. Those choosing the thesis option will be required to take 18 in ECEC courses, 6 credits in electrical engineering courses, 12 credits of engineering and/or mathematics and computer science courses, and 9 credits in thesis. The chart below summarizes this requirement in the M.S. in Computer Engineering plan of study.

Students may choose to participate in the College of Engineering Career Integrated Education (CIE), where they earn 6 academic credits for working in industry on computer engineering–related projects. Three of these credits may be used to satisfy either the “approved free elective? credits for the nonthesis option or toward satisfying the 12 required credits of engineering and/or mathematics and computer science courses for the thesis option. The students choosing the CIE option will need a total of 48 credits for graduation.

For more information on curriculum requirements, visit the Department of Electrical and Computer Engineering's Graduate Student Guide.

Non-thesis option
Computer engineering courses 18.0
Electrical engineering courses 6.0
Engineering and/or math/computer science courses 12.0
Electrical engineering or computer engineering electives 6.0
Approved free elective 3.0

Thesis option
Computer engineering courses 18.0
Electrical engineering courses 6.0
Engineering and/or math/computer science courses 12.0
M.S. thesis 9.0

All students are required to take at least two courses that emphasize development of mathematical skills required in the area of computer engineering. This requirement should be satisfied in consultation with the student’s advisor and the departmental graduate advisor.

Computer Engineering Courses
ECEC 501 Principles of Representation and Reasoning 3.0
ECEC 502 Principles of Data Analysis and Regularity Recognition 3.0

ECEC 503 Principles of Decision Making, Planning, and Control 3.0
ECEC 511 Issues in Combinational Circuit Design 3.0
ECEC 512 Issues in Sequential Circuit Design 3.0
ECEC 513 Computer Arithmetic 3.0
ECEC 621 High-performance Computer Architecture 3.0
ECEC 622 Parallel Computer Architectures 3.0
ECEC 623 Advanced Parallel Computer Architectures 3.0
ECEC 631 Principles of Computer Networking 3.0
ECEC 632 Performance Analysis of Computer Networks 3.0
ECEC 633 Advanced Topics in Computer Networks 3.0
ECEC 661 Top-down VLSI Systems Design 3.0
ECEC 662 Design for Synthesis, Testability, and Performance Modeling 3.0
ECEC 663 VLSI Array Processors 3.0
Performance Evaluation of Computer Architectures (new) 3.0
Computing Systems Security (new) 3.0

All students are required to take at least two courses that emphasize development of mathematical skills required in the area of computer engineering. This requirement should be satisfied in consultation with the student's advisor and the departmental graduate advisor.

Ph.D. Programs in Electrical and Computer Engineering

Superior students will be considered for the program leading to the degree of doctor of philosophy. The program of study is individually arranged, under supervision of a faculty advisor.

All Ph.D. applicants are required to participate in teaching, research, and the Electrical and Computer Engineering Department seminar program.

The department's offerings are focused on six general areas: Computer Engineering, Controls, Robotics & Intelligent Systems, Electrophysics, Image & Signal Processing and Interpretation, Power Engineering, Telecommunications & Networking.

Electrical Engineering

M.S. in Electrical Engineering
The Master of Science in Electrical Engineering degree requires a minimum of 45 approved credits chosen in accordance with a plan of study arranged with the permission of a student's adviser and the departmental graduate adviser. Students who complete a six-month period of internship through Drexel's Career Integrated Education (CIE) program must complete 48 credits including 6 CIE credits.

The plan must contain a selection of core courses from the department's offerings and may include appropriate graduate courses from other engineering departments or from physics or mathematics. Further information can be obtained from the department office or from the graduate adviser.

Full-time graduate students receiving teaching or research assistantships are required to complete a master's thesis, for which up to 9 credits may be earned. Other full-time and part-time students also are encouraged to engage in thesis research. The combined thesis and research cannot exceed 9 credits.

The program is organized so that a student may complete the degree requirements in two years of full-time study or three years of part-time study.

Before the end of the first quarter in the ECE department, for a full-time student, or by the end of the first year for a part-time student, the student must file, a plan of study with the graduate advisor. This must include at least six credits from departmental core courses in an area outside of his/her major area, in addition to those core courses taken in the specialty area.

Core Courses
Core courses present the subject matter that is basic to each curricular area. They are prerequisite to the more specialized courses. A minimum of 6 credits in core courses is required outside the student's major area, except in power systems. Students specializing in power systems are required to take ECEP 501, 502, and 503 and ECES 511, 512, and 513 (or ECES 521, 522, and 523). Each curricular group has a requirement of at least one full sequence of core courses

For more information on curriculum requirements, visit the Department of Electrical and Computer Engineering's Graduate Student Guide.

Electrophysics
ECEE 501 Physical Principles of Electrical Engineering I 3.0
ECEE 502 Physical Principles of Electrical Engineering II 3.0
ECEE 503 Solid-State Electronics 3.0
ECEE 507 Electromagnetic Field Analysis I 3.0
ECEE 508 Electromagnetic Field Analysis II 3.0
ECEE 509 Radiating Systems and Antennas 3.0
ECEE 517 Microwave Networks and Transmission Media 3.0
ECEE 518 Microwave Passive Components 3.0
ECEE 519 Microwave Active Subsystems 3.0

Systems

ECES 511 Fundamentals in Systems I 3.0
ECES 512 Fundamentals in Systems II 3.0
ECES 513 Fundamentals in Systems III 3.0
ECES 521 Stochastic Systems I 3.0
ECES 522 Stochastic Systems II 3.0
ECES 523 Principles of Detection Theory 3.0

Systems Power

ECEP 501 Power System Analysis 3.0
ECEP 502 Computer Analysis in Power Systems 3.0
ECEP 503 Synchronous Machine Modeling 3.0

Computer Engineering

ECEC 501 Principles of Representation and Reasoning 3.0
ECEC 502 Principles of Data Analysis and Regularity Recognition 3.0
ECEC 503 Principles of Decision Making, Planning, and Control 3.0
ECEC 511 Issues in Combinational Circuit Design 3.0
ECEC 512 Issues in Sequential Circuit Design 3.0
ECEC 513 Computer Arithmetic 3.0
ECEC 621 High-performance Computer Architecture 3.0
ECEC 622 Parallel Computer Architectures 3.0
ECEC 623 Advanced Parallel Computer Architectures 3.0
ECEC 631 Computer Network Design 3.0
ECEC 632 Performance Analysis of Computer Networks 3.0
ECEC 633 Advanced Topics in Computer Networks 3.0

Engineering Management

In our increasingly complex, technologically oriented economy, demand has risen for professionals with the expertise to manage both human and technological resources — a combination of talents crucial to organizations competing in the global marketplace. Students graduating with the M.S. in engineering management are significantly better positioned to meet the new challenge.

Engineering Management is a multidisciplinary program offering a core curriculum and specialization in a selected area of technology or management. Study can be on a part-time or full-time basis, and all courses are offered in the evening. Majors in engineering management must hold a bachelor's degree in engineering, basic science, or a related field. The program is open to those professionals who aspire to be engineering or technically based managers.

M.S. in Engineering Management

The M.S. degree requires 48 credits, including 33 credits in required core courses and 15 graduate elective credits, of which 6 or more credits are in a major area of interest. These electives may be taken in other colleges at Drexel consistent with the plan of study and any required prerequisites. Typical elective areas of specialization are listed below.

Students with a particular interest in technology or management who can satisfy the prerequisite and departmental requirements are free to select any 6- to 15-credit sequence with the approval of the program director. Alternatively, students may take the balance of required elective credits from any other graduate-level course(s) in engineering, business, or another college for which they have adequate preparation and can obtain approvals from the college and the Engineering Management program.

All candidates are urged to discuss their areas of interest with the program director and to develop a proposed plan of study during the early stages of their program.

Curriculum
Core courses Credits

Engineering Management
EGMT 501 Engineering Management I 3.0
EGMT 502 Engineering Management II 3.0
EGMT 504 Communications 3.0
EGMT 581 Problems in Human Relations 3.0

Finance & Business Policy
EGMT 531 Economics for Engineering Management 3.0
EGMT 535 Financial Management I 3.0
EGMT 536 Financial Management II 3.0
EGMT 537 Problems in Engineering Administration 3.0

Quantitative Analysis
EGMT 571 Managerial Statistics I 3.0
EGMT 572 Managerial Statistics II* 3.0
EGMT 573 Operations Research I 3.0
EGMT 574 Operations Research II 3.0
***EGMT 572 requires as a prerequisite EGMT 571 (Managerial Statistics I) or permission of the instructor. Students may take EGMT 571, but credit for it is not applicable to the degree. EGMT 571 is offered in the fall term.**

Note: Specific course requirements will be waived for students who have taken equivalent courses elsewhere.

Electives Credits

EGMT 607 Marketing for Engineer Management 3.0
EGMT 652 Engineering Law 3.0
EGMT 605 R&D Management I 3.0
EGMT 606 R&D Management II 3.0
EGMT 680 Six Sigma Planning for Engineers 3.0
EGMT 680 Special Topics: Project Management for Engineers 3.0
EGMT 680 Special Topics: Systems Methods 3.0

EGMT 680 Special Topics: Business Ethics for Engineers 3.0
EGMT 680 Special Topics: Leadership in Engineering Management 3.0
EGMT 680 Special Topics: Preventing Technological Disasters 3.0

Dual-Degree Requirements
Students may simultaneously pursue the M.S. in engineering management and another M.S. degree. Students must satisfy program requirements for each degree, with a maximum of 15 credits transferred from one program to the other. (The M.S. in engineering management requires 48 credits; if the other degree requires 45 credits, then 63 credits are required under the dual degree program.) Approval for the dual degree program must be obtained from the program advisor in each department.

Career Integrated Education Program
The Career Integrated Education program (graduate intern or co-op program) is available to master's-level engineering management students. The opportunity to spend six months in industry provides a significant opportunity for the engineer in transition to management. Through Drexel's Steinbright Career Development Center, students can explore new career directions. This program requires 6 additional credits, 3 for each term in industry.

Master of Engineering

The Master of Engineering with a practice-oriented manufacturing option, a multidisciplinary program, draws on the strengths of all the departments in the College of Engineering, as well as on the offerings of related areas within the University. Intense global competition has created a demand in American industry for engineering professionals with expertise in modern manufacturing technology, including both the management and physical aspects of manufacturing. The M.E. degree program with a practice-oriented manufacturing option is designed for working professionals and those seeking employment in a manufacturing-related industry.

The M.E. program offers wide flexibility for those students who wish to combine technical and nontechnical study with hands-on experience in industry. It is a career-focused program and may not be appropriate for those whose ultimate goal is a Ph.D. in engineering.

Master of Engineering

Program of Study

All students enrolled in the program receive the M.E. degree from the College of Engineering. Students take a series of manufacturing core courses, a set of discipline-oriented engineering courses, business core electives, and a mathematics/quantitative methods course. A six-month period of career-related employment through Drexel's Career Integrated Education (CIE) program is a requirement for full-time students. Students who are already employed as practicing engineers may apply to pursue the program on a part-time basis. A thesis is not required. The average time required to complete the master's degree is two years of full-time study or three years of part-time study.

Degree Requirements
The degree requires a total of 48 credits, including at least 18 credits from an engineering discipline core. This core may be from any engineering department: Civil and Architectural, Chemical, Electrical and Computer, Materials, or Mechanical Engineering and Mechanics. (Please refer to the appropriate departmental description in this catalog for more information about each department.) Students also complete 15 credits from the manufacturing core, which includes 6 credits in manufacturing and 9 credits of departmental manufacturing electives. Three credits of either engineering analysis or probability and statistics, 6 credits from either engineering management or the Bennett S. LeBow College of Business, and 6 credits of CIE round out the program.

Curriculum

Manufacturing core courses Credits

MEM 687 Manufacturing Processes I 3.0
MEM 689 Computer-Aided Manufacturing 3.0
Departmental manufacturing electives (see below) 9.0
Departmental engineering core 18.0
Engineering management/business requirements (see below) 6.0
Engineering analysis/probability and statistics requirement 3.0
CIE 6.0

Departmental Manufacturing Elective Courses
At least three of the following courses must be completed:
Chemical Engineering
Courses Credits

CHE 525 Transport Phenomena I 3.0
CHE 554 Process Systems Engineering 3.0
CHE 560 Transport Phenomena in Biological Systems 3.0
CHE 562 Bioreactor Engineering 3.0
CHE 564 Unit Operations in Bioprocess Systems 3.0

Civil Engineering

Courses Credits

CIVE 673 Construction Project Management 3.0
CIVE 674 Construction Contracting I 3.0
CIVE 770 Construction Process Modeling I 3.0
CIVE 771 Construction Process Modeling II 3.0
CIVE 773 Construction Management 3.0

Electrical and Computer Engineering
Courses Credits

ECEC 541 Robotics/Computer Interface and Controls I 3.0
ECEC 542 Robotics/Computer Interface and Controls II 3.0

Materials Engineering
Courses Credits

MATE 570 Materials Processing 3.0
MATE 651 Advanced Polymer Processing 3.0

Mechanical Engineering and Mechanics
Courses Credits

MEM 688 Manufacturing Processes II 3.0
MEM 717 Heat Transfer in Manufacturing Processes 3.0
MEM 727 Fluid Dynamics in Manufacturing Processes 3.0
MEM 772 Plasticity in Manufacturing 3.0
MEM 800 Special Topics: Concurrent Engineering I 3.0
MEM 800 Special Topics: Concurrent Engineering II 3.0
MEM 800 Special Topics: Engineering Finite Element Analysis 3.0

Business Core
At least two of the following courses must be completed:
LeBow College of Business
Courses Credits

POM 620 Management of Manufacturing Firms 3.0
POM 624 Management of Service Firms 3.0

Engineering Management
Courses Credits

EGMT 531 Economics for Engineering Management 3.0
EGMT 607 Marketing for Engineers 3.0
EGMT 652 Engineering Law 3.0
EGMT 680 Manufacturing Management for Engineers 3.0

Environmental Engineering

Environmental engineering is concerned with protecting human, animal, and plant populations from the effects of adverse environmental factors, including toxic chemicals and wastes, pathogenic bacteria, and global warming.

Environmental engineers also try to minimize the effect of human activities on the physical and living environment so that we can all live more healthy lives. This field builds on other branches of engineering, especially civil, chemical, and mechanical engineering. It also builds on information from many of the sciences, such as chemistry, physics, hydrology, geology, atmospheric science, and several specializations of biology (ecology, microbiology, and biochemistry). Students who elect to study environmental engineering will become familiar with many of these areas because maintaining and improving the environment requires that problems be evaluated and solutions found using a multidisciplinary approach.

Ph.D. in Environmental Engineering

Applicants to the doctoral program are judged on the basis of academic excellence and the alignment of their research interests with those of the faculty in the School. To be awarded the Ph.D., students must complete a major research project publishable in a peer-reviewed journal. The degree requires a total of 90 credits; credits earned toward a master's degree may apply toward the 90. There is no prescribed coursework -- students must take courses needed to complete their research under guidance of an academic advisor. There is a one-year residency requirement. Students must successfully pass the qualifying examination, the candidacy examination, and a Ph.D. dissertation and oral defense. Prospective Ph.D. student are welcome to contact the School to discuss their research interests.

Materials Engineering

The graduate program in Materials Engineering aims to provide an education which encompasses both the breadth and depth of the most recent knowledge base in the Materials Engineering field in a format suitable for individuals seeking careers in education and/or industry. In addition, the program provides students with research training through their course of thesis research at the M.S. and Ph.D. levels.

The graduate student body reflects a broad spectrum of undergraduate backgrounds. Students with undergraduate degrees in engineering fields, other than materials science, are encouraged to take selected undergraduate courses in materials. Because of the expansion into interdisciplinary areas, qualified physical and biological science graduates may also join the program. However, nonengineering graduates must take an appropriate number of undergraduate engineering courses to supplement their background.

Graduate work in materials engineering is offered both on a regular full-time basis and on a part-time basis. The General (Aptitude) Test of the Graduate Record Examination (GRE) is required for applicants pursuing full-time study.

A graduate seminar is required of all graduate students in the department. The seminar, which should be completed during the first year of the program, consists of an oral presentation based on a completed literature review of topics closely related to the student’s potential research area.

M.S. in Materials Engineering

A total of 45 credits is required for the M.S. degree. These include five required core courses on the structure and properties of metals, polymers, and ceramic and electronic materials; the thermodynamics of solids; and the mechanical behavior of solids.

A 3-credit course from the Department of Mathematics and Computer Science or the course in numerical methods (MATE 580), offered by the Department of Materials Engineering, fulfills the math requirement.

All full-time students are required to undertake a 9-credit thesis on a topic of materials research supervised by a faculty member and to submit a plan of study during their first year of the program. Part-time graduate students are encouraged to undertake a research thesis, but if this is not possible, a faculty-supervised 6-credit literature survey (involving a research proposal) is required.

All students are required, during their first year, to propose an advisor-supported research thesis topic or literature survey for approval by the department. Students are urged to make a choice of topic as early as possible and to choose appropriate graduate courses in consultation with their advisor. Both the research thesis and the literature survey are subject to an oral examination before the M.S. degree is awarded.

The program is organized so that part-time students may complete the degree requirements in two to four years. Full-time students may complete the program in two years.

Ph.D. in Materials Engineering

The graduate school requires at least 90 credits for the Ph.D. degree. An M.S. degree is not a prerequisite for the Ph.D. degree, but does count as 45 credits toward the 90-credit requirement. No additional courses are required for students entering the department with an M.S. degree. Students entering the department at the B.S. level must satisfy the course requirements for the M.S. degree.

Students choose a doctoral thesis topic after consultation with the faculty. Students are urged to consider topics early in the program. An oral thesis presentation and defense is scheduled at the completion of the thesis work.

In addition to the graduate seminar required of all graduate students, doctoral program students must pass a candidacy examination. This consists of two parts, a written part and an oral part. The written part consists of a four-hour examination covering the materials core course, and a four-hour examination in a specific subject area selected by the student in consultation with his or her faculty advisor and subject to approval by the department's graduate committee.

Mechanical Engineering and Mechanics

The field of mechanical engineering is rapidly changing due to advances in materials, manufacturing, and communication. Mechanical engineers must possess diverse interdisciplinary skills, including an understanding of the global, entrepreneurial and managerial abilities, and teamwork skills.

The Mechanical Engineering and Mechanics (MEM) Department offers Graduate work is offered on both a full-time and a part-time basis. The majority of courses are scheduled in the late afternoon and evening, so part-time students can take courses together with full-time students. The General (Aptitude) Test of the Graduate Record Examination (GRE) is required for applicants pursuing full-time study.

M.S. in Mechanical Engineering

The M.S. program has a two-fold mission: to prepare some students for continuation of their graduate studies and research toward a Ph.D. degree and to provide other students with a terminal professional degree to better prepare them for a career in industry.

The M.S. program is structured so that students have the opportunity to specialize in an area of interest while obtaining the broadest education possible.

M.S. candidates are required to take two core-course sequences (two terms each) from any two core areas. Candidates may choose either the thesis or nonthesis option; all M.S. students are strongly recommended to follow the thesis option.

Typical M.S. program
Two core-course sequences (required) 12.0
Three mathematics courses (required) 9.0
Eight technical electives (including 9 credits for thesis option) 24.0

Core Areas
All students take core courses in the department's areas of specialization as part of a comprehensive and flexible program. Further details can be obtained from the department's Graduate Programs Manual.

The core courses in each area are listed below:

Mechanics Area
Theory of elasticity Credits

MEM 660 Theory of Elasticity I 3.0
MEM 661 Theory of Elasticity II 3.0

Solid mechanics Credits

MEM 663 Foundations of Solid Mechanics 3.0
MEM 664 Introduction to Plasticity 3.0

Advanced dynamics Credits

MEM 666 Advanced Dynamics I 3.0
MEM 667 Advanced Dynamics II 3.0

Systems and Control Area
Robust control systems Credits

MEM 633 Robust Control Systems I 3.0
MEM 634 Robust Control Systems II 3.0

Non-linear control theory Credits

MEM 636 Theory of Nonlinear Control I 3.0
MEM 637 Theory of Nonlinear Control II 3.0

Real-time microcomputer control Credits

MEM 639 Real-Time Microcomputer Control I 3.0
MEM 640 Real-Time Microcomputer Control II 3.0

Thermal and Fluid Sciences Area
Advanced thermodynamics* Credits

MEM 601 Statistical Thermodynamics I 3.0
MEM 602 Statistical Thermodynamics II 3.0

Heat transfer
MEM 611 Conduction Heat Transfer 3.0
MEM 612 Convection Heat Transfer
or
MEM 613 Radiation Heat Transfer 3.0

Fluid mechanics*
MEM 621 Foundations of Fluid Mechanics 3.0
MEM 622 Boundary Layers: Laminar and Turbulent 3.0

***Consult the Thermal and Fluid Sciences area advisor for other options.**

Ph.D. in Mechanical Engineering

Outstanding students with a GPA of at least 3.5 in their master's program will be considered for admission to the program leading to the Doctor of Philosophy degree in mechanical engineering.

At least 90 credits are required for the Ph.D. degree. The master's degree is not a prerequisite for the Ph.D., but does count as 45 credits toward the 90-credit requirement. In addition to the 45 credits normally taken for the M.S. degree, students must take at least 18 credits of coursework (exclusive of independent study or thesis credits). The remaining 27 credits consist of a combination of dissertation, independent study, and additional advanced coursework consistent with the approved plan of study. All Ph.D. students are expected to participate in the department's seminar program, course instruction, and other academic activities.

Students who hold a B.S. degree and are currently enrolled in the MEM graduate program can take the Ph.D. candidacy examination after the completion of at least one year of graduate study at Drexel University with a minimum GPA of 3.5 in all engineering and science graduate courses. A student holding an M.S. degree that has not been granted by the MEM Department can take the Ph.D. candidacy examination after completing at least two terms of graduate study at Drexel University with a minimum GPA of 3.5 in all engineering and science graduate courses taken while in the MEM Department.

The Ph.D. candidacy examination consists of two parts, a written part and an oral part. The written part consists of one examination in applied mathematics and one examination in a major area established by the applicant and his or her advisor. Following successful completion of the written examinations, an oral examination is administered. This examination emphasizes, but is not restricted to, the student's major area.

The Ph.D. candidacy examination is given twice each year, at the beginning of the fall and spring terms. Additional details are given in the Mechanical Engineering and Mechanics Graduate Program Manual.

At least one year prior to graduation, candidates must give a presentation to the dissertation committee. The committee must approve the thesis topic and the general method of attack. A final examination consisting of a presentation and defense of the research dissertation is required, before the Ph.D. degree is granted.

Furthermore, Ph.D. students may have to take technical writing courses in fulfillment of their Ph.D. requirements. Foreign Ph.D. students are subject to the same ESL requirements as M.S. students.

Ph.D. students must comply with the University's one-year residency requirement.

Further details can be obtained from the department's Graduate Programs Manual.

M.S. in Software Engineering

The M.S. in Software Engineering (M.S.S.E.) degree program was created in response to the growing importance of software to the national infrastructure and the rapid rise in demand for professional software engineers.

All students in the M.S.S.E. program take a core curriculum that spans the scope of disciplinary areas relevant to the degree, thereby providing a common foundation for all students in the program. Students also elect an area of concentration, or track — a cohesive, more specialized set of courses that build on the core to support each student's particular career interest. Three tracks are available: information science and technology, computer science, and engineering. Students in all tracks are encouraged to participate in Drexel's Career Integrated Education (CIE) program. The average time to complete the master's degree is two years of full-time study or three years of part-time study.

Degree requirements vary by track. All students take the required six core courses (20 credits).

Core Courses
Core courses cover topics that are essential for the practicing software engineer.

Computer science courses Credits

CS 575 Software Design 3.0
CS 576 Dependable Software Systems 3.0

Electrical and computer engineering courses
ECEC 500 Fundamentals of Computer Hardware 3.0
ECEC 600 Fundamentals of Computer Networks 3.0

Information science and technology courses
INFO 627 Requirements Engineering and Management 4.0
INFO 638 Software Project Management 4.0

Total credits 20.0

Tracks
Students in each track follow the policies determined by the respective College.

Information Science and Technology Track
Track Coordinator: Dr. Gregory Hislop, 215-895-2179, hislop@drexel.edu

This track supports students interested in applying software engineering to information systems problems in commercial organizations and other settings. The principal focus is the process by which user and system requirements are converted into cost-effective, maintainable software systems. This is complemented by a concern for defining, creating, understanding, and evaluating the full range of software life-cycle products. The track places particular emphasis on systems values, such as the human-computer interface, front-end user requirements analysis, modeling and validation, and the use of off-the-shelf tools and components to assist in software processes.

Students in the information science and technology track take a total of nine track courses: four required track courses, three courses selected from the track distribution courses, and two courses selected from the distribution courses or other approved electives. This track requires a total of 56 credits, 20 of which are from the required core. CIE is available for up to six credits. Hence, the CIE option requires students to take six credits more than the non-CIE option.

Required courses Credits

INFO 608 Human-Computer Interaction 4.0
INFO 630 Evaluation of Information Systems 4.0
INFO 636 Software Engineering Process I 4.0
INFO 637 Software Engineering Process II 4.0

Distribution courses
INFO 503 Introduction to Information Systems Analysis 4.0
INFO 605 Database Management I 4.0
INFO 614 Distributed Computing and Networking 4.0
INFO 620 Information Systems Analysis and Design 4.0
INFO 646 Information Systems Management 4.0

Elective courses
INFO 603 Application Programming for Information Systems 4.0
INFO 606 Database Management II 4.0
INFO 607 Applied Information and Database Technology 4.0
INFO 616 Computer-Supported Cooperative Work 4.0

Computer Science Track
Track Coordinator: Dr. Spiros Mancoridis, 215-895-6824, mancori@mcs.drexel.edu

The computer science track welcomes students who are interested in a variety of technical topics pertaining to the development of software systems such as databases, networks, operating systems, graphics and animation systems, compilers, expert systems, and systems for scientific computing. Students will use languages and apply techniques to specify, design, implement, test, and maintain software systems.

Students in the computer science track take 9 courses in addition to the 6 core courses. Of the 9 courses, 4 courses must be from one of the six concentrations. The other 5 courses are electives that may be fulfilled by any course offered for the M.S.S.E. degree.

Students in their final 3 quarters of study who have a 3.5 GPA or better may take a 9-credit project instead of 3 elective courses. To register for a project, the student must select a project advisor (a member of the CS faculty who is willing to supervise). The project is a large-scale software development effort in which students specify, design, implement, and test a significant software system.

CIE is also available for up to 6 credits. Hence, the CIE option requires students to take 6 credits more than the non-CIE option.

Concentration courses
Computing systems concentration
CS 720 Operating Systems I 3.0
CS 721 Operating Systems II 3.0
CS 740 Computer Networks I 3.0
CS 741 Computer Networks II 3.0

Programming languages concentration
CS 559 Formal Language Theory 3.0
CS 560 Programming Languages 3.0
CS 761 Compiler Construction I 3.0
CS 762 Compiler Construction II 3.0

User interface software concentration
CS 585 Computer Graphics I 3.0
CS 586 Computer Graphics II 3.0
CS 680 Special Topics: Human-Computer Interaction 3.0
PSY 612 Psychology of Human-ComputerInteraction Design 3.0

Database systems concentration
INFO 605 Database Management I 3.0
INFO 606 Database Management II 3.0
INFO 607 Applied Information and Database Technology 4.0
INFO 612 Knowledge Base Systems 4.0

Artificial intelligence concentration
CS 590 Artificial Intelligence 3.0
CS 770 Topics in Artificial Intelligence 3.0
CS 771 Expert Systems 3.0

Scientific computation concentration Credits

CS 680 Special Topics: Computer Algebra I 3.0
CS 680 Special Topics: Computer Algebra II 3.0
CS 520 Numerical Analysis I 3.0
CS 521 Numerical Analysis II 3.0

For additional information on the Computer Science Track, as well as an FAQ, visit the Department of Computer Science's Master of Science in Software Engineering web page.

Engineering Track
Track Coordinator: Dr. P. M. Shankar, 215-895-6632, shankar@ece.drexel.edu

Students in this track pursue techniques to model engineering problems and offer software solutions. The courses in this track emphasize problems facing engineering industries including electrical, mechanical, environmental, chemical, and others. Systems modeling and simulation techniques will be used to solve these problems.

Students in this track take 25 or more credits of track courses in addition to the 20 credits of required core courses. Three computer engineering courses are required; the other courses are from one of five concentrations. A total of 45 approved graduate credits are required for the M.S.S.E., including the 20 credits of core courses. Students opting for the CIE option are required to complete 51 approved credits, including 6 CIE credits.

For more information on curriculum requirements, visit the Department of Electrical and Computer Engineering's Graduate Student Guide.

Courses Credits

ECEC 511 Issues in Combinational Circuit Design 3.0
ECEC 512 Issues in Sequential Circuit Design 3.0
ECEC 513 Design for Testability 3.0

Chemical engineering concentration Credits

CHE 554 Process Systems Engineering 3.0
CHE 658 Advanced Process Design 3.0

Civil and architectural engineering concentration Credits

CIVE 501 Model Analysis of Structures 3.0
CIVE 605 Advanced Mechanics of Materials 3.0
CIVE 701 Structural Analysis I 3.0
CIVE 702 Structural Analysis II 3.0
CIVE 703 Structural Analysis III 3.0
CIVE 704 Behavior and Stability of Structural Members I 3.0

Electrical and computer engineering concentration Credits

ECEC 621 High Performance Computer Architecture 3.0
ECEC 622 Parallel Computer Architecture 3.0
ECEC 623 Advanced Parallel Computer Architecture 3.0

NOTE: Any other ECE 600-level or above course may be eligible for credit for the Electrical and Computer Engineering concentration..
Materials engineering concentration Credits

MATE 605 Computer Simulation of Materials and Processes I 3.0
MATE 606 Computer Simulation of Materials and Processes II 3.0
MATE 670 Materials Processing I 3.0
MATE 671 Materials Processing II 3.0

Mechanical engineering and mechanics concentration Credits

MEM 534 Discrete Time Control and Estimation I 3.0
MEM 535 Discrete Time Control and Estimation II 3.0
MEM 536 Microcomputer-Based Control of Dynamic Systems I 3.0
MEM 537 Microcomputer-Based Control of Dynamic Systems II 3.0
MEM 574 Introduction to CAM 3.0
MEM 534 Reliability of Mechanical Systems I 3.0
MEM 677 Reliability of Mechanical Systems II 3.0
MEM 678 Reliability of Mechanical Systems III 3.0
MEM 681 Finite Element Methods I 3.0
MEM 682 Finite Element Methods II 3.0
MEM 683 Finite Element Methods III 3.0

Telecommunications Engineering

Fueled by the rapid spread of technologies such as electronic mail, cellular and mobile phone systems, interactive cable television, and the information superhighway, Drexel's program in Telecommunications Engineering responds to the growing demand for engineers with telecommunications expertise.

Drexel University's program in Telecommunications Engineering combines the expertise of its faculty in Electrical and Computer Engineering, Business, Information Systems, and Humanities. The program combines a strong foundation in telecommunications engineering with training in other important issues such as global communications, business aspects of telecommunications, and information transfer and processing. Through its interdisciplinary approach, Drexel's Telecommunications Engineering program trains and nurtures the complete telecommunications engineer.

Program of Study
The MSEE/Telecommunications Engineering degree is awarded to students who demonstrate in-depth knowledge of the field. All students will complete either a project in telecommunications or a six month period of internship through Drexel's Career Integrated Education (CIE) program. The average time required to complete the master's degree is two year of full-time or three years of part-time study.

M.S. in Telecommunications Engineering

The M.S.E.E./Telecommunications Engineering curriculum encompasses 45 or 48 credits (with the CIE option).

Students must complete 27 core credits: 6 credits in telecommunications theory, 9 credits in telecommunications engineering, 6 credits in advanced telecommunications engineering, 3 credits in telecommunications policy, and 3 credits in telecommunications management. Students may choose 12 to 15 credits of electives from the College of Engineering and up to 6 credits of graduate courses from the Colleges of Business and Administration, Information Science and Technology, and Arts and Sciences. Students also either choose to complete a 3-credit project, either theoretical or experimental, or to participate in 6 credits (6 months) of CIE.

For more information on curriculum requirements, visit the Department of Electrical and Computer Engineering's Graduate Student Guide.

Required Courses

Telecommunications Theory requirements
ECET 511 Telecommunications I* 3.0
ECET 512 Telecommunications II 3.0**

Telecommunications Engineering requirements
ECET 601 Telecommunications Engineering I
ECET 602 Telecommunications Engineering II
ECET 603 Telecommunications Engineering III

Advanced telecommunications engineering requirements
ECET 611 Advanced Telecommunications Engineering I 3.0
ECET 612 Advanced Telecommunications Engineering II 3.0
or
ECET 613 Advanced Telecommunications Engineering III 3.0

Non-Engineering requirements
COM 650 Telecommunications Policy 3.0
MIS 620 Telecommunications Management 3.0

The College of Information Science and Technology

Founded in 1892, the College offers programs leading to a Master of Science (Library and Information Science), a Master of Science in Information Systems (M.S.I.S.), and a Ph.D.

Both master's degree programs are offered online or on campus. The College also administers the information science and technology track of the University's multidisciplinary Master of Science in Software Engineering (M.S.S.E.) degree. Opportunities for professional development are available at the post-master's level, through non-matriculated coursework (up to 12 credits) or a post-master's certificate of advanced study (C.A.S.).
About the Goals of the College

Education

- To provide the student with a foundation for understanding, developing, and operating information systems, services, and products — including information creation, organization, communication, processing, and storage, as well as the technical, social, and human context in which information professionals operate
- To relate fundamental concepts to practical applications, and to provide the student with the

necessary skills to function as a responsive professional in a variety of specialized roles
- To ground the student in state-of-the-art information technologies

Research

- To encourage a spirit of inquiry and criticism, and to advance the theory and practice of the information professions through research and publication

Service

- To contribute to the growth and development of the information professions

The general learning objectives of the College are to prepare graduates of the degree programs to:

- Take positions of professional leadership
- Balance and integrate human and technical aspects of information systems, services, and products
- Exhibit a strong client orientation in delivering information systems, services, and products, including an understanding of the implications of a culturally diverse society
- Use a variety of information technologies and readily adopt appropriate new technologies
- Analyze people's information requirements and match them with available technologies
- Analyze the flow, structure, and use of information among people and within organizations
- Develop and defend positions on relevant social, political, and ethical issues
- Communicate effectively with others
- Develop critical thinking skills

Master of Science (Library and Information Science)

Learning Objectives of the M.S. Degree
Graduates of the M.S. program (Library and Information Science) are prepared to assume leadership positions in designing, executing, and evaluating information services and products, and managing organizations that facilitate access to recorded knowledge. Their preparation encompasses the knowledge and abilities required to:

- Describe in standard terms the major attributes of information resources
- Demonstrate knowledge of the structure and bibliographic control of literatures
- Augment access to information resources through processes such as thesaurus creation, classification, indexing, abstracting, systematic listing, and reviewing
- Select information resources appropriate for given audiences and develop appropriate information-seeking strategies
- Retrieve textual, numeric, bibliographic, image, and other information from all appropriate information sources
- Analyze or synthesize data and information for the client, in the form of digests, reviews of the literature, or technical reports
- Teach people to use information resources effectively
- Manage information organizations and the production of information services and products through planning, controlling, staffing, organizing, and leading

Accreditation
The College of Information Science and Technology is a member of the Association for Library and Information Science Education, and its M.S. program (Library and Information Science) is accredited by the American Library Association.

M.S. in Information Systems

Learning Objectives of the M.S.I.S. Degree
Graduates of the M.S.I.S. program are prepared to assume leadership and management positions designing, developing, and delivering innovative technological solutions to information problems in a variety of contexts. Their preparation encompasses the knowledge and abilities required to:

- Apply a systems approach to developing and delivering information systems and services:
- Identifying clients' information requirements
- Analyzing the flow and structure of information in user tasks and organizational processes with the appropriate formal tools and methods
- Matching requirements to technological opportunities and performing benefit/cost tradeoff analyses among design options
- Designing, implementing, and integrating specified system solutions
- Evaluating development products, including interim deliverables and
- Developing and implementing plans for maintenance and support of operational systems

- Lead and manage teams of information professionals in the development of quality systems and services:
- Understanding the business aspects of information systems development and application in organizations and
- Planning, controlling, staffing, and organizing to manage the processes for system development, services delivery, or system support
- Prepare general managers with technical information systems competencies

Ph.D. in Information Science and Technology

Purpose and Scope
The Ph.D. degree is not based on the accumulation of credits but represents a high level of scholarly achievement in both supervised and independent study and research. There are few fixed program requirements, and the master's degree is not a prerequisite for the Ph.D. The doctoral program has two major goals: to allow students to acquire in-depth knowledge of a specialized area within the field of information science and technology and to prepare students for a career in which research is a basic element, whether that career is in administration, research, or teaching.

The College of Media Arts and Design

The College of Media Arts and Design is a center for studying both the process and the products of design in the human environment and on media. Curricula concentrate on design as a process that can be defined, understood, and applied to solve human problems. Students study conceptualization and implementation of ideas within a creative environment involving aesthetics, function, ethics, technology, and the realities of the marketplace. They focus on the use of artifacts of daily life and react to creations that reflect the human condition.

Post-Professional Master of Architecture

The scope of the architectural profession is expanding, and so is its complexity. Design solutions have become more sophisticated, using many alternative approaches rarely covered in undergraduate education. These changes include:

Increased concern for the environmental impact of building

Concern for contextual variables
A renewed interest in preservation and historical design
Graduate courses provide specialized knowledge in areas of the profession not emphasized in undergraduate program, such as management, technology, and theory.

The profession recognizes that architects must advance their understanding, knowledge, and skills to deal with the changes affecting the profession. Lifelong learning is a part of architects' professional life. Many states and the American Institute of Architects require continuing education for architects to maintain registration or membership. Drexel's post-professional master's degree courses can meet those requirements.

In many universities, a Master of Architecture degree is the minimum educational requirement to teach. Newly graduated holders of a bachelor's degree can use graduate studies to satisfy internship requirements for licensure.

The work-study approach helps to manage the costs of education. This model is also employed by other Drexel graduate programs, such as the MBA.

Finally, the Drexel program provides an opportunity to pursue graduate study without interrupting a professional career. Students typically come from Philadelphia and the surrounding area, have several years of professional experience, and hold responsible positions in their firms. International students can also pursue graduate architectural studies at Drexel.

About the Program
The program requires 48 credits, consisting of a combination of graduate design studios and advanced courses and seminars.

Graduate studios offer intensive specialized investigations involving research, problem solving, theory building, and practical application. Graduate courses in three subject areas—management, history and theory, and architectural technology—let students pursue either a specialized or a general program. The department's summer study tours in Rome and Paris are also included in the graduate offerings.

This program builds upon Drexel's well-established and successful evening program, whose strength lies in its experienced and committed faculty of practicing architects who bring both practical and theoretical knowledge to the classroom. Courses utilize the assets of this practitioner-faculty as well as collaborative arrangements with other disciplines at Drexel.

Seminars are generally taught independently of studios, but the two can be integrated when subject matter and enrollment warrant it.

M.S. in Arts Administration

Students may enroll in the program on a full- or part-time basis. Classes are offered in the evening. With the exception of the internship, the entire program can be completed in the evening. Students may enter the program at the start of the fall, winter, or spring term. Full-time arts administration students may complete the degree in one and a half years.

Professional Opportunities
Graduates of the program serve in various administrative capacities with museums, historical societies, ballet and dance companies, government agencies, symphony orchestras, and philanthropic and corporate foundations.

M.S. in Fashion Design

The Design Department offers a full-time, two-year design program leading to the M.S. degree in fashion design. This is a first professional degree program that stresses the development of technical skills and research and experimentation in the business of fashion design. The curriculum is organized so that studio, laboratory, and classroom work give the graduate student a directed experience in the study of aesthetics, criticism, and contemporary art concepts; contemporary and historic art and design; current technology; the discipline of drawing; and the making of art.

The goal of the M.S. program in fashion design is to integrate the understanding of design with the construction of clothing so that the final products answer physical, aesthetic, psychological, and social needs within the context of contemporary fashion and industrial limitations. This approach provides a sound basis for a broad range of employment in the fashion industry and in education. Other professional opportunities lie in merchandising, costume design, curatorial work, and computer-aided design.

The faculty of the Design Department includes art historians, CAD specialists, designers, fiber artists, painters, and sculptors. The department also draws on practicing professionals as adjunct professors for specialized coursework and for critique of student work.

A limited number of graduate assistantships are available to students after the first year.

At Drexel, students can participate in the activities of the Fashion Group of Philadelphia, the local chapter of an international fashion industry organization. Students may also participate in the Student Fashion Group and attend trips to fashion events in New York City. The Fashion and Design and Merchandising programs produce a professionally juried annual fashion show, which provides excellent exposure for graduate students.

For more information, visit Drexel's Graduate Program in Fashion Design web page.

M.S. in Interior Design

The M.S. program in interior design is a First Professional M.S. degree program. The goal of the program is to prepare students with diverse undergraduate backgrounds to enter the field of interior design, encompassing public, commercial, and institutional spaces; offices; and residences. Program faculty includes architects, art historians, graphic designers, interior designers, painters and fine artists. The department also draws on practicing professionals as adjunct professors for specialized coursework and for critique of student work.

Student Background
The diversity of students in the program demonstrates its appeal and international reputation. Students enter the interior design program from diverse backgrounds, including liberal arts, fine arts, architecture, business, and science. Many candidates making a career change to interior design do so several years after receiving their baccalaureate degrees and after gaining experience in their original professions. Entering students are committed to intensive exploration of design in general and interior design specifically.

Professional Opportunities
Alumni are principals of their own interior design firms, project managers in major design and architectural firms, facilities managers, and design coordinators. About one-third of the students obtain entry-level employment before graduation from the program; within five years, many hold managerial positions.

Professional exposure occurs in exchanges with practitioners through professional jurying of all major student projects. Students are also encouraged to become members of local, national, and international interior design professional organizations.

A limited number of graduate assistantships are available to students after the first year.

College of Nursing and Health Professions

Drexel's College of Nursing and Health Professions' programs serve as models for experiential learning and have garnered national distinction. For example, the Physician Assistant program is one of the earliest and most well-developed programs of its kind, and the doctoral Physical Therapy program is ranked as one of the top 30 in the United States. Drexel's Couple and Family Therapy program is a leader in the culturally competent care of diverse families, and the acclaimed learn and earn BSN Co-op program is only the second of its kind in the United States.

The College of Nursing and Health Professions offers the following programs:

Family Therapy (M.F.T.)

Couple and Family Therapy (Ph.D.)

Creative Arts in Therapy (M.A)

Emergency and Public Safety Services (M.S.)

Nursing Programs (M.S.N.)

- Clinical Trials Research
- CRNA M.S.N. Completion
- Nurse Anesthesia
- Nursing Education
- Nursing Leadership and Management
- Nurse Practitioner
- Acute Care
- Family
- Pediatric
- Psychiatric Mental Health
- Woman's Care Nurse Practitioner
- Public Health Nursing
- RN-MSN Bridge Program
- Versatile Individualized Program (VIP)

Physician Assistant Studies (M.H.S.)

- Entry-level Physician Assistant Studies
- Advanced Physician Assistant Studies

Rehabilitation Sciences and Physical Therapy Programs

Entry-Level Doctor of Physical Therapy (D.P.T.)

Post-Professional Doctor of Physical Therapy (D.P.T.))

MHS and Certificate Program in Hand/Upper Quarter Rehabilitation

Doctor of Philosophy in Rehabilitation Sciences and Physical Therapy (Ph.D.)

The School of Public Health

The Drexel University School of Public Health offers exciting opportunities to those who want to make a difference in the health of communities and populations. SPH prepares graduates to have a positive effect on the health of the public. The curriculum combines knowledge of the disciplines of public health with practical applications of that knowledge. By working collaboratively with community groups, agencies, and populations, the school prepares professionals who can effectively address today's most pressing public health problems.

Public health problems have existed for centuries. Despite many important public health interventions, new problems continue to emerge: HIV/AIDS, complications of drug- and alcohol-induced premature births, tuberculosis, teenage pregnancy, substance abuse, violence, and poor diet and exercise habits. In addition, the structure of health care delivery continues to change. The public health arena needs professionals who can develop, implement, and evaluate strategies to practically and effectively address these problems.

The school prepares professionals to assess population health; to ensure appropriate services through programmatic, economic, and organizational interventions; and to develop and evaluate policy interventions.

The School of Public Health at Drexel University believes that professionals can best meet the needs of today and

tomorrow with expertise in the integration and practical application of all disciplines of public health. This belief led to the establishment of a School of Public Health unlike any other--a School whose educational and research programs are built upon partnerships with communities and the organizations that serve them.

The school defines its programs based on the needs of neighboring populations and communities and on the effective integration of the traditional public health disciplines of epidemiology, biostatistics, community health and prevention, environmental and occupational health, and management and health policy. This practical approach to learning gives our students a solid grounding in the core public health disciplines.

The School of Public Health uses problem-based learning methods to promote the skills of lifelong learning. Also, the school incorporates practical experiences throughout the curriculum. Thus, students translate what they learn into programs that make a difference in people's lives. Because personal health care and public health systems will have increasing importance in the future, the school has made the management of such systems an integral part of its educational program.

This unique approach to education and public health is typical of the University's historical willingness to break new ground. In 1848, the founders of Hahnemann University taught that there were better ways to treat patients than the harsh medical practices of the time, which included bleeding, purging and leeching. In 1850, the founders of the Medical College of Pennsylvania scandalized established medicine by starting the first medical school in the country for women. These two Philadelphia institutions joined as one and, in 2002, officially merged with Drexel University.

The School of Public Health offers a full-time Master of Public Health Program. In it, students have an opportunity to develop concentrated knowledge and skills in a selected core public health discipline (i.e. epidemiology, biostatistics, social and behavioral sciences, environmental and occupational health, or health management and policy). Students may also pursue the Executive M.P.H. Program, or the joint Doctor of Medicine and Master of Public Health degree (M.D./M.P.H.).

Master of Public Health (M.P.H.): Full-time Program

The Master of Public Health full-time program is intended for individuals interested in careers as community educators, population health planners, policy analysts, evaluators, researchers, and managers of health service delivery organizations and systems, managed-care programs, and other population-based organizations. The program is interdisciplinary and requires students to complete a comprehensive community-based master's project. It prepares students to enter an array of fields related to public health or a range of doctoral programs.

All coursework is offered within the context of culture and community.

Students are required during the second year to select a concentration in one of the school's four departments:

Biostatistics and Epidemiology
Community Health and Prevention
Environmental and Occupational Health
Health Management and Policy
With the exception of Blocks I and VIII, the curriculum is divided into discrete 8-week blocks, 10 in total, with the primary learning objectives of each block focused on one or two core disciplines of public health. In addition to group case discussion sessions, case-related activities are integral to the student experience. They include the following:

- Resource sessions (both years) provide students access to the expertise of scholars, institutional directors, and community leaders
- Case symposia (Year I) provide opportunities to write collaboratively, build collegial teams, and develop communication and public-speaking skills.
- Site visits (Year I) to community agencies, organizations, and health care providers foster an appreciation of public health in a complex urban setting.
- Concentration seminars (Year II) provide opportunities for students to pursue learning, application, and integration of knowledge within their selected major discipline.
- Service-learning workshops (Year I) allow students to combine community service with academic preparation and reflection.
- Skill development labs (both years) provide hands-on experience.

Degree Requirements
The full-time educational program is structured on a semester basis, with a total credit hour requirement of 50 credit hours. This is generally taken as a two-year program; all course work must be completed within four years of the date of matriculation for the full-time program.

A minimum of a "Satisfactory" evaluation is required in all curricular blocks for graduation. At the end of Year 1,

students select a public health major, known as the concentration area, which becomes their focus during Year 2. The community service-learning component begins in Year 1 with community site visits, service learning workshops and practicum experiences. In Year 2, the Community-Based Masters Project (CBMP) Program requires students to conduct projects that require on-site activities throughout the academic year culminating with a comprehensive paper, a poster presentation, and an oral defense.

Executive Master of Public Health Degree

Modeled on the highly successful full-time MPH program offered by the School of Public Health since 1996, the Executive Program is designed for working professionals, whether in public health or considering a career change to public health, who wish to accelerate or redirect their career. The program is tailored for individuals who are committed to advancing their careers and acquiring the knowledge and tools to advance to leadership roles in public health. The program is fast-paced, intensive and demanding but builds on each individual's former education, work experience and skills.

The MPH Executive Program is designed to enable individuals to acquire their MPH in 16 months with a convenient class schedule and intensive utilization of the internet. The class meets one Friday and one Saturday each month. Between class sessions, students utilize web-based technologies to interact with facilitators and other students with whom they may be collaborating in preparation for the next class. The curriculum is modeled on the highly successful full-time program of the school, and offers the student an intensive experience with each of the disciplines of public health.

Like the full-time MPH Program, the Executive Program covers the major disciplines of public health, including Community Health and Prevention, Environmental and Occupational Health, Epidemiology and Biostatistics, Health Management and Policy. It is case-based and built upon the Problem Based Learning (PBL) model in which the student becomes a self-directed learner as well as a collaborator in learning with her/his peers, assisted by the faculty facilitator. The PBL model develops in the student a set of skills designed to effectively address the increasingly dynamic, uncertain world in which we live and work and prepares each individual to be an effective life-long learner.

Students also have the opportunity to attend large group forums at the School of Public Health, including the twice-monthly Public Health Grand Rounds, Resource Sessions, and Workshops. Students in the Executive Program are also encouraged to participate in the School's Student Government Organization, journal clubs and other social events of the School community.

The program requires a minimum of 40 semester credits. All degree requirements must be completed within five years of the date of matriculation.

A minimum of five academic semesters, divided into blocks of residency, is required for the degree. Blocks of enrollment must be continuous unless academic leaves are granted. A minimum of a "Satisfactory" evaluation is required in all curricular blocks for graduation.

Drexel University College of Medicine Affiliated Programs

Biomedical Graduate Studies

Combined M.D./Ph.D.
Biochemistry (M.S., Ph.D.)
Microbiology and Immunology (M.S., Ph.D.)
Molecular and Cell Biology and Genetics (M.S., Ph.D.)
Molecular Pathobiology (M.S., Ph.D.)
Neuroscience(M.S., Ph.D.)
Pharmacology & Physiology (M.S., Ph.D.)

Professional Masters Degrees

The Biomedical Graduate Studies program instruction in professional areas and serves as preparation for the practice of these professions. In a certain fields, the professional degree is a prerequisite for licensure to practice.

Master of Science in Clinical Research
Master of Science in Research Management
Masters of Laboratory Animal Sciences
Certification in Laboratory Animal Sciences
Post-Baccalaureate Certification in Veterinary Medical Sciences
Master's in Medical Science

Post-Baccalaureate Pre-Medical Programs

Interdepartmental Medical Science (IMS)
Medical Science Preparatory (MSP)
Evening Post-Baccalaureate Pre-Medical (EPBPM)

The School of Biomedical Engineering, Science, and Health Systems

The School of Biomedical Engineering, Science, and Health Systems (formerly the Biomedical Engineering and Science Institute, founded in 1961) is the beneficiary of a major endowment that sponsors chair professorships and fellowships. Research and educational strengths include biosensors, biomedical ultrasound, biomedical imaging, biomedical systems and signal processing, biomechanics, biomaterials, tissue and cellular engineering, neuroengineering, cardiovascular systems, and bioinformatics and computational biomedicine.

Our faculty includes individuals with specialties in engineering, physics, mathematics, biostatistics, life sciences, medicine, and other clinical disciplines. Of the 90 Drexel faculty members associated with the School, 27 hold primary appointments in the School. Some 52 adjunct faculty members from regional institutions and industry also participate in the research and academic programs of the School.

In addition to the curriculum offered by the School, various departments at Drexel University offer courses that are suited for students in biomedical engineering and biomedical science. These courses offer advanced knowledge needed for industrial careers, health professions, graduate research, or careers in highly specialized fields.

Metropolitan Philadelphia has one of the nation's highest concentrations of medical institutions and pharmaceutical, biotechnology, and medical devices and systems industry. The School has formed an academic alliance with Thomas Jefferson University and has entered into a joint initiative in bioinformatics with the Coriell Institute for Medical Research and the Windber Research Institute. These initiatives provide students with ample opportunities in basic and clinical research as well as innovative academic programs.

Applicants to the graduate program must meet the requirements for admission to graduate studies at Drexel University. Candidates for degrees in the School of Biomedical Engineering, Science, and Health Systems are required to maintain academic standards applicable to all graduate students at Drexel University.

Biomedical Engineering

Biomedical engineering is concerned with the application of engineering and science methodologies to the analysis of biological and physiological problems and to the delivery of health care. The biomedical engineer requires the analytical tools and broad physical knowledge of modern engineering and science, fundamental understanding of the biological or physiological system, and familiarity with recent technological breakthroughs.

The biomedical engineer serves as an interface between traditional engineering disciplines and living systems and may work in either direction, applying the patterns of living organisms to engineering design or engineering new approaches to human health. Thus the biomedical engineer may use his/her knowledge of physiological systems to reverse engineer nature, creating, for example, artificial tissues and neural networks. On the other hand, a biomedical engineer may use his/her knowledge of engineering to create new equipment or environments for such purposes as maximizing human performance, accelerating wound healing, or providing non-invasive diagnostic tools.

M.S. in Biomedical Engineering

The core requirements for the master's in biomedical engineering encompass approximately 45 course credits. (Most courses carry three credits each.) A thesis is highly recommended. A non-thesis option is also offered (students who choose this option must pass a comprehensive examination.) Students who receive an assistantship or other form of assistance from the University must complete a thesis.

Curriculum
Courses Credits

BIO 501 Biochemistry Laboratory 2.0
BMES 501 Medical Sciences I: Cellular and Tissue Biology 4.0
BMES 502 Medical Sciences II: Organ-Level Physiology 4.0
BMES 503 Medical Sciences III: Neural and Endocrine Control Systems 4.0
BMES 680 Special Topics: Biosimulation I: Virtual Instrumentation 2.0
BMES 680 Special Topics: Biosimulation II: Modeling of Physiological Systems 2.0
BMES 864 Seminar 0.0

Three of the following courses 9.0

BMES 680 Special Topics: Introduction to Bioacoustics 3.0
BMES 621 Medical Imaging Systems I 3.0
BMES 641 Biomedical Mechanics I 3.0
BMES 661 Biomedical Materials I 3.0
BMES 551 Biomedical Signal Processing 3.0
INFO 503 Introduction to Information Systems Analysis 3.0
ENVR 501 Chemistry of the Environment 3.0
BMES 561 Introduction to Systems Analysis in Biology 3.0

Electives (selection varies by area of specialization) 18.0

BMES 897 Research
BMES 898 Master's Thesis*

***The research for the thesis may include work carried out during an internship.**

Biomedical Engineering: Areas of Specialization
Concentration areas in biomedical engineering include:

Biomechanics and Biomaterials
Biomechanics and biomaterials is designed to meet two objectives: to acquaint students with the responses of biological tissues to mechanical loads as well as with the mechanical properties of living systems; and to familiarize the student with natural tissues and the implants designed to replace them.

Tissue Engineering
The concentration in tissue engineering is offered jointly with the Department of Chemical and Materials Engineering. The program builds on the fundamental knowledge of natural and synthetic biomaterials and cellular biology and educates students in the emerging field of cellular and tissue engineering. Specialized courses developed for this program include Advanced Scaffold Design and Manufacturing, Factor-Mediated Tissue Engineering, Biosurfaces, Computer-Aided Tissue Engineering, Integrated CAD/CAM for Tissue Engineering Applications, and Cellular Biomechanics.

Biomedical Imaging
Biomedical imaging focuses on the theoretical and practical issues related to machine vision, image processing and analysis, and signal processing associated with such medical applications as ultrasound, optics, magnetic resonance, and autoradiographic imaging.

Human Factors and Performance Engineering
Human factors and performance engineering provides the student with the background and skills needed to create work and living environments which improve human health and enhance performance. Courses in this area of specialization cover such topics as evolutionary medicine, chronobiology, biomechanics, motor systems, human nutrition, toxicology, risk assessment, social factors in health and aging, and environmental design.

Neuroengineering
Neuroengineering is broadly defined to include the modeling of neural and endocrine systems, neural networks, complexity in physiological systems, evolutionary influences in biological control systems, neurocontrol, neurorobotics, and neuroprosthetics.

Ph.D. in Biomedical Engineering

To be awarded the Ph.D., students must complete 90 credits (credits earned toward a masterís degree may apply toward the 90), fulfill a one-year residency requirement, and successfully pass the qualifying examination, the candidacy examination, and a Ph.D. dissertation and oral defense.

The qualifying examination is intended to test students' general knowledge of biomedical engineering and science. It is a written examination that covers the basic knowledge expected of students wishing to proceed toward a Ph.D. Biomedical engineering students are also expected to demonstrate physical science aptitude and preparation.

Biomedical Science

Biomedical science is a broad field concerned with the application of fundamental biological research and quantitative analysis to human health.

The School of Biomedical Engineering, Science, and Health Systems is a nationally recognized center of research and graduate education offering multidisciplinary graduate instruction and research in biomedical engineering and science on both a full- and part-time basis. The faculty includes individuals with engineering, physics, mathematics, biostatistics, life science, medical, and clinical specialties.

M.S. in Biomedical Science

The core requirements for the degree in biomedical science encompass approximately 45 course credits. (Most courses carry three credits each.) A thesis is highly recommended. A non-thesis option is also offered (students who choose this option must pass a comprehensive examination). Students who receive an assistantship or other form of assistance from the University must complete a thesis.

One unique aspect of the school's program in biomedical science is its ability to integrate aspects of physiology and molecular biology with quantitative analysis, mathematical modeling, and computer processing to create a systems approach to biomedical research and applications. Elective courses such as Biological Controls Systems I, II, and III; Evolutionary Medicine; Human Chronobiology and Sleep I and II; and Complexity in Living Systems reflect the

school's emphasis on a multidisciplinary approaches to the most current research in biology and medicine.

Curriculum
BIO 643 Modeling Methods in Biology II 3.0
BMES 505 Mathematics for Biomedical Science I 3.0
BMES 506 Mathematics for Biomedical Science II 3.0
BMES 507 Mathematics for Biomedical Science III 3.0
BMES 510 Biomedical Statistics 3.0
BMES 511 Principles of Systems Analysis Applied to Biomedicine I 3.0
BMES 512 Principles of Systems Analysis Applied to Biomedicine II 3.0
BMES 515 C Programming for Life Scientists 3.0
BMES 681 Physics of Living Systems I 3.0
BMES 864 Seminar I 0.0

Electives 18.0

BMES 897 Research (max. 6.0)
BMES 898 Master's Thesis

Additional courses in biostatistics Credits

MATH 510 Applied Probability and Statistics I 3.0
MATH 511 Applied Probability and Statistics II 3.0
MATH 512 Applied Probability and Statistics III 3.0
STAT 620 Applied Multivariate Analysis 3.0
STAT 628 Regression and Correlation Analysis 3.0
STAT 632 Multivariate Discrete Analysis 3.0
STAT 636 Experimental Design 3.0

Biomedical Science: Areas of Specialization

Biostatistics is currently offered as a specialization in biomedical science. The program responds to the demand for life scientists with advanced training in biostatistics and experimental design. A list of courses in biostatistics is available in the M.S. in Biomedical Science curriculum.

Two new specialization areas under development are genome science and systems biology. Genome science is designed to provide students with advanced training in biochemistry, recombinant DNA technology, and information science. Systems biology trains students to deal with organisms as systems and includes coursework in biochemistry, biological control systems, cell biology, and neural networks.

Ph.D. in Biomedical Science

To be awarded the Ph.D., students must complete 90 credits (credits earned toward a master's degree may apply toward the 90), fulfill a one-year residency requirement, and successfully pass the qualifying examination, the candidacy examination, and a Ph.D. dissertation and oral defense. Prospective Ph.D. students are welcome to contact the school to discuss their research interests.

The qualifying examination is intended to test students' general knowledge of biomedical engineering and science. It is a written examination that covers the basic knowledge expected of students wishing to proceed toward a Ph.D. Biomedical science students are expected to demonstrate aptitude and preparation in life sciences, as well as an understanding of mathematics and basic principles of physical science.