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www.iit.edu

Illinois Institute of Technology

Bulletin: Graduate Programs 2006 – 2008

ILLINOIS INSTITUTE
OF TECHNOLOGY

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Bulletin:
Graduate Programs
2006 – 2008

Foreword for the IIT Graduate Bulletin 2006–2008

Purpose of the IIT Graduate Bulletin

This bulletin describes the academic programs and resources, policies, procedures and student services in effect at the time of publication. It serves as a primary source of information for graduate students, faculty and administration. Prospective students and others can also use these sections to gain an understanding of the university —its history, its campus setting, its campus life, etc.—as a whole.

The programs described in this bulletin are applicable to those students who enter Illinois Institute of Technology (IIT) in the academic years 2006-2007 and 2007-2008. Students follow the programs described in the bulletin in effect at the time of their first registration.

Changes in programs and policies often occur before a new bulletin is published. A faculty adviser from the student's major department is the best source for current curriculum information. Updates are also listed on www.grad.iit.edu. The graduate dean's office can also refer students to the appropriate administrative office for current policies and procedures.

IIT's intention is to act in accordance with all regulations of the federal, state and local governments with respect to providing equality of opportunity in employment and in education, insofar as those regulations may pertain to IIT. IIT prohibits and will act to eliminate discrimination on the basis of race, color, religion, national origin, sex, age, handicap or veteran status.

Any student, applicant or employee of IIT who believes that he or she has received inequitable treatment because of discrimination violating IIT's stated policy of equal opportunity in employment and in education should communicate, either in writing or in person, with the director of equal opportunity programs in Room 223 of Perlstein Hall on IIT's Main Campus.

Descriptions of undergraduate programs and courses are in the *IIT Bulletin: Undergraduate Programs*; descriptions of law programs and courses are in the *Chicago-Kent College of Law Bulletin*.

Note: The information in this bulletin is subject to change without notice.

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Calendar

IIT Academic Calendar for Fall

	Fall 2006	Fall 2007	Fall 2008	Fall 2009
Last day for reinstatement	Aug 8	Aug 7	Aug 5	Aug 11
Registration & orientation period	Aug 21-23	Aug 20-22	Aug 18-20	Aug 24-26
Classes begin	Aug 24	Aug 23	Aug 21	Aug 27
Labor Day Holiday	Sept 4	Sept 3	Sept 1	Sept 7
Last day to submit application for graduation (without late fee)	Sept 8	Sept 7	Sept 5	Sept 11
Last day to schedule Ph.D. comprehensive/oral examinations	Sept 8	Sept 7	Sept 5	Sept 4
Mandatory thesis discussion	Sept 20	Sept 19	Sept 17	Sept 16
Last day to remove "I" grades	Oct 6	Oct 5	Oct 3	Oct 9
Fall Break	Oct 19-21	Oct 18-20	Oct 16-18	Oct 22-23
Last day for official withdrawal	Nov 3	Nov 2	Oct 31	Nov 6
Last day to submit application for graduation (with late fee)	Nov 3	Nov 2	Nov 7	Nov 6
Last day to submit 406 forms (only for students who have applied for graduation)	Nov 3	Nov 2	Nov 7	Nov 6
Advanced registration & advising begins	Nov 6-17	Nov 5-16	Nov 3-14	Nov 9-20
Thanksgiving Day Holiday	Nov 23-25	Nov 22-24	Nov 27-29	Nov 26-27
Last day to report masters comprehensive or Ph.D. oral exam to Graduate College	Nov 24	Nov 23	Nov 28	Nov 27
Last day to deposit thesis and pay fee	Dec 1	Nov 30	Dec 5	Dec 4
Classes end	Dec 9	Dec 8	Dec 6	Dec 5
Final exam period	Dec 11-16	Dec 10-15	Dec 8-13	Dec 6-12
Commencement	Dec 17	Dec 16	Dec 14	Dec 13

IIT Academic Calendar for Spring

	Spring 2007	Spring 2008	Spring 2009	Spring 2010
Last day for reinstatement	Dec 11, 2006	Dec 17, 2007	Dec 15, 2008	Dec 14, 2009
Registration & orientation period	Jan 8-11	Jan 14-17	Jan 12-15	Jan 11-14
MLK, Jr. Holiday	Jan 15	Jan 21	Jan 19	Jan 18
Classes begin	Jan 16	Jan 22	Jan 20	Jan 19
Last day to submit application for graduation (without late fee)	Jan 26	Feb 1	Jan 30	Jan 29
Last day to schedule Ph.D. comprehensive/oral examinations	Jan 26	Feb 1	Jan 30	Jan 29
Mandatory thesis discussion	Feb 7	Feb 12	Feb 11	Feb 10
Last day to remove "I" grades	Feb 23	Feb 29	Feb 27	Feb 26
Spring vacation	Mar 12-17	Mar 17-22	Mar 15-21	Mar 15-20
Last day for official withdrawal	Mar 30	Apr 4	Apr 3	Apr 2
Last day to submit application for graduation (with late fee)	Mar 30	Apr 4	Apr 3	Apr 2
Last day to submit 406 forms (only for students who have applied for graduation)	Mar 30	Apr 4	Apr 3	Apr 2
Advanced registration & advising begins	Apr 9-20	Apr 14-25	Apr 13-25	Apr 11-22
Last day to report masters comprehensive or Ph.D. oral exam to Graduate College	Apr 27	May 2	May 1	Apr 30
Last day to deposit thesis and pay fee	May 4	May 9	May 8	May 7
Classes end	May 5	May 10	May 9	May 8
Final exam period	May 7-12	May 12-17	May 11-16	May 10-15
Commencement	May 13	May 18	May 17	May 16

IIT Academic Calendar for Summer

	Summer 2007	Summer 2008	Summer 2009	Summer 2010
Last day for reinstatement	May 15	May 14	May 13	May 19
Registration & orientation period	May 30-31	May 28-29	May 27-28	June 2-3
Classes begin	Jun 4	Jun 2	June 1	June 7
Last day to submit application for graduation (without late fee)	Jun 8	Jun 6	June 5	June 11
Last day to schedule Ph.D. comprehensive/oral examinations	Jun 8	Jun 6	June 5	June 11
Mandatory thesis discussion	Jun 13	Jun 11	June 10	June 16
Independence Day holiday	Jul 4	Jul 4-6	July 3-5	July 3-5
Last day for official withdrawal	Jul 13	Jul 11	July 10	July 16
Last day to submit application for graduation (with late fee)	Jul 13	Jul 11	July 10	July 9
Last day to submit 406 forms (only for students who have applied for graduation)	Jul 13	Jul 11	July 10	July 9
Last day to report PhD comprehensive/oral exam	Jul 13	Jul 11	July 17	July 16
Last day to deposit thesis and pay fee	Jul 20	Jul 18	July 24	July 23
End of eight-week session	Jul 28	Jul 26	July 24	July 31

Dates are subject to change. Please confirm them with the Office of Academic Affairs for each term.

Objective of Education at IIT

To provide post-baccalaureate education and research programs that enhance students' fundamental knowledge of their chosen field.

To educate and mentor graduate students to function in a global community with an appreciation of the economic, environmental, and social forces that impact professional choices.

To strengthen IIT's leadership role in higher education by focusing on the core research competencies and enhancing partnerships with industry, government laboratories, and academic and research institutions.

The Colleges of Illinois Institute of Technology

Graduate College

Ali Cinar
Dean and Vice Provost for Research
301 Main Building
3300 S. Federal St.
Chicago, IL 60616
312.567.3024
www.grad.iit.edu

The Graduate College coordinates the programs of advanced study offered by the academic units of the university. The college consists of the following offices: Office of the Dean/Vice Provost for Research; Office of Academic Affairs; Research Support Services; Center for Professional Development; Rice Campus; Technology

Transfer & Intellectual Property; Distance Learning; and the Office of Editorial Assistance (Thesis Examiner). The dean chairs the Graduate Studies Committee and the Research Council, sets minimum standards for graduate students, represents the university in national forums for graduate education, and serves as an advocate for promoting graduate education across the university.

The Master of Science (M.S.) degree, which typically includes a thesis requirement, is offered in 28 fields. The professional Master's (MAS) degree, which does not require a thesis, is offered in 33 fields. Doctoral degrees (Ph.D.) are offered in 21 fields.

College of Architecture

Donna Robertson, FAIA
Dean
S. R. Crown Hall
3360 South State Street
Chicago, IL 60616
312.567.3230
www.arch.iit.edu

The program in architecture was established at Armour Institute of Technology, one of IIT's predecessors, in 1895. In 1938, the program came under the directorship of the world-renowned architect and educator Ludwig Mies van der Rohe. The college is housed in S.R. Crown Hall, one of Mies' most significant buildings and a major contribution to Chicago's rich architectural heritage. The college emphasizes applied studio work under the tutelage of a faculty of practicing architects; the study of architectural theory; interdisciplinary learning; and international study.

The University

Armour College of Engineering

Hamid Arastoopour
Dean
Engineering 1 Building, Suite 220
10 W. 32nd St.
Chicago, IL 60616
312.567.3009
www.iit.edu/~armour

The IIT Armour College of Engineering traces its roots to Armour Institute, founded in 1892 to prepare students of all backgrounds for leadership roles – primarily as engineers – in a challenging industrial society. Armour College carries on that tradition of excellence in engineering education and research.

Today, Armour College is home to about 90 full-time faculty, more than 2,000 undergraduate and graduate students, and the graduate and undergraduate programs of five engineering departments.

Undergraduate degrees offered by Armour College are accredited by the Engineering Accreditation Commission of the Accreditation Board of Engineering and Technology. All IIT graduate and undergraduate programs are also accredited by the North Central Association (NCA).

The mission of the Armour College of Engineering is to: provide state-of-the-art education and research programs that enhance Armour's reputation as an internationally recognized engineering school; educate a new breed of engineers with a strong fundamental knowledge of engineering principles and an understanding and appreciation of the economic, environmental, and social forces that impact intellectual choices; and strengthen Armour's leadership role by focusing on the core research competencies and enhancing partnerships with industry, government laboratories, and academic and research institutions.

Institute of Business and Interprofessional Studies

Dennis Roberson
Executive Director
John Bilson
Academic Director
3424 S. State St.
Chicago, IL 60616
312.567.3947
www.iit.edu/~usb

The Institute of Business and Interprofessional Studies was established at IIT in 2003. The institute is home for the undergraduate business administration degree programs, and three co-curricular academic programs. The Leadership Academy offers seminars, the Sophomore Leadership Retreat, mentoring programs, and a certificate in leadership studies. The Entrepreneurial Studies program sponsors seminars, specialized Interprofessional Projects (EnPROs), and courses leading to a minor in entrepreneurship. The Interprofessional Projects Program supervises special team projects and applied studies (IPROs) taken by all undergraduates.

Chicago-Kent College of Law

Harold J. Krent
Dean
Downtown Campus
565 West Adams Street
Chicago, IL 60661
312.906.5000
www.kentlaw.edu

Chicago-Kent College of Law is the second oldest law school in Illinois. When it joined the university in 1969, IIT became the first major institute of technology to include law among its disciplines. Chicago-Kent offers programs leading to the degrees of Juris Doctor and Master of Laws, and participates in joint-degree programs with the Stuart School of Business and the Graduate Program in Public Administration.

Institute of Design

Patrick F. Whitney
Director
350 N. LaSalle St., Fourth Floor
Chicago, IL 60610
312.595.4900
www.id.iit.edu

The Institute of Design (ID), which was founded by Laszlo Moholy-Nagy in 1937 as the New Bauhaus, merged with IIT in 1949. Since its founding, it has grown into the largest full-time graduate design program in the U.S., and was the first school in the country to create a Ph.D. program in design.

The Institute of Design offers a Doctor of Philosophy (Ph.D.) research degree, a Master of Design (M.Des.) professional degree, and a Master of Design Methods (M.D.M.) for mid-career designers seeking advanced new methods.

Center for Professional Development

C. Robert Carlson
Director
Daniel F. and Ada L. Rice Campus
201 East Loop Road
Wheaton, IL 60187
630.682.6000
www.cpd.iit.edu

The Center for Professional Development (CPD) offers technology-oriented training and education for working professionals. Courses are taught by IIT professors and industry professionals with significant working, teaching and research experience in their fields. The CPD offers education and training in a wide variety of formats including degree, non-degree, certificate, credit and non-credit programs; corporate training; short courses; and seminars ranging from a few hours to several days in

length. Completion of all CPD non-credit courses will result in the assignment of Continuing Education Units (CEU) fully accredited by the International Association for Continuing Education and Training (IACET).

The Center for Professional Development offers undergraduate degree programs in Information Technology and Management, and Industrial Technology and Management; graduate programs in Information Technology and Management, and Industrial Technology and Operations; undergraduate certificates in Manufacturing Technology and Management and Training the Technical Trainer; a graduate certificate in Computer and Network Security Technologies; Professional Engineer (PE)/Engineering Intern (EI) Review courses and continuing education courses for Professional Engineers; and a wide variety of non-credit semester-length and short courses in all disciplines.

Institute of Psychology

M. Ellen Mitchell
Director
252 Life Sciences Building
3101 S. Dearborn St.
Chicago, IL 60616
312.567.3500
www.iit.edu/colleges/psych

Established in 1995, the Institute of Psychology was created from the Department of Psychology, previously housed within IIT's Lewis College of Liberal Arts. It is noted for its applied graduate programs in clinical, industrial/organizational and rehabilitation psychology. It offers an undergraduate program that is focused on psychology as a science linked to the professions.

College of Science and Letters

F. R. McMorris
Dean
125 E1
10 W. 32nd St.
Chicago, IL 60616
312.567.3800
www.iit.edu/~csl

The College of Science and Letters was formed in 2003 by splitting off the following departments from the Armour College of Engineering and Science: Applied Mathematics; Biological, Chemical and Physical Sciences; Computer Science; Humanities; Mathematics and Science Education; and Social Sciences. The graduate mission of the college is to deliver superior educational and research opportunities M.S. and Ph.D. degree programs as well as certificate, professional masters, and short-course programs.

Stuart School of Business

Harvey Kahalas
Dean
Downtown Campus
565 W. Adams St.
Chicago, IL 60661
312.906.6500
www.stuart.iit.edu

The Stuart School provides a distinctive graduate business education focused on the needs of business, management, and finance, with an emphasis on global and technological issues.

The School was established in 1969 with a gift from IIT alumnus and noted financier Harold Leonard Stuart. The School houses the Center for Financial Markets, the Center for Sustainable Enterprise, and the Center for the Management of Medical Technology.

The Stuart School degrees are: M.B.A., M.S. in Environmental Management, M.S. in Finance, M.S. in Financial Markets, M.S. in Marketing Communication, and Ph.D. in Management Science, and a series of dual degrees with the IIT Chicago-Kent College of Law.

Accreditation

IIT is accredited by the Higher Learning Commission of the North Central Association of Colleges and Secondary Schools (www.ncahigherlearningcommission.org 312.263.0456). Specific professional curricula are accredited by the Engineering Accreditation Commission and the Computing Accreditation Commision of the

Accreditation Board for Engineering and Technology, American Psychological Association, Council on Rehabilitation Education, American Bar Association, Association of American Law Schools, The Association to Advance Collegiate Schools of Business, and National Architectural Accrediting Board.

IIT History and Campuses

IIT's traditions span more than a century of innovation and educational leadership. IIT came into being in 1940 with the merger of Armour Institute of Technology (founded in 1892) and Lewis Institute (founded in 1896).

Today, the university has several campuses and offers degree programs through the College of Architecture, Armour College of Engineering, Institute of Business and Interprofessional Studies, Chicago-Kent College of Law, Institute of Design, Center for Professional Development, Institute of Psychology, College of Science and Letters, and Stuart School of Business.

The 120-acre Main Campus is located three miles south of the central business district in Chicago, and is internationally known for its architecture. The Master Plan of the campus and many of its 50 buildings were developed by Ludwig Mies van der Rohe, one of the century's most influential architects, and his students.

IIT's Downtown Campus, at 565 W. Adams St. in the West Loop business district, houses the Chicago-Kent College of Law, Stuart School of Business, and Master of Public Administration program. A shuttle-bus provides transportation between the Main and Downtown campuses. The Stuart School's M.B.A. program is also offered at IIT's Rice Campus.

The Institute of Design moved in January 1998 to 350 N. LaSalle St. The move provides the institute with an outstanding downtown location and state-of-the-art facilities.

The Daniel F. and Ada L. Rice Campus, at 201 E. Loop Road in Wheaton, IL, is IIT's west-suburban location. Graduate and upper-division undergraduate courses and degree programs are available at the Rice Campus via evening and Saturday classes, and via courses broadcast live through IIT Online.

The Center for Professional Development offers degree programs in information technology and management, and in industrial technology and operations, non-credit short courses, and information technology training programs.

IIT Online delivers courses via the Internet and links classroom studios on campus with remote TV receiving sites. IIT Online's talk-back feature permits students in receiving classrooms to participate in class discussions. IIT has more than 40 receiving sites throughout the Chicago area.

Moffett Campus, in southwest-suburban Summit-Argo, houses the National Center for Food Safety and Technology (NCFST), a multidisciplinary food safety research facility, which is funded by the U.S. Food and Drug Administration and the food industry. Established with a gift from CPC International, Inc., the campus has enabled the university to develop academic programs in food safety and technology. Courses leading to master's degrees and a certificate program in food safety and technology, and in food process engineering, are offered at this facility.

Chicago and Its Environs

Chicago is world-renowned for its museums and architecture, and offers exceptional career and internship opportunities in all of IIT's fields of study. The city and its surroundings form an international center of finance and law, a manufacturing and transportation hub, and the home of two national research laboratories (Argonne National Laboratory and Fermi National Accelerator Laboratory), as well as numerous medical facilities and corporate headquarters.

Diversions range from a world-class symphony orchestra to major league sports teams. Located on the southwestern shore of Lake Michigan, Chicago boasts miles of attractive beaches and parks for jogging, biking, swimming and boating. Ethnic neighborhoods throughout the city provide an international array of cultures and cuisine. Chicago is also rich in live theater, and music clubs abound.

A Snapshot of the IIT Community

Enrollment (Fall 2005)

Undergraduate	2,216 students
Graduate	3,112 students
Law	1,144 students
Total	6,472 students

Student Demographics

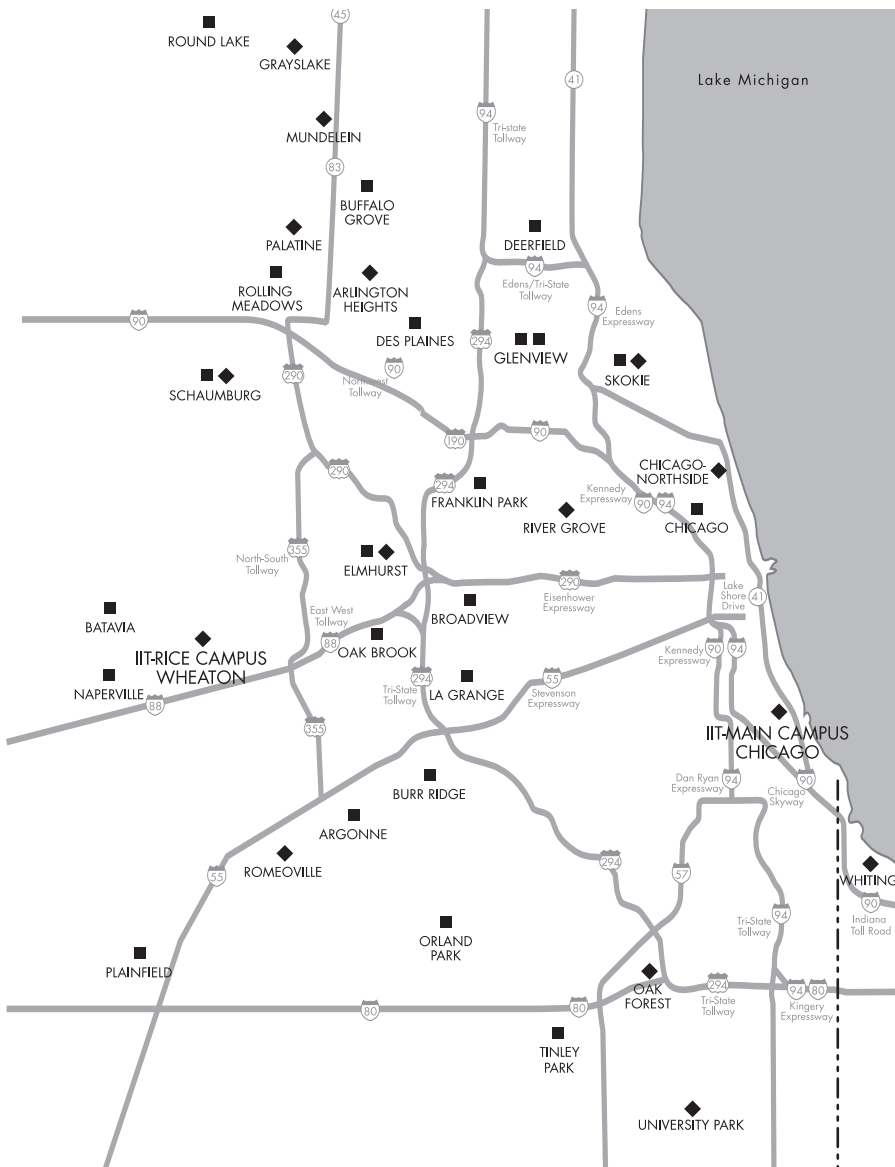|	
Male	68%
Female	32%
Minority	19%
(includes African American, Asian American, Hispanic American, and Native American)	
International	31%
Countries of Origin	105
Student/Faculty Ratio	11:1

Degrees Awarded 2004-2005

Bachelor	370
Master and Professional Master	904
Law	376
Ph.D.	62
Total	1,712

IIT Online TV Receiving Sites

Sites are subject to change. For a current list of IIT Online viewing sites and a detailed map of those public and corporate viewing sites, students should contact IIT Online by e-mail at online.clientsvc@iit.edu or visit www.iit-online.iit.edu.

◆ Public Sites:

Calumet College of St. Joseph (Whiting, IN)

College of Lake County (Grayslake)

Elmhurst College (Elmhurst)

Governors State University (University Park)

Harry S Truman College (Chicago)

IIT Daniel F. and Ada L. Rice Campus (Wheaton)

Joliet Junior College, North Campus (Romeoville)

Mundelein High School (Mundelein)

Oakton Community College, Ray Harstein Campus (Skokie)

Schaumburg Township District Library (Schaumburg)

South Suburban College University & College Center (Oak Forest)

Township H.S. District 214 – Forestview Educational Center (Arlington Heights)

Triton College (River Grove)

William Rainey Harper College (Palatine)

■ Corporate Sites:

A. Finkl and Sons (Chicago)

Andrew Corporation (Orland Park)

Argonne National Laboratory (Argonne)

Baxter Healthcare Corporation (Round Lake)

CNH Global (Burr Ridge)

Chicago Bridge and Iron (Plainfield)

Elkay Manufacturing Company (Broadview)

Elkay Manufacturing Company (Oak Brook)

Fermi National Accelerator Laboratory (Batavia)

General Motors, Electro-Motive Division (LaGrange)

Kraft Foods, Research and Development (Glenview) – Internet Only

Motorola, Inc. (Schaumburg)

MPC Products (Skokie)

Northrop Grumman Corporation (Rolling Meadows)

Panduit Corporation (Tinley Park)

Siemens Building Technologies, Inc., Landis Division (Buffalo Grove)

Tellabs (Naperville)

Teradyne Company (Deerfield)

The Chamberlain Group, Inc. (Elmhurst)

UOP, Inc. (DesPlaines)

IIT Online is IIT's distance education unit, delivering courses via the Internet and by live televised course broadcasts to public and corporate viewing sites. A "public" viewing site is a location where students registered for the appropriate section of a course may view that course live; a "corporate" site is for the use of employees of the corporation.

Campus Resources

Academic Resource Center

The Academic Resource Center (ARC), in Galvin Library, is a comprehensive center for academic excellence. Its mission is to provide both students and faculty with intellectual resources to achieve excellence through student-centered education, with an emphasis on peer tutoring.

Select undergraduate and graduate peer-tutors are available on a drop-in basis for consultation in physics, mathematics, chemistry, computer science and engineering course work during the fall and spring semesters.

The ARC hosts a state-of-the-art multimedia computer laboratory. The lab hosts an array of Macintosh, SGI, Dell and IBM PC computers, scanners, and a color laser printer. Students may learn to use discipline specific software programs from a trained ARC scholar at the laboratory.

Because faculty members in the Applied Mathematics, and Biological, Chemical and Physical Sciences departments direct the ARC, ARC tutors receive weekly preparation for current classes in these areas.

Student feedback is solicited and reviewed on a regular basis to assess the ARC's effectiveness and to provide for ongoing development.

The ARC is open from 9:30 a.m. to 7:00 p.m., Monday through Thursday, and from 9:30 a.m. to until 4:00 p.m. on Friday. The ARC also offers a weekend and late evening tutoring program at the McCormick Campus Center. For more details please visit the ARC website: http://arc.iit.edu.

Athletics and Recreation

The Department of Athletics and Recreation offers a comprehensive program of varsity sports, intramural competition, instruction and informal recreational activities for both men and women. The Scarlet Hawks men's varsity teams compete in intercollegiate baseball, basketball, cross-country, soccer, and swimming; women's varsity teams compete in cross-country, swimming, basketball, soccer, and volleyball. The university is an active member of the National Association of Intercollegiate Athletics (NAIA). For non-varsity athletes, intramural teams provide spirited competition in basketball, handball/squash, cricket, racquetball, softball, tennis, touch football, swimming, cross-country and volleyball. Recreational activities, open swimming and open free-play activities are all available. For more information, please visit www.iit.edu/~athletic.

Spiritual Life

The Campus Ministry, located in the McCormick Tribune Campus Center, works with student religious organizations on campus. These organizations sponsor activities for faith development, worship, socializing and service. The campus minister is available to all students to discuss personal or spiritual issues in a confidential setting and to help students look for opportunities for volunteering or community services. The Robert F. Carr Memorial Chapel of St. Savior was designed by Mies van der Rohe and built in 1952. It is the only building designed by Mies for religious services. The chapel is open to persons of all faiths for religious services and other appropriate uses. For additional information, students should contact Student Affairs at 312.567.3080 or email spiritual.life@iit.edu.

Career Development Center

Located on the upper level of the Galvin Library, the Career Development Center (CDC) offers individual career counseling and testing, résumé critiques, job search assistance, mock interviews, and labor market and salary data. The CDC also facilitates the Cooperative Education and Summer Internship Programs, whereby qualified students gain experience in their field of study prior to graduation. Both programs are options for domestic and international students at the undergraduate or graduate level.

The CDC conducts a variety of professional development workshops on topics including résumé and cover letter writing, job search strategies, and interviewing skills. The CDC also hosts biannual career fairs, an annual summer job fair, employer information sessions, and on-campus interviews. Career related resources, articles, workshop schedules and a link to job postings in the CDC's e-Recruiting system may be found at www.cdc.iit.edu. Individual sessions with a career counselor may be scheduled by appointment at (312) 567-6800.

Communication Across the Curriculum Program

The CAC helps students understand the role of writing and speaking in their academic and professional lives. Both on its website (http://www.cac.iit.edu) and in the CAC Writing Center, located in Siegel Hall 232, the CAC provides assistance in communication skills for academic inquiry, professional research, and the workplace. The CAC also assists IIT instructors in developing materials relevant to written, oral, electronic, and interpersonal communication in discipline-specific-courses—particularly Introduction to the Profession (ITP), writing-intensive (C-Courses), and Interprofessional Projects (IPROs). The CAC director also administers IIT's Basic Writing Proficiency requirement.

Commuter Student Services

IIT's commuter student organization, Commuter Students Association, informs commuter students about available student services and serves as a place where commuter students get to know one another and voice their concerns. The group also plans a variety of events and activities throughout the year. For more information on CSA's programming, students should consult the Office of Student Activities in the McCormick Tribune Campus Center.

Cooperative Education Program

Cooperative education is a learning approach that integrates college studies with professional working experiences in industry, business, or government. Salaries among IIT co-op students are competitive and help defray educational expenses. Frequently the co-op experience improves employment opportunities upon graduation. Full-time IIT graduate students who are in their second through fifth semesters at IIT and who have and maintain at least a 3.0 GPA are eligible to apply for the co-op program.

The co-operative education program uses three established schedules. These schedules are:

- Alternating: Students alternate terms of full-time work with full-time school. A full-time work schedule must involve the same number of work hours each week as other full-time employees. A minimum of three full-time work terms with the same employer is required.

- Sandwich: Students work three consecutive full-time work terms in twelve months.

- Parallel: Students work part-time during academic terms. Part-time employment must involve an average of 20 hours of work per week. A minimum of six consecutive part-time work terms with the same employer is required. Summer work may be full-time, and the student may register for full-time co-op for the summer, fulfilling the requirement of two part-time work terms.

Students on an alternating or sandwich schedule may take up to six hours of coursework during a work term. Students on a parallel schedule may take up to twelve hours of coursework. Coursework over these limits during a work term constitute an overload and require the approval of the associate academic dean.

Counseling Center

The Counseling Center provides professional counseling and psychological services, including evaluations and therapy for a wide variety of personal situations. These range from adjusting to a new environment to significant depression, anxiety, anger, trauma, interpersonal problems, and other difficulties. Psychological assessments are available for learning disabilities, attention deficit disorders and other conditions that may affect a student's performance and for which accommodations can be made in the classroom and for exams. Academic and career concerns are also addressed, including assistance with study skills, test taking, indecision about majors or career directions.

Services are provided by professionals with doctoral degrees in counseling and psychology and externs from local doctoral programs who are closely supervised by the Counseling Center staff. A psychiatrist is on campus one half-day a week for medication. There is no charge for most services, although there is a fee, usually covered by insurance, for appointments with the psychiatrist and medication. The Counseling Center follows the ethical and professional standards of the American Psychological Association and state laws regarding confidentiality.

In addition to individual appointments, the Counseling Center offers therapy groups, educational programs on topics such as cultural adjustment, time management, stress reduction, alcohol and drug use, communicating effectively, dating, and responsible sexual behavior. For emergencies when the Counseling Center is closed, contact Public Safety.

Campus Resources

Disability Resources

Services for persons with disabilities are coordinated by the Center for Disability Resources and Educational Development. Persons with disabilities who are interested in applying for admission to any of IIT's educational programs are invited to call the center prior to their arrival on campus to discuss their individual needs. Enrolled students with disabilities are encouraged to consult the office regarding access to IIT facilities.

Access, Card, and Parking Services

The Access, Card, and Parking Services Office issues HawkCards and parking permits for the university. The HawkCard is the picture identification card for IIT students, staff, and faculty. Not only does it serve as an ID, it also grants access to buildings, parking lots, computer labs, Keating Athletic Center, the shuttle bus, library materials' check-out services, and HawkCash balances. Permits to park in IIT lots are available for purchase on an annual, academic year, or semester basis. Students should visit Access, Card, and Parking Services in Herman Hall, Room 201 for more information, or visit www.hawkcard.iit.edu or www.parking.iit.edu.

International Center

The International Center (www.ic.iit.edu) promotes international education and cultural exchange by: 1) supporting international students, faculty and staff, as well as students studying abroad; 2) assisting in the compliance of immigration and other related regulations; and 3) providing services and resources to the IIT community. These services include: individual and group orientation to the university and community; information and advice on immigration regulations; assistance with document preparation for employment and other related non-immigrant benefits; and information and advice on study abroad programs. All international students, faculty and staff must report to the International Center immediately upon arrival at IIT.

Interprofessional Projects

The Interprofessional Projects (IPRO) Program coordinates IIT's interprofessional course, which organizes students in semester-long multidisciplinary project team sections based on real-world topics from sponsors that reflect the diversity of the workplace: corporations, entrepreneurial ventures, non-profit organizations and government agencies. The IPRO teams are self-directed, offering terrific opportunities for developing leadership potential and collaborating on interesting technical and business challenges with faculty and sponsor mentors. Entrepreneurial IPRO (EnPRO) teams address the added challenge of developing a business plan for a new venture concept. IPRO teams may include five to 15 students from all academic levels (sophomore through graduate school), and across IIT's professional programs (engineering, science, business, law, psychology, design, and architecture). Integration of both horizontal (bridging professional programs) and vertical (bridging academic levels) dimensions within a project team experience stimulates student interaction across the boundaries of individual disciplines and experiences. To learn more or to review a list of current projects, students should visit the IPRO Program Office in 3424 S. State St. room 4C7, or visit http://ipro.iit.edu.

Libraries

IIT's library system includes the Paul V. Galvin Library; the Center for the Study of Ethics in the Professions Library; the Graham Resource Center; the Louis W. Biegler Library; the Downtown Campus Library, serving the Chicago-Kent College of Law and the Stuart School of Business; the Moffett Center Library; and the University Archives.

Paul V. Galvin Library
www.gl.iit.edu
(312) 567-3616
Paul V. Galvin Library is IIT's main library, and offers an array of innovative digital services along with traditional library collections. The library's holdings include approximately 980,000 volumes, government publications, microforms, and University Archives. Galvin Library also provides 24-hour access to more than 100 electronic databases, indexing millions of articles; approximately 20,000 full-text electronic journals; e-books; electronic course reserves; and the I-Share system, a statewide resource sharing consortium of 65 university libraries. Galvin Library also provides web-based delivery of a variety of materials, including documents requested via interlibrary loan.

Graham Resource Center
www.gl.iit.edu/grc
(312) 567-3256
The Graham Resource Center (GRC) is a branch of IIT's Paul V. Galvin Library that serves the College of Architecture. The GRC houses books, journals, images, maps, and architecture-related special collections. The GRC is located on the lower level of S.R. Crown Hall.

Center for the Study of Ethics in the Professions (CSEP) Library
www.iit.edu/libraries/csep
(312) 567-6913
The CSEP Library meets the needs of students, teachers, researchers and practitioners in the field of practical and professional ethics. The Library contains a variety of materials, including codes of ethics, books, professional journals, newsletters, bibliographies, and videos dealing with such topics as autonomy, confidentiality, loyalty, conflicts of interest, and self-regulation.

Louis W. Biegler Library
www.gl.iit.edu/biegler
(630) 682-6050
Located on the Rice Campus in Wheaton, Biegler Library provides access to a small circulating print collection, reference materials, and journals, as well as digital access to all of the databases subscribed to by the Galvin Library. Services include interlibrary loan, e-reserves, Web-based document delivery, research consultations, and library instruction.

Downtown Campus Library
library.kentlaw.edu
(312) 906-5670
Serving Kent College of Law as well as the Stuart School of Business, the Downtown Campus Library is a technologically advanced facility with an outstanding law, business, and social science collection. The library houses the Library of International Relations (LIR), which contains one of the largest collections of international law materials in the Midwest and is an official depository of the United Nations and the European Union.

National Center for Food Safety & Technology Library
www.ncfst.iit.edu
(708) 563-8163
Located on the Moffett Campus, this library supports research on food technology and food safety. It is a depository library for the FAO (Food and Agriculture Organization of the United Nations.) The NCFST Library is a member of OCLC and the Illinois Metropolitan Library System.

University Archives
archives.iit.edu
(312) 567-6840
Located in the Paul V. Galvin Library, University Archives serves as a repository for information on IIT's institutional history. University Archives serves internal clients as well as outside scholars and researchers in locating and interpreting records of activities at IIT.

Multicultural Student Services

The mission of The Office of Multicultural Student Services (OMSS) addresses issues of diversity and encourages awareness and respect of all cultures globally. The OMSS serves as a clearing house for data on multicultural issues and assists the IIT community to better understand the issues that confront multicultural students.

Serving as the primary office of advocacy for students of color, women, gay/lesbian and disabled students the OMSS offers support services, educational and social programming aimed at the recruitment, retention, personal and professional development, and success of all IIT students.

Multicultural Student Services will:
· Promote and enhance multicultural opportunities for the campus;
· Prepare students to live and work in an increasingly diverse and global society; and
· Create more culturally sensitive climates on the campus and in the surrounding communities.

OMSS Services include:
· Multicultural data sources and resource library
· Workshops, seminars and networking for personal and professional development
· FIRST Program for New Students
· Traditional multicultural event planning (i.e. History Months)
· Multicultural student organization advising

Campus Resources

Research Centers

The **Center for Accelerator and Particle Physics** (CAPP) provides a locus for interdisciplinary activities at IIT aimed at the continued development of research in elementary particle physics, at developing new particle-accelerator technologies, and at education and outreach to educational institutions and to the wider business, philanthropic and general public sectors. It serves as a base to coordinate the activities of a group of IIT faculty, graduate students, and staff from various departments currently involved in a number of research programs, and will promote substantial increases in such involvement through a close working relationship with other universities in the region and with Fermilab. Daniel Kaplan, CAPP director, can be reached at 312.567.3389 or at kaplan@iit.edu. Web: www.capp.iit.edu.

The **Center for Complex Systems and Dynamics** (CCSD) provides an interdisciplinary collaborative environment for fundamental and applied research for understanding and mathematically describing complex systems; developing mathematical and computational techniques for simulating, analyzing, and modifying their behavior; and applying these methods to various complex systems of national interest. Current research areas include nonlinear and stochastic phenomena in complex systems, multiagent systems, complex networks and adaptive systems, natural and industrial ecologies, dynamics of multiphase systems, fluid turbulence, molecular level modeling of physical systems, brain electrophysiology and computational neuroscience, and transportation systems. Ali Cinar, director, can be reached at 312.567.3637 or cinar@iit.edu. Web: www.grad.iit.edu/researchcenters/ccsd/.

The **Center for Electrochemical Science and Engineering** conducts basic and applied research primarily in fuel cells and batteries, while preparing students for a career in advanced energy technology. Jai Prakash, director, can be reached at 312.567.3639. Web: www.chee.iit.edu/research/cese/cese.html.

The **Center of Excellence in Polymer Science and Engineering** is an interdisciplinary research and education center established in 1990 through a grant from the Amoco Foundation, is devoted to the advancement of polymer science and engineering. Research is conducted on synthesis, rheology, characterization and processing of polymers. Education programs include concentrations for B.S., MAS (non-thesis), M.S. and Ph.D. degrees. Jay Schieber, director, can be reached at 312.567.3046 or schieber@iit.edu. Web: www.chee.iit.edu/research/cepse.

The **Center for Integrative Neuroscience and Neuroengineering Research** (CINNR)'s mission is to foster research in systems and behavioral neuroscience at the University of Chicago and neural engineering at Illinois Institute of Technology. Work in the Center proceeds from basic science and clinical efforts and emphasizes interdisciplinary approaches to understanding the nervous system. Philip Ulinski, director, can be reached at 773-702-8081 or pulinski@uchicago.edu. Vincent Turitto, co-director can be reached at 312-567-6927 or turitto@iit.edu. Web: www.cinnresearch.org/index.html

The **Center for the Management of Medical Technology** (CMMT) is dedicated to research, education and dissemination of knowledge in the management of medical technology. The CMMT has five major research thrusts: 1) generation, adoption and utilization of medical technologies; 2) the nature of medical technology and innovation and the role it plays in health care delivery; 3) evaluation of medical technologies; 4) ethics, social implications and patient value of medical technologies, and 5) management of medical information and emerging technologies. Eliezer Geisler, director, can be reached at 312.906.6532.

The **Center for the Study of Ethics in the Professions** (CSEP) was established in 1976 to promote research and teaching on practical ethical issues in the professions. It was the first multi-disciplinary ethics center to focus on the professions. CSEP continues to be one of the nation's leading ethics centers, and is internationally recognized for its work on ethics in science and engineering. CSEP has been committed to carrying out multi-disciplinary, multi-institutional projects that introduce and propagate innovations in teaching and that produce research combining empirical investigation with conceptual analysis. This focus equips CSEP very well for the ESI component of the NNIN. Vivian Weil, director, can be reached at 312.567.3472 or weil@iit.edu. Web: www.iit.edu/departments/csep/.

The Center for Synchrotron Radiation Research and Instrumentation CSRRI promotes, coordinates, and fosters research and educational activities in synchrotron radiation science and related fields at IIT. CSRRI works not only among the core faculty, but also among faculty in other areas and at other institutions across the nation and around the world. CSRRI fosters education in x-ray sciences both at IIT and in the larger scientific community through developing training programs, academic courses and specialized short courses as well as participating in summer schools and training workshops at national and international conferences. Tom Irving, director, can be reached at 312.567.3489 or irving@iit.edu.

Electric Power and Power Electronics Center IIT has long maintained high quality education and research programs in electric power and energy systems. The mission of the Electric Power and Power Electronics Center (EPPEC) is to make significant educational, research, and practical contributions to the fields of electric power, power electronics, electric machines, motor drives, and vehicular power systems. The tasks of the Center include the sponsorship of technical studies, which will enhance the role of university faculty, manufacturers, vendors, and consumers in power engineering research and education. The Center works with centers and departments across IIT, other institutions, government agencies, and industry to sponsor research projects, short courses, conferences, and seminars. Ali Emadi, director, can be reached at 312.567.8940 or emadi@iit.edu. Web: http://power.iit.edu.

Research Centers continued

Energy +Power Center offers research and education programs that respond to the needs of the energy and power industries. The center's activities include the Energy/Environment/Economics (E3) program. Henry R. Linden, center director, can be reached at 312.567.3095 Web: www.chee.iit.edu/research/enrg_pow/enrgpow.html.

The **Energy and Sustainability Institute** develops close collaborations among numerous programs at IIT with a focus on development of energy-related inter-professional educational and research programs and proposals. The strategy of the institute is to use a least-cost path to improve energy efficiency, enhance power reliability and security, minimize pollution, and continue the decarbonization of the global energy system. IIT researchers believe that the endpoint of this evolution will be electrification of most stationary energy uses with such high-tech renewables as photovoltaic, solar-thermal and wind energy, and the use of hydrogen as the dominant transportation fuel in fuel-cell-powered electric vehicles. The institute also has plans to develop research and educational partnerships with the City of Chicago, State of Illinois, industry, national laboratories and other universities. The institute goal is to play a major role in identifying future research directions for shaping national energy policy and sustainability initiatives. Hamid Arastoopour, director, can be reached at 312.567.3038 or arastoopour@iit.edu.

The **Engineering Center For Diabetes Research and Education** (ECDRE)'s objective is to use engineering techniques to develop treatment modalities for diabetes and its many complications. ECDRE is the first center in the U.S. to focus on diabetes treatment. IIT faculty members, in collaboration with investigators and clinicians at the University of Chicago and Argonne National Laboratory, are working on a variety of diabetes-related research projects. ECDRE is a component of the Pritzker Institute of Biomedical Science and Engineering, which is developing a biomedical research thrust on the campus of IIT. Ali Cinar, director, can be reached at 312-567-3637 or cinar@iit.edu. Emmanuel Opara, co-director, can be reached at 312-567-3858 or opara@iit.edu. Web: www.ecdre.iit.edu/.

The Fluid Dynamics Research Center conducts experiments and theoretical studies on fluid flow management and control, particularly in the area of boundary layer turbulence, applying the principles of computational fluid dynamics. The center is the site of the National Diagnostic Facility, the world's largest university wind tunnel, fully dedicated to basic research, and supported by the Air Force Office of Scientific Research and the Office of Naval Research. David R. Williams, director, can be reached at 312.567.3192. Web: http://fdrc.iit.edu.

The **High Performance Computing Center** (HPCC) is based on the successful collaboration among Illinois Institute of Technology faculty and the Office of Technology Services. The HPCC serves a critical computing need among IIT researchers: the availability of high performance computing resources. In particular, the HPCC charter has three main goals: to provide expertise on the integration of new computing equipment into IIT's HPC pool; to attract external funding for HPC infrastructure; and to promote HPC at IIT. The HPCC oversees the university's central research computing resources: the 32 processor "gigawulf" Linux cluster www.iit.edu/~gigawulf.

IIT Research Institute (IITRI) is IIT's not-for-profit contract research affiliate. With a focus on biomedical research, IITRI's staff of approximately 150 scientists and technicians conducts programs for both government and commercial sponsors. Specific areas of expertise include preclinical toxicology; carcinogenesis and cancer prevention; inhalation technology; molecular biology; analytical chemistry; and biodefense. David McCormick, IITRI vice-president and director of its Life Sciences Group, can be reached at 312.567.4972. Web: www.iitri.org.

The **International Center for Sensor Science and Engineering** (ICSSE) coordinates education and research activities in sensor science and engineering. The center addresses significant national and international needs for research and development in sensor science. Current research activities include: biosensors, electrochemical sensors, nanosensors, physical sensors, computations for optimum sensor applications, pattern recognition and artificial intelligence in sensor systems, artificial chemical sensor arrays like electronic noses and tongues, prosthetic sensing like eyes, ears and noses, sensor modeling and design, the shared sensor technology user facility for extreme sensor evaluation, and sensors for chiral molecules. Sensor applications include medicine, environment, human health and safety, industrial and automotive, homeland security, and the NASA space station. Joseph Stetter, director, can be reached at 312.567.5875 or stetter@iit.edu.

The **Medical Imaging Research Center** (MIRC) at the Pritzker Institute of Biomedical Science and Engineering promotes, coordinates, and fosters research and educational activities at IIT in medical imaging and related fields. Educational programs include B.S. and Ph.D. programs in Biomedical Engineering. Current projects include: mapping the human brain, new x-ray imgaging techniques, computer-aided diagnosis, and imaging the heart. Miles Wernick, director, can be reached at 312.567.8818 or wernick@iit.edu. Web: www.mirc.iit.edu/.

The **National Center for Food Safety and Technology** (NCFST) at IIT's Moffett Campus is a consortium comprised of IIT, IITRI, the U.S. Food and Drug Administration, the University of Illinois and industrial sponsors, to advance the safety and quality of our food supply, through research and education programs and extensive pilot plant facilities in food biotechnology, food packaging and food processing. Martin Cole, director, can be reached at 708.563.1576. Web: www.ncfst.iit.edu.

Campus Resources

Research Centers continued

The **Particle Technology and Crystallization Center** (PTCC) is devoted to the development of fundamental knowledge, methods and strategies in the areas of nucleation, crystallization, particle technology, and characterization that will result in faster development of new pharmaceutical compounds, development of new solid forms, and a reduced time to bring a new compound to market. This center is a collaboration of IIT, Purdue University, and Massachusetts Institute of Technology. A unique mechanism for addressing these important problems in particle technology and crystallization in the pharmaceutical industry arises from the combination of the particle technology and crystallization group at IIT, which includes characterization facilities at the Advanced Photon Source (APS) at Argonne National Laboratory; the expertise provided by the department of Industrial and Physical Pharmacy at Purdue University in polymorphism, materials science, spectroscopic analysis, and manufacturing; and MIT in benchmarking and process analysis. The center has developed relationships to firms within the pharmaceutical industry to ascertain and address important issues that are essential to new manufacturing knowledge and development. Dimitri Hatziavramidis,director, can be reached at 312.567.5302. Web: www.grad.iit.edu/researchcenters/ptcc.

The **Pritzker Institute of Biomedical Science and Engineering** is an umbrella organization that enhances the biomedical science and engineering research activities on the IIT campus. Pritzker develops and coordinates relationships and programs with traditional science and engineering departments within IIT, as well as outside institutions, especially, Argonne National Laboratory and the University of Chicago. Vincent Turitto, director, can be reached at 312.567.5324. Web: http://www.pritzker.iit.edu/.

Through the **Thermal Processing Technology Center** (TPTC), faculty and students undertake research to support the needs of the materials processing and manufacturing industries. The center performs high quality basic and applied research in thermal processing technology of interest to the primary metals and manufacturing industry. In addition, the center provides training and education to enhance the human resources available to industry. Multi-disciplinary research teams are used to provide innovative crosscutting technological solutions to industrial materials processing problems. Philip Nash, director, can be reached at 312.567.3056. Web: http://tptc.iit.edu.

Service, Education and Outreach Centers

The **Center for Research and Service** offers professional consulting services through the Institute of Psychology at IIT. The center supports its clients through research-based solutions that improve individual, team and organizational performance. Bruce Fisher, director, can be reached at 312.567.6471. Web: www.iit.edu/~psyccrs/.

The **Center for Sustainable Enterprise** can bring the many disciplines resident at the Illinois Institute of Technology together in a collaborative relationship with business corporations, other academic institutions, government agencies and members of the NGO community to identify, develop, communicate, and help implement practical and equitable business strategies that advance the ecological sustainability of the Greater Chicago Area, while fostering our current and future economic viability. George Nassos, director, can be reached at 312.906.6543 or gnassos@stuart.iit.edu. Web: www.stuart.iit.edu/cse/home.html.

Energy/Environment/Economics (E³) is an academic program of research and coursework for students in chemical, mechanical, environmental and electrical engineering. The research program encompasses areas of specialization that relate to energy, sustainable development, industrial ecology and environmental design. Hamid Arastoopour, director, can be reached at 312.567.3038.

The **Institute for Science, Law & Technology** provides a forum to produce and disseminate knowledge on the implications and applications of science within societal and legal contexts. As part of its mission, the institute sponsors long-term, multi-disciplinary research, public conferences, judicial training, symposia for journalists, and other programs. Public programming, scholarship and research, and student educational opportunities in the Institute focuses on biotechnology, information technology, environmental science, and cross-cutting issues such as products liability, intellectual property, design of legal and market institutions, and use of technology in the courtroom. In addition, institute staff and faculty draft laws and regulations and develop other programs that guide public policy decisions. Lori Andrews, director, can be reached at 312.906.5359.

The **Invention Center** helps students and faculty develop a studio approach to engineering. The center's philosophy is project-oriented, creativity-driven and encompasses all the stages of invention, including idea generation and development. prototype development and proof-of-concept, the patent process and commercialization. Francisco Ruiz, director, can be reached at 312.567.3212. Web: www.iit.edu/~invention/.

The **Manufacturing Productivity Center** is the hub of all activities relating to manufacturing technology and management. Keith E. McKee, director, can be reached at 312.567.3650. Web: www.mtm.iit.edu/mpc.html.

The **Office of Intellectual Property and Technology Transfer** supports all IIT efforts to build and sustain relationships with corporations and other external organizations. The office coordinates the process of identifying evaluating, protecting, marketing and licensing all IIT inventions and copyrightable material. Robert Anderson, director of technology transfer and intellectual property, can be reached at 312.567.3462. Web: www.grad.iit.edu/techtr/.

Residence and Greek Life

More than half of IIT's full-time undergraduates live on campus. The Residence Life Office offers a wide range of programs and services designed to enhance campus life. The office coordinates resident advisers, student security, and the Residence Hall Association. In addition to seven residence halls, there are six fraternity houses and two sorority houses. Fraternities and sororities have very active programs, and membership is open to commuting as well as resident students. Housing for married students is available in four campus apartment buildings.

Student Activities

Co-curricular activities and events provide opportunities for students to expand their intellectual, social and recreational interests. The McCormick Tribune Campus Center (MTCC) is the site for feature films, comedians and live music. The campus center has lounges, study areas, meeting rooms, student organization offices, an auditorium, a ballroom, a cafeteria, a pub, and a recreation room. The Office of Student Activities oversees many student groups and acts as liaison between the administration and the various organizations. The campus is home to numerous student organizations including the Student Government Association (SGA), Graduate Student Association; the Residence Halls Association (RHA), which governs the hall councils; Greek Council, the governing organization for social fraternities and sororities; the National Society of Black Engineers (NSBE); Latinos Involved in Further Education (LIFE); Union Board, which plans much of the campus social and cultural activities; Technology News, the student newspaper; WIIT-FM, the student radio station; and Commuter Student's Association, the commuter student organization.

Student Affairs

The office of the Dean of Student Affairs oversees many areas of student life and serves as the primary advocate and ombudsperson for students. The office also manages the student conduct process. Students, faculty and staff are encouraged to contact the office for help or referrals. Activities outside the classroom and laboratory complement and enhance IIT's central educational mission. IIT encourages all students to participate in athletics, student organizations and professional societies. Students are also encouraged to take advantage of the cultural, educational and recreational resources on campus, as well as in the Chicago area. For additional information on activities, organizations and services, students should consult the IIT Student Handbook, available at www.iit.edu/~osa/.

Student Health Center

Health services are available for all students regardless of insurance coverage. The health service is staffed by master's prepared nurse practitioners who function as advanced practice clinicians in collaboration with a physician. Diagnosis and management of common illnesses and injuries as well as prescriptive authority is within the scope of advance practice nurses. Preventative medicine such as women's health care, immunizations, nutrition and diet information and laboratory testing are available. The health service also provides educational programs throughout the academic year and is available to assist students with wellness or information workshops. A nurse practitioner is available Monday through Friday by appointment and on a walk-in basis in emergency situations. The physician is on site approximately two hours per week. The Student Health Center also serves as the administrator of the student health insurance. The Student Health Center is in 112 Farr Hall; appointments may be made by calling 312.808.7100. Hours are from 9 a.m. to 4 p.m., Monday through Friday.

Technology Commercialization

The **Office of Intellectual Property and Technology Transfer,** www.grad.iit.edu/techtr, supports all IIT efforts to build and sustain relationships with corporations and other external organizations. The office coordinates the process of identifying, evaluating, protecting, marketing and licensing all IIT inventions and copyrightable material. Assistance with business startup issues is available Robert Anderson, director of technology transfer and intellectual property, can be reached at 312.567.3462. Dr. Myron Gottlieb, manager of technology transfer and intellectual property, can be reached at 312-567-3596 or gottlieb@iit.edu.

Campus Resources

Technology Services

The Office of Technology Services (OTS) supports IIT's primary technology systems including administrative systems, network and telephone infrastructure, and distance learning programs. OTS departments include Technology Infrastructure, Programming and Client Services, Telecommunications, and IIT Online Technical Services.

OTS maintains over 300 computers in its classrooms and public terminals throughout Main and Rice campuses. The classrooms are used for both academic courses and IIT-organized events. The computers in these classrooms are refreshed on a three-year cycle, to ensure that students have access to equipment that supports their academic goals. The instructional software in the classrooms is also reviewed every semester by the IIT Software Committee, and is updated after thorough testing for compatibility with existing lab hardware/software.

The Blackboard course management system is also maintained by OTS. The system hosts a website for every course offered at IIT and serves as a portal to IIT Online streaming media, which can be accessed by students in both online and live course sections. Instructors post notes, lectures, and assignments on the course page, which also features a discussion board and chat room. IIT Online continues to grow rapidly with an increasing number of classes being broadcast over the Internet and IITV microwave channels each semester. IIT Online also broadcasts special IIT events such as guest lectures and commencements.

The OTS Support Desk is the central point of contact for technology support at IIT. The Support Desk staff provides technical troubleshooting and administrative support for all students, faculty and staff. Services include troubleshooting, account management, and configuration assistance. The Support Desk website (http://support.iit.edu) houses a knowledge database that is available to all clients and includes how-to and self-help information for common technical issues and questions. Members of the IIT community may submit a request for technical support by opening a ticket on the support website and via email (support@iit.edu) or by calling the Support Desk at 312.567.3375 (on-campus ext. 7-DESK).

At IIT there are two options for connecting to the network, wired and wireless. Most campus buildings have wired internet access and wireless access is available in Galvin Library, most residential areas, and some academic buildings. Visit the OTS web site to view IIT's current wireless zones. Instructions for connecting to the Internet through the IIT Network, including how to configure your computer and register your wireless network card, are also available on the OTS website, http://ots.iit.edu.

The OTS website contains links to detailed information on all of the topics discussed above, as well as useful details for other services, such as e-mail and software licensing. For any questions about the services that OTS provides, the most current information can be obtained by consulting the Support Desk or OTS website.

Women's Services and Diversity Education

The office of Women's Services and Diversity Education serves as a compass for students of the IIT community to navigate through issues that confront today's society including equality, women's rights, health, social responsibility, financial education, personal enrichment, and cultural awareness. Students, faculty, staff and friends are provided services and programs that nurture leadership talents, address motivational needs, offer life-management options, advocacy, and self-assessment. Fun and creative social, cultural, and educational events are designed and administered to foster learning and growth. Pertinent resources and tools are provided to help patrons succeed in their life, school, and career. WSDE enjoys the honor of being affiliated with other great campus departments and community oganizations.

Writing Centers

Students can seek assistance with written and oral assignments at two writing centers, both located in Siegal Hall 232. First, the CAC Writing Center supplements instructional material available at the Communication Across the Curriculum website (http://www.cac.iit.edu), and primarily serves students in engineering, sciences, and computer science courses—especially those enrolled in writing-intensive courses (Introduction to the Profession, C-courses, and IPROs). Appointments may be made online at http://www.cac.iit.edu/calendar/default.asp.

Second, the Humanities Writing Center primarily serves students with assignments in history, literature, philosophy, social sciences, and art and architecture history courses. Its staff are also expert in English as a Second Language, offering special attention to students whose primary language is not English.

Graduate Degree Programs and General Requirements

The university's Armour College of Engineering, College of Architecture, Center for Professional Development, Chicago-Kent College of Law, Institute of Design, Institute of Psychology, and Stuart School of Business award graduate degrees. In many fields, students in master's programs may choose either a thesis track or non-thesis track program. These academic units also work together to offer a wide variety of joint- and dual-degree programs.

Doctoral Degrees

Applied Mathematics
Architecture
Biology
Biomedical Engineering
Chemical Engineering
Chemistry
Civil Engineering
Computer Engineering
Computer Science
Design
Electrical Engineering

Environmental Engineering
Management Science
Materials Science and Engineering
Mathematics Education
Mechanical and Aerospace Engineering
Molecular Biochemistry and Biophysics
Physics
Psychology
Science Education
Technical Communication

Law Degrees

Juris Doctor (J.D.)
Master of Laws (LL.M.)
LL.M. in Family Law
J.D./M.B.A. (joint degree)
J.D./M.S. in Environmental Management (joint degree)
J.D./LL.M. in Taxation (joint degree)

J.D./LL.M in Family Law (joint degree)
J.D./M.S. in Financial Markets (joint degree)
J.D./LL.M. in Financial Services Law (joint degree)
J.D./Master of Public Administration (joint degree)
J.D./Master of Public Health (joint degree in cooperation with University of Illinois at Chicago)

Master of Science Degrees

Applied Mathematics
Biology
Chemical Engineering
Chemistry
Civil Engineering
Computer Engineering
Computer Engineering and Electrical Engineering
    (dual degree)
Computer Science and Master of Chemical Engineering
    (dual degree)
Computer Science
Computer Science for Teachers
Electrical Engineering
Environmental Engineering
Environmental Management
Finance
Financial Markets
Food Process Engineering
Food Safety and Technology
Information Architecture
Manufacturing Engineering

Marketing Communication
Materials Science and Engineering
Mathematics Education
Mechanical and Aerospace Engineering
Molecular Biochemistry and Biophysics
Personnel and Human Resources Development
Personnel and Human Resources Development
    (dual-degree w/ B.S. in Psychology)
Physics
Psychology
Rehabilitation Counseling*
Rehabilitation Counseling
    (dual-degree w/ B.S. in Psychology)*
Science Education
Technical Communication and Information Design*

* application to these programs does not require the GRE

Graduate Degree Programs and General Requirements

Professional Master's Degrees

These programs are specifically designed with the needs of professionals in mind. Most are course-only and do not require a thesis. In addition, the GRE requirement is waived for applicants to professional master's degree programs who hold a bachelor's degree from an accredited U.S. institution with a cumulative GPA of at least 3.0/4.0.

Architecture (full-time only)
Architectural Engineering
Biological Engineering
Biology
Biomedical Imaging and Signals
Business Administration (M.B.A.)
Business Administration/
     M.S. in Environmental Management (dual degree)
Business Administration/M.S. in Finance (dual degree)
Business Administration/M.S. in Financial Markets
     (dual degree)
Business Administration/
     M.S. in Marketing Communication (dual degree)
Business Administration/
     Master of Public Administration (dual degree)
Chemical Engineering
Chemical Engineering and M.S. in Computer Science
     (dual degree)
Chemistry
Chemistry in Analytical Chemistry
Chemistry in Materials and Chemical Synthesis
Computer Science
Computer Science with a specialization in Business (MCS)
Construction Engineering and Management

Design (full-time only)
Design Methods
Electrical and Computer Engineering
Electricity Markets
Engineering in Manufacturing (via Internet)
Environmental Engineering
Food Process Engineering
Food Safety and Technology
Gas Engineering (Internet only)
Geoenvironmental Engineering
Geotechnical Engineering
Health Physics
Industrial Technology and Operations
Information Technology and Management
Landscape Architecture
Manufacturing Engineering
Master of Public Administration (M.P.A.)
Materials Science and Engineering
Mathematical Finance
Mathematics Education
Mechanical and Aerospace Engineering
Network Engineering
Nonprofit Management (M.P.A.)
Power Engineering
Public Administration (M.P.A.)
Public Works
Science Education
Structural Engineering
Telecommunications and Software Engineering
Transportation Engineering
VLSI and Microelectronics

Graduate Certificate Programs

Designed to provide knowledge in a specialized area within an academic discipline, these programs typically consist of 9–12 credit hours of coursework that might otherwise be applicable to a master's degree. Students who successfully complete graduate certificate programs and who subsequently apply for admission and are admitted to a master's degree program at IIT may apply all approved coursework taken in the certificate program and passed with a grade of "B" or better toward the master's degree. Admission to a certificate program does not guarantee future admission to a degree program.

Biological, Chemical and Physical Sciences
Analytical Method Development
Analytical Spectroscopy
Characterization of Inorganic and Organic Materials
Chromatography
Radiological Physics
Synthesis and Characterization of Inorganic Materials
Synthesis and Characterization of Organic Materials

Chemical and Environmental Engineering
(Chemical Engineering:)
Biological Engineering
Current Energy Issues (Internet only)

Food Process Engineering
Particle Processing
Pharmaceutical Engineering
Polymer Science and Engineering
Process Operations Management

(Environmental Engineering:)
Air Resources
Hazardous Waste Engineering
Indoor Air Quality
Water and Wastewater Treatment

Civil and Architectural Engineering
Construction Management
Earthquake and Wind Engineering Design
Geoenvironmental Engineering
Infrastructure Engineering and Management
Transportation Systems Planning

Computer Science
Computer Networking and Telecommunications
Information Systems
Software Engineering

Graduate Programs and General Requirements

Graduate Certificate Programs continued

Electrical and Computer Engineering
Advanced Electronics
Applied Electromagnetics
Communication Systems
Computer Engineering
Control Systems
Electricity Markets
Power Electronics
Power Engineering
Signal Processing
Wireless Communications Engineering

Mechanical, Materials and Aerospace Engineering
Computer Integrated Design and Manufacturing
Product Quality & Reliability Assurance

National Center for Food Safety and Technology
Food Process Engineering
Food Safety and Technology

Public Administration
Nonprofit Studies and Management
Public Safety and Crisis Management

Information Technology and Management
Computer and Network Security Technologies

Lewis Department of Humanities
Ethics in the Workplace: Business, Engineering and
     Government
Instructional Design
International Technical Communication
Technical Communication

Institute of Psychology
Compensation Management
Psychiatric Rehabilitation
Rehabilitation Engineering Technology

Professional Certificates

Chicago-Kent College of Law
Students must be enrolled as J.D. students to earn these
certificates:
Environmental Energy and Law
Intellectual Property Law
International and Comparative Law
Labor and Employment Law
Litigation and Alternative Dispute Resolution
Public Interest Law

College of Science and Letters
Math and Science Education: Professional Teacher
Education

Stuart School of Business

Graduate Management Certificates
(Available only to students who possess advanced degrees
in business, finance, or management.)
Entrepreneurship
Financial Management

Information Management
International Business
Management Science
Marketing
Operations, Quality, and Techology Management
Strategic Management of Organizations

Graduate Certificates
E-Business
Environmental Management
Healthcare Management
Healthcare Marketing Communication

Financial Markets Certificates
Alternative Investments
Electronic Trading
Financial Markets
Financial Programming
Portfolio Management

Undergraduate Programs

A complete description of undergraduate programs and
admission requirements is available from the Office
of Undergraduate Admission at www.iit.edu/
admission/undergrad.

Graduate Programs and General Requirements

Synopsis of Graduate Studies at IIT

The following guideline for prospective and current students shows the steps that must be taken and the forms that must be completed, signed by appropriate university officials, and submitted to the Graduate College Office of Academic Affairs in order to proceed from application to graduation to receipt of degree. The forms indicate which signatures are needed. All forms are available at www.grad.iit.edu/forms.

For applicants	Form or Application Required
1. Formal application	Regular application and all supporting materials including official transcripts, letters of recommendation, test scores (if required), professional statement, portfolio (if required) and application fee.
2. Admission decision	Admission letter from the Office of Graduate Admission outlining terms of admission offer, or informing the student that admission has been denied.

For admitted and continuing Ph.D. students	
3. Registration	Registration may be approved online at http://webforsun.cns.iit.edu/ahomepg.htm or forms signed by appropriate officials. Continuing students not enrolling for the current term must submit Form #216, Leave of Absence.
4. Approval of the program of study	Form 401 must be submitted by the student online at www.grad.iit.edu/forms/ and will be electronically approved by the faculty adviser and academic unit head/department chair. Form 406 can be submitted to revise an approved 401 form.
5. Ph.D. qualifying examination	Department administering exam submits Form #303* (if required).
6. Ph.D. comprehensive examination	Form #301A. Department submits exam results in Form #309.*
7. Fulfillment of Ph.D. residency requirement	No form needed.
8. Appointment of the thesis examining committee/ comprehensive examination committee	Form #301A.
9. Preliminary Ph.D. thesis approval	Form #501A.
10. Final Ph.D. thesis committee approval	Form #301B.
11. Final thesis defense / comprehensive examination	Department submits exam results in Form #309.*
12. Thesis fee	Bursar's receipt.
13. Ph.D. thesis approval signed by the thesis examiner	Form #501B.
14. Completion of courses and other requirements	Listed on Form #401, and Form #406 if there are modifications to Form #401
15. Application for Graduation	Application for Graduation Form. (Check deadline listed in the *Enrollment Guide* for semester of desired graduation.)
16. Fulfillment of all financial obligations to the university	
17. Commencement (attendance is voluntary)	Registrar will mail details in October and April.
18. Diploma	Registrar will mail diplomas four to six weeks after semester grades are reported.

Synopsis of Graduate Studies continued

For admitted and continuing M.S. students

3. Registration	Registration may be approved online at http://webforsun.cns.iit.edu/ahomepg.htm or forms signed by appropriate officials. Continuing students must submit Form 216, Leave of Absence.
4. Approval of the program of study	Form 401 must be submitted by the student online at www.grad.iit.edu/forms/ and will be electronically approved by the faculty adviser and academic unit head/department chair.
5. Preliminary M.S. thesis approval	Form #501A (if required).
6. Final thesis/ comprehensive examination for M.S. or MAS where applicable	Department submits Form #303. (if required).
7. Final M.S. thesis committee approval	Form #501B (if required).
8. Thesis fee (if applicable)	Bursar's receipt.
9. M.S. thesis approval signed by the thesis examiner	Form #501B.
10. Completion of courses and other requirements	Listed on Form #401 and Form #406.
11. Application for Graduation	Application for Graduation Form. (Check deadline listed in the *Enrollment Guide* for semester of desired graduation.)
12. Fulfillment of all financial obligations to the university	
13. Commencement (attendance is voluntary)	Registrar will mail details in October and April.
14. Diploma	Registrar will mail diplomas four–six weeks after semester grades are reported.

Note: Copies of the forms and applications may be obtained from the respective academic unit; the Office of Academic Affairs, 110 Main Building, 3300 S. Federal St., Chicago, IL 60616 or at 312.567.3024; or the Graduate College Web site at www.grad.iit.edu. A copy of the sequence of events for students who have applied for graduation may also be obtained from the Office of Academic Affairs or at www.grad.iit.edu.

*Forms 303 and 309, Exam Results Forms, are not given to students. Academic units send 303 and 309 forms to the Office of Academic Affairs.

Admission

Admission

Application for Admission

Application information and forms for degree and non-degree admission may be obtained from the Office of Graduate Admission by visiting www.grad.iit.edu/admission/, by calling 312.567.3020, by e-mailing grad-stu@iit.edu, or by writing to 10 W. 33rd St., Perlstein Hall, room 203, Chicago, IL 60616.

All documents submitted in support of an application must be the original or a certified copy. Documents may not be duplicated, transferred, forwarded or returned once they have been submitted to IIT. A one time application/processing fee must accompany the application. Students will find current application fees, applications and instructions at www.grad.iit.edu/admission. Students applying to Stuart School of Business, Chicago-Kent College of Law and the Institute of Design should visit their websites for information. Any applicant or student who has applied to or attended IIT previously is not required to submit an additional application fee.

Students who do not register for the semester they originally applied for must contact the Graduate Admission Office to request to defer their admission for one semester. Transcripts must be submitted for all courses attempted at other institutions that were not listed on previously submitted transcripts. Students wishing to register more than one year after the initial application must apply as a new student and resubmit all documents.

Applications and information for graduate programs in business may be obtained from Stuart School of Business by visiting www.stuart.iit.edu, by calling 312.906.6576, or by writing to the school at 565 W. Adams, Chicago, IL 60661.

Applications for programs in law may be obtained from Chicago-Kent College of Law by visiting www.kentlaw.edu, by calling 312.906.5020, or by writing to the college at 565 W. Adams, Chicago, IL 60661.

Applicatons for the College of Architecture are available by visiting www.arch.iit.edu or by phoning 312.567.3260. The college's mailing address is Crown Hall, 3360 S. State, Chicago, IL 60616.

Degree-Seeking Versus Non-Degree Status

A degree-seeking student is a registered student who submitted an application for admission as a degree-seeking student, was accepted by an academic unit in a specific degree program, and received a formal letter of admission. Degree-seeking students are required to register every semester except summer unless they receive special permission in writing for a leave of absence (Form 216) from the Graduate College, Office of Academic Affairs.

A non-degree student is a registered student who holds an undergraduate degree from an accredited institution, submitted an application for admission as a non-degree student, and was admitted. Non-degree students are those who wish to improve their professional or personal development without being required to fulfill degree requirements, are not certain about their prospective field of study at IIT, have less than a 3.0/4.0 undergraduate GPA, or are unable to submit a completed regular application prior to the beginning of the semester. Non-degree students are not accepted into a graduate degree program and are not classified as degree-seeking students. (See the section on Admission as a Non-Degree Student for procedures on becoming a degree-seeking student.)

Admission as a Degree-Seeking Student

To apply, please submit an application, including all supporting documents and application fee, prior to the published deadlines. Applications received after the specified dates will be considered only if circumstances permit. In addition to the application form, the applicant must submit the following:

1. Official transcripts, or certified copies thereof, of all academic work at the college level or above.
2. Two letters of recommendation (three for Ph.D. applicants).
3. Professional statement.
4. Required test scores.

All applicants are required to submit GRE general test scores. A minimum combined general GRE score of 1200 is required for tests taken before October 1, 2002. For tests taken on or after October 1, 2002, a minimum score of 900 (quantitative + verbal) and 2.5 (analytical writing) is required for M.S./MAS applicants. Ph.D. applicants must meet the minimum requirements of 1000 (quantitative + verbal) and 3.0 (analytical writing), for tests taken on or after October 1, 2002. Individual departments, colleges and institutes of IIT may require higher scores. Students should see the specific admissions requirements listed for each academic unit in the relevant sections of this bulletin. GRE scores may be no more than five-years old. The IIT code number is 1318. The GRE requirement is waived for applicants to professional master's degree programs who hold bachelor's degrees from an accredited degree program at a U.S. college or university with a cumulative GPA of 3.0/4.0 or higher. The required minimum cumulative undergraduate GPA for regular admission is 3.0/4.0. Students with a 2.5/4.0 GPA may be admitted as non-degree students with probationary status. (See Admission as a Non-Degree Student.)

Applicants to Chicago-Kent College of Law must submit LSAT scores and other documentation as required by the law school. Stuart School of Business applicants are required to submit GMAT and other documentation as required by the business school. Prospective students can obtain more information about admission requirements for Chicago-Kent College of Law at http://www.kentlaw.edu/ and for Stuart School of Business at http://www.stuart.iit.edu/.

Meeting the minimum required test scores and GPA does not guarantee admission. Specific requirements and factors considered by academic units in admission decisions for specific degree programs are outlined in the relevant sections of this bulletin.

Admission as a Certificate Student

Admission as a certificate student requires that the student submit the application form and official transcripts of all college-level coursework. A certificate student must possess a bachelor's degree with a cumulative GPA of 2.5/4.0. A certificate student whose bachelor's degree(s) is not in the field of certificate study or a closely related field may be required to take additional prerequisite courses that may not count toward the certificate.

Certificate students are permitted to enroll in as many credit hours as are necessary to complete the certificate. Certificate students who later apply and are admitted to a master's degree program may apply only approved certificate coursework with a grade of "B" or higher to the master's degree.

Admission as a Non-Degree Student

Citizens and permanent residents of the United States with incomplete applications, who have a minimum undergraduate GPA of 2.5/4.0, or who cannot submit required documentation by the application deadline, can apply for non-degree student admission. A final admission decision (degree-seeking admission) may be deferred until the requisite GPA has been achieved in study as a non-degree student, or until the required documents are available. Non-degree students seeking to convert to degree-seeking status must complete a regular application to a degree program prior to the completion of nine credit hours of study. If a non-degree student applies for and is granted admission to a degree program, a maximum of nine credit hours of approved coursework taken

as a non-degree student and passed with a grade of B or better may be applied to the degree. The Office of Graduate Admission will notify non-degree students of the conditions under which they are admitted. Students should also refer to the section on transfer of credit on page 33.

International students on an F-1 visa cannot be admitted as non-degree students. Non-degree students who wish to continue to take courses as non-degree students beyond nine credit hours must declare, in writing, their respective intents not to pursue a degree program to the Graduate College's Office of Academic Affairs.

Admission

International Applicant Requirements

General Requirements

International applications are incomplete until the following are received:

1. Application fee.
2. TOEFL scores (if required).
3. GRE scores.
4. Official transcripts of all academic work at the university level or above.
5. Professional statement and portfolio (if required).
6. Two letters of recommendation (three for Ph.D. applicants).

If any of these documents are not in English, the student must provide a certified English translation by a qualified translator, together with the original certified non-English credentials. A minimum combined general GRE score of 1200 is required for tests taken before October 1, 2002. For tests taken on or after October 1, 2002, a minimum score of 900 (quantitative + verbal) and 2.5 (analytical writing) is required for M.S./MAS applicants.

Ph.D. applicants must meet the minimum requirements of 1000 (quantitative + verbal) and 3.0 (analytical writing), for tests taken on or after October 1, 2002. Individual departments, colleges and institutes of IIT may require higher scores. Students should see the specific admissions requirements listed for each academic unit in the relevant sections of this bulletin. GRE scores may be no more than five-years old.

English Competency

Non-native English speakers must prove proficiency in English by submitting TOEFL scores with a score of no less than 600 (paper-based) or 100 (internet-based). Applicants with TOEFL scores above 550 (paper-based) or 213 (computer-based) or 80 (internet based) swill be admitted with the stipulation that they pass the IIT English Proficiency Review (EPR) exam upon their arrival. If they fail this exam, they will be required take any one or all of ENG 051, 052, and 053 based on the recommendation of the Humanities Department. Applicants with four or more years of undergraduate education with English as the medium of instruction will be exempt from the TOEFL and EPR exams. Applicants should have the official results sent from the Educational Testing Service to the Office of Graduate Admission, 10 W. 33rd St.,

Illinois Institute of Technology, Room 203, Chicago, IL 60616. The IIT code number is 1318.

Since fluency in the English language is a requirement for advanced degrees at IIT, any newly admitted international student whose performance on the English Proficiency Review (EPR) is not acceptable will be required to enroll in, and pass, up to nine credit hours of courses in English as a Second Language. There will be an additional tuition charge for the payment of these required courses. Courses from the English as a Second Language Program focus on various aspects of fluency in English: ENGL 051 emphasizes speaking and listening; ENGL 052 stresses reading comprehension and vocabulary building; and ENGL 053 introduces graduate students to the research paper and its standards.

Financial Support

IIT funds available to assist international students are limited and are usually awarded to a small number of selected students with outstanding academic credentials. Applicants on F-1 student visas are not eligible for part-time employment during their first year at IIT. International students must provide a certified financial affidavit from a responsible government official, or an official of a recognized financial institution, certifying that the student has (or will have available) funds to cover their entire period of study at IIT, and that the funds are free from restrictions and immediately available to cover a period equivalent to one calendar year. The I-20 or DS-2019 cannot be issued until an acceptable affidavit of financial support is received. Additional funds will be needed for travel expenses. Simple statements from parents or relatives to pay all expenses are not acceptable. Bank statements are not acceptable unless accompanied by a certified statement that the funds may be transferred to the United States for the student's use.

All credentials for international students should be received by the published deadlines. Completion of applications after that date may not allow time for a decision to be made and/or a visa to be issued for the semester requested. It is also helpful for applicants to submit a copy of their passport with their application materials, to verify accuracy of the applicant's name. Applicants are warned not to make definite arrangements for attending IIT until they have received a formal notice of admission. Students will be advised of their admission or denial as soon as possible after IIT's receipt of all credentials, usually within six weeks, unless additional information is required.

Readmission for a Second Graduate Degree

A student who earns a graduate degree at IIT is not automatically accepted as a student in a second-degree program in either the same or a different academic unit. Continuation for a second degree is contingent upon admission in the second program. Additional information is available from the Office of Graduate Admission.

Newly Admitted Students

Accompanying the admission letter will be a website link to the Intent to Enroll form, housing information, initial registration instructions, medical examination form, and an immunization form. For international students the admission packet will include the I-20 or DS-2019 and a link to the International Student Handbook. To register in the semester for which they were admitted, students must return the completed medical form and immunization form.

Arrangements for campus housing must be made directly with the Director of Housing, Illinois Institute of Technology, 3303 S. State St., Chicago, IL 60616 (phone: 312.567.5075) or email housing1@iit.edu. Admission does not include commitments for room and board. A cash deposit is required with the application for housing. In general, IIT cannot provide housing assistance for students who wish to live off campus.

Newly admitted students should consult their academic units concerning program, degree requirements and special departmental regulations, and should make every effort to arrive at IIT in time for the initial registration advising date. If students cannot arrive before the last day of late registration, the Office of Graduate Admission must be notified in writing.

Enrollment Confirmation and Deferral Requests

At the time of admission, the student should submit a non-binding *Intent to Enroll Form* at http://gradenrol.iit.edu/joiniit/joiniit.htm, or send an email to joinus@iit.edu, to reserve a place in the program. All students who wish to defer their enrollment to the subsequent semester must request the deferment by contacting the Graduate Admission Office (gradstu@iit.edu, 312.567.3020.). International students also must return the original I-20 and submit a new bank statement.

Immunization Requirement

In accordance with Illinois law, all students born on or after January 1, 1957, and enrolling at IIT for the first time after July 1, 1989, must supply health provider-documented evidence of vaccination for diphtheria, tetanus, measles, rubella and mumps. Transfer students are considered as first-time enrolled students. Students enrolling for the first time during a summer session may be permitted to enroll in the subsequent fall semester before providing proof of immunity. Students who wish to enroll only in one class per semester or via IITV at corporate sites may file a written request for an exemption. Exemption from one or more of the specific requirements may also be granted based on documented medical or religious reasons. A student who fails to provide acceptable evidence of immunity shall be prevented from registering for classes in the next semester. Individuals who are not properly immunized or who do not have proof of immunization may receive the required immunizations at the Student Health Center for a nominal fee. The Certification of Immunization form is available at http://www.iit.edu/~shc/forms/ImmunizationReq.pdf. Questions regarding this policy should be directed to the Student Health Center, Illinois Institute of Technology, 3300 S. Michigan Ave., Chicago, IL 60616, 312.808.7100 or student.health@iit.edu.

Admission

Post-Baccalaureate (UPB) Students

Applicants with bachelor's degrees who are ineligible for graduate admission may be admitted as undergraduate post-baccalaureate (UPB). In general, UPB admission may be offered to domestic applicants who are required to complete a number of prerequisite courses to improve their undergraduate performance or complete prerequisites for graduate study. These students may later be considered for admission as non-degree graduate students at IIT. Students should apply for Undergraduate Admission-UPB status through the Office of Educational Services, 101 Main Building, 312.567.3300 or go to edserve.iit.edu

ILLINOIS INSTITUTE OF TECHNOLOGY

Registration

Full-Time Versus Part-Time Status

Full-time students are regular, matriculated students that meet any of the following criteria:

a.   Register for a minimum of nine credits per semester (six credits in summer).

b.   Hold university-approved fellowships, or teaching or research assistantships, regardless of the number of credits of registration. Additional restrictions may apply to International students enrolled for less than six hours. Consult the International Center.

c.   Are occupied with an academic activity that mandates an equivalent of full-time study, regardless of the number of credits of registration. (This privilege may be used in a limited number of occasions and requires the written consent of the faculty adviser and the endorsement of the Graduate College's Office of Academic Affairs.)

Note: Full-time international students must fall into categories (a) or (b). International students enrolling less than full-time in the semester of graduation or falling into category (c) must file a petition (less than full-time eligibility) in the International Center by registration deadline. In order for the nine hours of registration to be considered full-time, only one course may be audited. International students may only take **one** online course per term, to count towards their full-time enrollment. The maximum study load for regular students is 15 credit hours per semester except by permission of the Graduate College's Office of Academic Affairs. During the summer session, the normal study load is six credit hours.

Part-time students are those who do not fulfill any of the above criteria for full-time students.

Who Should Register

Any graduate student who is using university facilities and/or faculty time must register for a minimum of one credit in fall, spring and summer semesters. A student must be registered:

1.   During the semester of qualifying and comprehensive examinations.

2.   During the semester of final thesis defense.

3.   During the semester in which the degree is awarded.

Note: Registration may be waived if all requirements are completed by the first day of class.

A graduate student who receives any type of stipend must meet the minimum registration requirements for the fall and spring semesters. Occasionally, students may need to complete an internship or thesis or dissertation fieldwork away from the university as part of their academic program; those students may petition to be considered full time while conducting field research or completing an internship if they previously satisfied the university residency requirements. The full-time equivalent for such students is one semester credit. The petition must be endorsed by the student's adviser and academic unit head, and forwarded to the Graduate College's Office of Academic Affairs for approval.

Course Numbering

Course numbers 100–399 are primarily used for undergraduate courses. Courses 400–499 may be used for minor credit or as prerequisites when taken as part of an approved graduate program (see department require-ments: a maximum of 12 credit hours of 400 level classes may be included). Courses numbered 500–799 are graduate level and are primarily for graduate students; the grade earned by graduate students must be a "C" or better.

Course Description

Course descriptions are available in the Academic Programs section of this bulletin and online at www.enrollment.iit.edu—go to IIT Web for Students Course Descriptions.

Registration

Registration for Fall and Spring Semesters

Specific procedures and regulations for registration are found each semester in the *Enrollment Guide* or at www.enrollment.iit.edu, under IIT Web for Students. The schedule for the spring semester is available the second week of November, and schedules for the summer session and the fall semester are available the second week of April. Students who were admitted to, but did not attend, IIT must be readmitted by the Office of Graduate Admission before they can register. Continuing students may register for classes through regular registration procedures either online, in person, by fax or by mail through selected registration locations or online at www.enrollment.iit.edu. For those people registering by fax or by mail, IIT Registration Forms are also available through download at www.enrollment.iit.edu, go to Forms.

All graduate students registering for research courses numbered 591, 594, 597 and 691 must receive written or online approval from their faculty adviser before registration. These registrations may be completed through web registration if an online permit is submitted by the course advisor/instructor.

Newly admitted and continuing students may register in advance in November (for spring) or April (for summer or fall) of each year. Students may also register in August (for fall), January (for spring) or in May and June (for summer). Registration confirmations are sent via email within 24 hours of completing registration. For questions concerning registration procedures, students should contact the Student Services Center at 312.567.3100 or at student.services@iit.edu.

Registration for T.A. Seminar

All new teaching assistants are required to register for a zero-credit hour T.A. Seminar (department's course number 601) given every fall semester.

Registration for Continuation of Residence

Degree-seeking students in the final semester are allowed to register for one semester of non-credit, or a continuation of residence (course number 600), for a fee equivalent to one credit hour.

IPRO Registration

Graduate students may serve as project leaders on an Interprofessional Project (IPRO). A student who wishes to do so must first consult his or her academic adviser and the project adviser. With the approval of both, the student should register for IPRO 597.

Change of Registration After Initial Registration

The term "change of registration" means adding a course (a "course" includes courses, projects or research courses/hours); dropping a course; shifting from one section to another in the same course; or changing the number of credits in a variable-credit course (e.g., research hours). A course may not be added or changed to another section after the first week of course instruction.

The Change of Registration Form may be obtained from the Student Services Center in 104 Main Building on the Main Campus or at www.enrollment.iit.edu under Forms. Students may also change their schedule at www.enrollment.iit.edu, in person at the Student Services Center, by fax to 312.567.3313, or by mail to the Student Services Center, 104 Main Building, 3300 S. Federal St., Chicago, IL 60616. A course may be dropped during the first two weeks of the regular semester for refund or credit, and during the first week of the summer semester. A course may be withdrawn with no refund or credit between the third and the tenth week of the semester. No courses may be withdrawn after the withdrawal deadline; extenuating circumstances must be petitioned for review in the Graduate College, Office of Academic Affairs. No registration change or withdrawal is official until the form is approved by the Student Services Center. Notifying the instructor or merely discontinuing course attendance is not sufficient for withdrawal. The date of the withdrawal slip will be the official date of withdrawal. All billing inquiries related to registration changes may be referred to the Student Services Center. International students are required to remain full-time, i.e. carry nine credit hours of study and may not change their registration to become part-time except in the semester of graduation. (Students should refer to the note on page 29.)

Students are allowed to change registration to Audit up to the tenth week of the semesster. Full-time International students can take up to 3 credits of Audit

Withdrawal from the University

Students who wish to withdraw should first consult their academic adviser. The adviser may be able to suggest resources or alternate solutions to the student's problems. International students wishing to withdraw are required to consult the foreign student adviser in the International Center as well. For withdrawal, regular graduate students must fill out a Withdrawal Form (Form #217) and an Add/Drop Form, which are to be approved by the academic adviser, academic unit head and the Graduate College, Office of Academic Affairs. Withdrawal from IIT is not complete until an official Add/Drop Form is approved in the Student Services Center.

Undergraduates Registering for Graduate Courses

An undergraduate degree-seeking student who wishes to enroll in a graduate 500-level course must first obtain written approval from the course instructor and faculty adviser stating that the student is qualified. Undergraduate students registering for more than nine credit hours of graduate courses must also obtain written approval from the Graduate College, Office of Academic Affairs. This approval must be presented at the time of registration. An undergraduate non-degree student may be permitted to enroll in a graduate 500 level course in certain instances, but will require the permission of the Office of Educational Services and the Graduate College's Office of Academic Affairs. All undergraduate students who enroll in graduate courses are governed by the graduate grading system for those courses. Failure to obtain the appropriate approvals may prevent transfer of credits earned into graduate degree programs at IIT. No credits approved toward the undergraduate-degree requirements will transfer into any graduate program at IIT. Students should consult the rules for transfer of credit on page 33.

Academic Policies for Continuation of Studies

Leave of Absence

Degree-seeking students who intend to leave IIT for one semester or more must file a Leave of Absence Form (Form 216). A leave of absence will not be granted for more than one year, at which time, a request for an extension of leave may be submitted. A leave of absence will not extend the time limit required for the completion of a degree. A leave will not be approved after the sixth week of the current semester. Students who have not renewed their leaves of absence and have not registered for courses as of the end of their respective leaves must petition for reinstatement to the Graduate College, Office of Academic Affairs. Degree-seeking students who do not plan to return to the program should submit the Withdrawal Form (#217). Non-degree students are not required to file a Leave of Absence Form. Students should consult the procedures for filing a petition on page 43.

Note: International students must also receive approval from the International Center. If an international student wishes not to enroll in a given term, the leave of absence should be approved by the interntional center, by the registration deadline of that term.

Reinstatement and Enrollment After an Absence

Degree-seeking graduate students who discontinue their studies without an official request for leave of absence may later be refused reinstatement or enrollment at IIT. Students with an unofficial interruption of studies must petition for reinstatement to the Graduate College's Office of Academic Affairs. Students should contact the Graduate College, Office of Academic Affairs for additional information. Procedures for filing a petition are on page 43.

Grade Point Average

Satisfactory performance in the graduate divisions (except the Stuart School) is defined as the maintenance of a minimum cumulative GPA of 3.0/4.0, as reported by the registrar. The minimum GPA for graduation is 3.0/4.0. This figure is based only on those courses that appear on the approved program of study and not on the total cumulative GPA reported by the registrar; there is no exception or waiver to this rule. If a student repeats a course, the last grade issued for the course will be used to compute the cumulative GPA and the program of study GPA. Students should consult the section on repeating a course on page 35.

Academic Probation

A student whose cumulative GPA falls below 3.0/4.0 is no longer in good standing and must petition the Graduate College, Office of Academic Affairs for permission for provisional enrollment. Students for whom provisional enrollment is granted must not receive any grade below a "B" while their overall GPA is below 3.0. Probationary students who receive "C" or "E" grades will immediately be dismissed from IIT. Students may not register for Co-op while on academic probation. If a student's GPA in his or her approved program of study is below 3.0, then graduate courses approved on Form 406 may be added to the program until the corresponding GPA is at least 3.0.

Credit Requirements

Unless otherwise specified, all master's degree candidates must complete a minimum of 30 credits beyond the bachelor's degree at IIT. Consult this bulletin on the total credit hour requirements for each degree. A maximum of nine semester hours, earned with "A" or "B" grades, may be transferred from other accredited institutions.

Ph.D. candidates must complete a minimum of 84 credits beyond the bachelor's degree.

Each Ph.D. student must include the equivalent of at least one year of full-time work devoted to research. In general, this requirement is fulfilled by registering for a minimum of 24 credit hours of research. However, some departments require a more extensive research experience. The upper limit is 48 credit hours for research. The remaining credit hours required for the Ph.D. degree, a minimum of 36, are satisfied by registration in and completion of courses deemed pertinent to the Ph.D. program by the students advisory committee and by the Graduate College, Office of Academic Affairs.

Transfer Credits

For masters degree programs, a maximum of nine semester hours taken elsewhere and not applied toward any earned degree, which were passed with grades of "B" or better, may be transferred, subject to the approval of the academic unit and the Graduate College, Office of Academic Affairs. Students who have completed their baccalaureate degree at IIT with course credits in excess of the number of hours required for that degree, which were not applied toward the baccalaureate degree, may also be allowed to transfer up to nine of those excess hours. Course credits in excess of the nine credit hours may be used for a degree program provided the credits were not applied toward a prior degree and the student has received the permission of the adviser, the academic unit head, and the Graduate College, Office of Academic

Affairs prior to registering for any of the additional courses. Doctoral degree candidates may transfer previously completed graduate work not applied toward any prior earned degree, up to a maximum of 42 semester hours of credit beyond the baccalaureate degree, or 50 percent of their total IIT Ph.D. program credit hour requirements, whichever is smaller. The work must be judged to be relevant to the current doctoral program, must have been completed with grades of "B" or better, and must be acceptable for graduate credit at the institution where taken. However, when a master's degree is transferred, only 32 hours of credit are given regardless of the number of hours required for that master's degree. The master's degree must have been granted within the previous six years. Grades for transferred credits will not be included in the student's GPA at IIT.

Transferring from Another Program

A regular student planning to transfer from one degree program to another should discuss the matter with academic advisers in both programs. The student should then submit an application for admission to the new depart-

ment in the Office of Graduate Admission. The student will be notified once the decision is made.

Program of Study

A graduate degree will be awarded upon the completion of a coherent program of study. Form #401 is the mechanism for outlining and obtaining approval of a coherent program and may be accessed and submitted online at www.grad.iit.edu/forms/. Master's and doctoral students must file a program before completing nine credits of graduate study. However, doctoral students without a prior master's degree may file a program of study before

completing 27 credit hours. After these deadlines, further registration may not be allowed until a program of study is approved by the Graduate College, Office of Academic Affairs. A graduate student will be assigned to a preliminary adviser when admitted as a regular student. An academic adviser will be officially assigned when the student's program of study is approved. The student may subsequently change advisers by filing Form #410.

Course Substitution

Once a student has filed a program of study, deviation from the program requires the same formal approval on Form #406, Change of Program of Study Form, as the original plan of study. The Graduate College, Office of Academic Affairs may not approve changes in the program after the student has filed an application for

graduation. Once a course on the program has been completed (i.e., grades have been issued), it may not be dropped to raise the program GPA required for graduation. Form #406 can be accessed and submitted online at www.grad.iit.edu/forms/.

Credit by Examination

With the prior approval of their respective advisers, academic unit heads and the Graduate College's Office of Academic Affairs, students may obtain credit for a course by paying a $100 per credit hour fee and taking a special examination. Credit by examination is limited to nine credits with grades of "A" or "B" and is subject to the lim-

itations for transfer credit in a degree program. Special exams are not permitted for courses in which the student has previously enrolled or for topics in which the student has never taken a course. Students need to be registered in a semester in which a special examination is taken.

Academic Policies for Continuation of Studies

Academic Grades

The following grades are given to graduate students and count in calculating a student's cumulative GPA. GPA is calculated by dividing the total number of grade points earned by the total number of graded semester or quarter hours. Courses not taken at IIT are not included in com-puting the GPA. Students may access their grades online at www.enrollment.iit.edu. Students should log on to Student Services and go to the Grades or Institutional Transcript section.

Grade	Grade Points	Description
A	4	Excellent.
B	3	Performance at the level necessary for a graduate degree.
C	2	Performance below the overall level necessary for a graduate degree. Some academic units require students to repeat certain courses if the initial grade was a "C."
D	1	Passing. Used for undergraduate students and in the Stuart School's master's degree programs
E	0	Unsatisfactory performance. This grade cannot be used to fulfill a graduate program requirement. If required in a program of study, the course must be repeated.
AU	N.A.*	Audit. No credit is given for an audited course and it is not used to calculate a student's GPA.
I	N.A.*	Incomplete.
WP	N.A.*	Withdraw passing.
WE	0	Withdraw failing.
S/U	N.A.*	Satisfactory or Unsatisfactory.

* "N.A." means "not applicable."

Incomplete ("I") Grades

The "I" grade indicates that the student's work to date is of passing quality but is incomplete for reasons accept-able to the instructor. The grade of "I" may be assigned only in the case of illness or for unusual or unforeseeable circumstances that were not encountered by other stu-dents in the class and that prevent the student from completing the course requirements by the end of the semester. "I" grades should not be used to allow a student to repeat a course. Prior to assignment of the "I" grade, the student and the instructor should agree on the work that needs to be completed. The work must be completed by no later than the end of the sixth week of class of the next regular (fall or spring) semester.

A grade of "I" will be removed with the approval of the department chair and the Graduate College's Office of Academic Affairs after all remaining work is completed and the instructor assigns a regular grade. If no regular grade has been received in the Office of Student Records and Registration by the deadline, the "I" grade will revert to a grade of "E." No exceptions will be granted except through appeal to the Graduate College's Office of Academic Affairs.

In the case of research courses, courses numbered 591 and 691, the grade of "I" may be assigned for the reasons listed above and will remain until the student has satis-factoraly completed the course work. Once assigned, the grade of "I" will remain on the student's transcript until the research as determined by the research professor is completed. "I" grades should be removed as soon as possi-ble and no later than the start of the semester in which the student plans to graduate.

Academic Policies for Continuation of Studies

Withdraw Passing ("WP") and Withdraw Failing ("WE") Grades

Withdraw passing ("WP") and withdraw failing ("WE") are grades issued to students who withdraw from a class after the term has begun. Neither "WP" or "WE" can be changed to a legitimate letter grade. The failing withdrawal grade ("WE") is issued when a student fails to attend a section for which he or she registered or withdraws from a course without notifying the registrar. This grade is treated the same as an "E." (See "Academic Grades" chart.)

Satisfactory ("S") and Unsatisfactory ("U") Grades

Satisfactory ("S") and unsatisfactory ("U") grades are only used for the following courses: 591 (Research and Thesis), 594 (Project and Report), 691 (Research and Thesis), noncredit courses and individual courses specifically approved to receive such grades. A student who receives a "U" in course numbers 591, 594 or 691 must demonstrate to his or her adviser, academic unit head and the Graduate College's Office of Academic Affairs why he or she should be allowed to continue as a graduate student. Students registered for course number 597 are not eligible for "S/U" grades. "S/U" grades are not used in calculating the GPA.

Audit ("AU")

In general, grades of "E", "I", "U", "WE", "WP" or "AU" cannot be used to fulfill the requirements of a graduate program.

Auditing of courses is discouraged, but a student may do so if he or she has taken the necessary prerequisites, if the student's presence does not exclude a student who wishes to enroll for credit and if the student's presence does not distract from the conduct of the course as determined by the instructor. An auditor must pay full tuition for the course but is not held for examinations and does not receive credit. Auditors may not change their registration to receive credit after the deadline posted in the Enrollment Guide. The "AU" grade issued for an audited course can never be changed, used for graduate credit, or for fulfillment of degree requirements at IIT.

Change of Grade

Once grades are posted by the registrar or instructor, grade changes can only be accomplished by a Change of Grade Form. The student's instructor must indicate the requested change, and give a reason as to why the change should be approved by the academic unit head. The approved form should be forwarded to the Graduate College's Office of Academic Affairs which will either reject the request and return the form to the academic unit, or approve the change and send the form to the registrar. No grade change is official until it is posted on the student's transcript by the registrar. Incomplete ("I") grades in thesis, project or special problem courses numbered 591, 594 and 691 remain on the student's record until changed by the instructor. A student receiving an incomplete in any other course must arrange with the instructor to change the grade before the end of the sixth week of the semester following the term in which the incomplete was granted. An incomplete will revert to an "E" and cannot be changed to a passing grade at a later date, unless approved by the course instructor, the academic unit head and Graduate College's Office of Academic Affairs.

Repeating a Course

Students may repeat up to two distinct courses with each course being repeated once. Both grades will be recorded and the grade used in the calculation of the GPA will be the latest recorded. Re-registration to repeat a course will require the permission of the student's adviser, academic unit head, and the associate dean for academic affairs, and will also require completion of the "Course Repeat/Audit Form." This form must be submitted at the time of registration and can be accessed online at www.enrollment.iit.edu/forms/.

Academic Policies for Continuation of Studies

Residence Requirement

Degree-seeking graduate students are required to register every semester unless they receive special permission in writing from the Graduate College's Office of Academic Affairs for a leave of absence. In addition, doctoral students must spend a minimum of one year of full-time study at IIT. (Students should consult the definitions of a full-time student on page 29 and credit requirements on page 32). That year must occur within six years prior to awarding the degree. Some academic units have academic residence requirements for master's degrees as well.

Time Limit to Complete a Degree

All requirements for a master's degree must be completed within the 12 semesters immediately preceding graduation. All requirements for a doctoral degree must be completed within twelve regular semesters after the approval of the program of study. If the twelve-semester deadline is not met, then a petition for extension must be filed by the student and the outdated courses listed on the student's program of study (Form #401) must be revalidated. The petition must include a detailed plan for the completion of the degree and be endorsed by the academic adviser and the academic unit head. The student's petition for extension must be presented before the time limit is reached. The Graduate College's Office of Academic Affairs will notify the student of their decision and any additional requirements that must be met. In no case will an approved extension of time eliminate the need for revalidation of outdated courses for a graduate degree at IIT. A statement from the academic unit head indicating the list of courses on the student's program of study that are to be revalidated (Form #504) and the expected date for the revalidation must accompany the extension approval. The M.S. or Ph.D. comprehensive examination may serve the purpose of revalidating the outdated program of study.

Class Attendance

All students are expected to attend their courses regularly. Excessive absences may cause a student to be dropped from the course at the discretion of the instructor, academic unit head and the Graduate College's Office of Academic Affairs. A dropped student receives a grade of "WP" or "WE" in the particular course. In the case of illness or other emergencies that require a student to be absent for more than two days of courses, the dean of student affairs should be notified at the earliest possible date. In case of an emergency on campus, students should contact the Public Safety Department at 312.808.6300.

Master's and Doctoral Examinations

Master's Comprehensive Examination

The master's comprehensive examination is used to determine whether the student has acquired the knowledge commensurate with the courses shown in the student's program of study. The examination may be oral, or written, or both. The academic unit determines the form, scope, and time of the examination. The master's thesis examination may serve as the comprehensive examination. The academic unit has the option of offering professional master's degrees with a minimum of 30 credit hours without requiring a comprehensive exam (i.e. coursework only). In the case of an oral examination, at least two Category I (tenure track) faculty members must be present to serve in the student's committee at the examination. One external, non-IIT or other faculty categories at IIT, committee member with voting privilege may be included with the approval of the Dean of the Graduate College. With the approval of the academic unit chair, the student's advisor must recommend the external member to the Dean of the Graduate College. A resume should be attached to the recommendation. Other faculty and external visitors may attend. The result of the examination must be approved by a majority of the committee. The committee's decision must be submitted to the Graduate College on Form #303 at least 15 days prior to the end of the semester. The graduate student must be registered in the semester in which the examination is given. A student who fails the comprehensive examination may repeat the examination once after a period of at least 30 days from the initial examination. Any additional consideration must be petitioned, supported by the academic unit, and approved in writing by the Graduate College's Office of Academic Affairs.

Master's Thesis Examination

Once the preliminary draft of a master's thesis is prepared, the head of the student's academic unit will appoint a master's thesis committee, consisting of at least two or more Category I (tenure track) IIT faculty members. One external, non-IIT or other faculty categories at IIT, committee member with voting privilege may be included with the approval of the Dean of the Graduate College. With the approval of the academic unit chair, the student's advisor must recommend the external member to the Dean of the Graduate College. A resume should be attached to the recommendation. The thesis committee is responsible for approving the preliminary thesis draft using Form #501A, which the student brings to the thesis examiner prior to the final oral examination. The form, scope, and time of the examination are determined by the academic unit. The examination result must be submitted on Form #303 at least 15 days prior to the last day of courses. The graduate student must be registered in the semester in which the examination is taken. A student who fails the thesis examination may repeat the examination once after a period of at least 30 days from the initial examination. Any additional consideration must be petitioned, supported by the academic unit and approved in writing by the Graduate College's Office of Academic Affairs.

Doctoral Examinations

Qualifying Examination

A qualifying examination is required for all doctoral students. The composition of the qualifying examination committee is determined by the academic unit. The voting members of the committee should be Category I faculty. One external, non-IIT or other faculty categories at IIT, committee member with voting privilege may be included with the approval of the Dean of the Graduate College. With the approval of the academic unit chair, the student's advisor must recommend the external member to the Dean of the Graduate College. A resume should be attached to the recommendation. The exam may be given along with the master's comprehensive examination. Students must be registered in the semester in which the qualifying examination is administered. The following rules apply to the qualifying examination:

1. The qualifying examination may be written and/or oral, and cover major and minor subjects.

2. If the academic unit requires a written exam, the student's committee is responsible for submitting the questions and for conducting the exam. The committee may conduct an oral portion of the qualifying examination. A minimum of four Category I (tenure track) faculty members must participate in the oral portion of the examination.

3. The examination must be taken within the first year of Ph.D. study if the student has an M.S. degree.

4. All work for a doctoral degree must be completed within six calendar years after the approval of the program of study or this examination must be repeated.

5. The results of the qualifying examination must be submitted within fifteen days of the administration of the examination on Form #303 to the Graduate College's Office of Academic Affairs.

6. If the student fails the qualifying examination, the examining committee may recommend a re-examination. At least one semester of additional preparation is considered essential before re-examination. The second chance for taking the qualifying exam is regarded as final. Any additional considerations must be petitioned, supported in writing by the academic unit and approved in writing by the Graduate College's Office of Academic Affairs.

Master's and Doctoral Examinations

Comprehensive Examination

After the approval of a program of study and within a period of time specified by the academic unit, the student must appear for the comprehensive examination. Though students typically take this examination at the end of the second year of Ph.D. study, the only time requirement is that the comprehensive examination is completed at least one year prior to the final thesis examination. The student must be registered in the semester in which the examination is taken. The proposal for Ph.D. dissertation is normally presented as part of the comprehensive examination. The following rules apply to the comprehensive examination:

1. The examination may be written, oral or both.

2. A minimum of four Category I (tenure track) faculty are required for all examining committees of doctoral candidates. The chair and two other members from the committee must be from the student's major, and the fourth member must be from outside the student's major (e.g., MAE faculty may serve on an MSE student committee). One external, non-IIT or other faculty categories at IIT, committee member with voting privilege may be included with the approval of the Dean of the Graduate College. With the approval of the academic unit chair, the student's advisor must recommend the external member to the Dean of the Graduate College. A resume should be attached to the recommendation. The graduate dean is an ex-officio member of all examining committees. To substitute for the chair of the committee, the new chair must be a Category I (tenure track) faculty member in the same academic unit. The role of the outside member of the committee is to provide an element in the examining committee function that is independent of the immediate interest of the academic unit in which the candidate is seeking his or her degree. The outside member of the committee has the responsibility of representing the interest and function of the Graduate College and the university in a context distinct from that of the degree-granting academic unit. Faculty holding joint or adjunct appointments in the degree-granting academic unit or non-faculty co-advisers cannot be outside members on a student's committee. They may, however, serve as the additional members of the committee.

3. The committee is nominated by the academic unit head and appointed by the Graduate College's Office of Academic Affairs. The nominations must be received on Form #301A by the end of the second week of the semester in which the examination is going to be held. The Graduate College must be notified on Form #301A of the time and date of the comprehensive examination at least two weeks before the examination.

4. Any faculty member may attend oral comprehensive examinations, but only the appointed Category I and external committee members may vote. Passing the examination requires one vote more than a majority of the official committee. Dissenting members may bring a split decision before the graduate dean for adjudication.

5. If part of the examination is failed, the report should note which part is to be repeated in a second examination. A student who fails the comprehensive examination may be re-examined after a period of 30 days has elapsed. Students failing the examination twice will be asked to terminate their graduate study at IIT. In extenuating circumstances the academic unit head may show cause why a third examination should be given. A re-examination after two failures requires the approval of the Graduate College's Office of Academic Affairs. Failure of the third examination will result in termination without recourse.

Final Thesis Examination

The final thesis examination may be scheduled at least one year after the comprehensive examination. The following rules apply to the final thesis examination:

1. The eligibility for the membership of the final thesis examination is the same as that listed earlier for the comprehensive examination. The examining committee must consist of at least four Category I (tenure track) faculty members who must sign Form #301B. One external, non-IIT or other faculty categories at IIT, committee member with voting privilege may be included with the approval of the Dean of the Graduate College. With the approval of the academic unit chair, the student's advisor must recommend the external member to the Dean of the Graduate College. A resume should be attached to the recommendation. Faculty members holding the rank of research professor or associate professor may be appointed as non-voting co-chairs of the final thesis examination committee. An emeritus professor who has a current research professor appointment and who has been active in guiding and supporting the student may be co-chairs and voting members of the student's committee. The examining committee is nominated by the academic unit head and appointed by the Graduate College's Office of Academic Affairs by the second week of the semester in which the examination will be administered.

2. At least five weeks prior to commencement, the preliminary draft of the thesis must be approved on Form #501A by the committee and by the thesis examiner before the student's appearance for the oral examination. The oral examination will be canceled if the preliminary draft is not acceptable before the scheduled time for the oral examination.

3. Form #501A is to be signed by committee members as they receive the draft of the final copy of the dissertation prior to the defense and for review. The approval of Form #501A indicates that faculty members have received a copy of the dissertation and are willing to read and comment on it. The members of the committee are not allowed to share the content of the draft with any outside individuals without the permission of the committee chair. After the first submission of the dissertation, the thesis examiner checks Form #501A for signatures of committee members, and the academic unit head. The thesis examiner also checks the format, paper stock and pagination, and reviews portions of the text for general usage, references and bibliographic form.

4. Upon final submission, the signature pages and the final thesis approval form (Form #501B) are checked by the thesis examiner for signatures of committee members, academic unit head and the Graduate College's Office of Academic Affairs. The signatures on Form #501B indicate that the committee members are satisfied with the content of the dissertation and no additional changes are required before its final submission to the Graduate College's editorial office. It is the responsibility of the student and the committee chair to notify the Graduate College of any changes in the structure of the examining committee. The same committee that approved the preliminary dissertation must also approve the final copy of the dissertation.

5. The examination is open to all faculty but only the appointed committee members may vote. The chair of the committee is responsible for the conduct of the examination. In addition, Form #301B must be received by the Graduate College's Office of Academic Affairs by the end of the second week of the semester in which the examination is going to be held. The Graduate College must be notified of the date and time of the final thesis examination at least two weeks before the examination using Form #301B. Examination results reported on Form #309 must be received in the Graduate College at least 15 days before commencement. Three copies of the completed dissertation must be deposited with the thesis examiner at least nine days before commencement.

6. A student who fails the thesis examination may be re-examined after a period of 30 days has elapsed. Students failing the examination twice will be asked to terminate their graduate study at IIT. In extenuating circumstances the academic unit head may show cause why a third examination should be given. A re-examination after two failures requires the approval of the Graduate College's Office of Academic Affairs. Failure of the third examination will result in termination without recourse

Qualifying, comprehensive and final examinations for graduate students are to be held on the IIT Main Campus. Exceptions to this policy are made only for certain graduate students whose examinations are administered at other IIT campuses.

Completion of Studies and Graduation

As part of the requirements for the completion of graduate studies at IIT, each student must be admitted as a regular student, file and complete a program of study approved by the corresponding degree program officials and the Graduate College's Office of Academic Affairs. Ph.D. students must also pass the qualifying and comprehensive examinations, fulfill the residence requirement and submit a dissertation before graduation. (Students should refer to page 22 for a list of steps and corresponding forms that must be completed, the detailed degree requirements listed under the relevant academic unit in this bulletin, and the information on page 1 of this bulletin regarding program changes, for additional information.) Every semester, the Office of Academic Affairs will provide students with a program audit, which describes the student's academic status to date and specific requirements for the completion of graduate studies.

Completion of Degree

Master's Degree Candidates

The starting date for any course applied toward the degree must be no earlier than six years before the graduation date. If this condition cannot be met, the student may petition the Graduate College's Office of Academic Affairs for an extension. Any courses that fall outside the six-year time limit must be revalidated.

Doctoral Degree Candidates

Doctoral study must be completed within six years of the date of approval of the program of study. An extension will require an agreed upon schedule for the completion of remaining degree requirements. Any courses that fall outside the six-year limit must be revalidated.

Application for Graduation

Students expecting to graduate in a given semester must file an application for graduation in the Graduate College's Office of Academic Affairs, by the deadline listed in the *Enrollment Guide* for the semester of graduation. Late applications will be accepted with a $100 fee until the extended deadline listed in the *Enrollment Guide*. No changes in a program of study are allowed after that date. Students' names may be deleted from the graduation list upon request, but no new names will be added after the late deadline. Upon submission of a graduation application, the Graduate College's Office of Academic Affairs will check for completion of IIT's degree requirements. The diploma will be issued by the registrar after grades are reported, usually about five weeks after the end of the term. Students should not file the Intent to Graduate Form unless they are reasonably sure that they can complete the degree requirements in time to meet the deadlines. An application for graduation is good for only one semester. If the student fails to graduate in the intended semester, a new application must be filed for a later semester.

Professional Master's Degree

A professional master's degree is offered to graduate students who seek the non-thesis option. As used here, a thesis is a written document or manuscript that concerns an investigation or discourse. A professional master's degree program may require a project and a project report (e.g., Course 594); however, neither the project itself nor the project report is considered a thesis. Storage of project reports will be at the discretion of academic units and cannot be done in the IIT library. Registration for thesis research cannot fulfill a requirement for a non-thesis degree.

Change from Master's Thesis to Non-Thesis Option

In several majors, a master's degree may be earned without the preparation of a thesis. When changing from a thesis to non-thesis option, a student may transfer up to four hours of credit for satisfactorily completed Course 591 (Research and Thesis for the Master's Degree) to satisfy the requirement for Course 594 (Special Projects), provided that two conditions are met: first, the student's GPA must be at least 3.0/4.0; second, the student's academic unit must permit the change to a non-thesis option after consulting with the student's adviser and must

approve the transfer on the grounds that the thesis-oriented work is equivalent to work on a project.

Procedures for evaluating the transfer of credits from 591 and 691 to 594 (and for evaluating the student's performance on the Special Project) must be documented and monitored by each academic unit. The graduate college will allow up to 4 credits of 591 or 691 to be converted to 594 credits.

Certificate Programs

A graduate certificate program (GCP) is defined as a group of three to five 400- and 500-level courses in a concentration within a department or program organized with the objective of training students in a specific area of expertise. Admission to a GCP is limited to students who qualify as non-degree graduate students who hold a bachelor's degree with a GPA of 2.5/4.0 or higher. The GRE is not required. Admission as a certificate student does not guarantee future admission to a graduate degree program.

Course requirements for a GCP are determined by the individual department, and must have a minimum of nine credit hours with at least one course at the 500 level. No more than nine credit hours of 400-level courses can be included; no more than half the credits or courses may be specialized (topical) accelerated courses. Transfer credit cannot be applied toward a graduate certificate.

The time limit for its completion is three years. A student may complete more than one graduate certificate.

A GPA of 3.0/4.0 or greater is required in the certificate courses before a graduate certificate can be awarded. An application for a certificate must be filed by certificate students delineating the courses completed for a particular graduate certificate. This form is available from Graduate College, Office of Academic Affairs, and must be approved by that office and by the academic unit head.

The completion of a GCP will be indicated on the student's transcript. A certificate student who subsequently applies to and is admitted to a specific master's degree program may apply all approved coursework taken as a certificate student and passed with a "B" grade or better to the master's degree program.

Graduate Accelerated Courses

An accelerated course (formerly known as a "short course") is a graduate-level course offered in a two-week (14-day) or shorter duration of time, and satisfies the lecture contact-time standard of fifteen 50-minute class sessions per semester credit hour, excluding final exam time. These are topical courses that should be no more than three credit hours. A new accelerated course is subject to the normal departmental review as for a regular new graduate course. Approval is required by the department curriculum committee, the academic unit head and the Graduate College's Office of Academic Affairs.

No more than six credit hours of accelerated courses may be included in a master's degree program of study. Accelerated courses can be selectively included in a Ph.D. program of study at the rate of six credits per 32 course credits, and their inclusion is subject to approval of the adviser, academic unit head and the Graduate College's Office of Academic Affairs .

Students must register for the accelerated course before the first class session in order to receive credit for the course.

Thesis Preparation Meeting

A mandatory thesis preparation discussion is held at the beginning of every semester to assist graduate students with the preparation of their theses. (For the exact date and time, students should contact the Graduate College's Office of Academic Affairs at 312.567.3024.) All students

who are required to submit a thesis for graduation must attend this meeting, which is open to all students, faculty and staff. Graduate student theses must conform to the guidelines given in the latest *IIT Thesis Manual*, available online at www.grad.iit.edu/thesis.html.

Completion of Studies and Graduation

Appointment with Thesis Examiner

All students submitting a thesis must make an appointment with the thesis examiner for the approval of the preliminary draft of their theses. The meeting with the thesis examiner must be scheduled at least six weeks before the end of the semester and prior to the thesis defense. At least three weeks before the end of the semester of graduation, all students submitting a thesis must make a second appointment with the thesis examiner for the approval of the final draft.

The second meeting with the thesis examiner must take place after the thesis defense and the approval of the final draft by the thesis review committee.

Graduation in the Stuart School of Business

Because the Stuart School of Business is on a quarter system, diplomas and commencement activities for graduates must be explicitly stated. Students completing their degree requirements in the fall quarter may participate in the December commencement ceremony. Winter quarter students receive diplomas dated February and may attend the spring commencement in May. Spring quarter graduates participate in the May commencement ceremony. Students graduating in the summer receive diplomas dated August.

Letter of Completion

A student who has completed all the requirements for graduation may request a letter of completion from the graduate dean at any time during the semester. The student will not receive his or her diploma until grades are reported by the registrar, usually within five weeks after the end of the semester or term.

Transcript of Grades

Transcripts of grades are issued from Student Services Center, 104 Main Building. Requests must bear the signature of the student to comply with the Family Educational Rights and Privacy Act of 1974 as amended. Requests for transcripts should be made at least 10 days prior to the date the transcript is needed and should include the student's Social Security or ID number, dates of attendance and address where the transcript should be sent. During registration week, please allow additional time for processing transcripts. Transcripts will be released only after the student has fulfilled all financial obligations to the university. Students may view their transcripts online and may complete a transcript request form at www.enrollment.iit.edu. A fee of $10 is charged for each transcript issued.

General Policies

Regulations Subject to Change

Regulations and policy guidelines are established by the Graduate Studies Committee, composed of the graduate dean and an elected representative from each graduate degree program on the Main Campus. Every attempt is made to keep this bulletin up to date; students, however, should consult the Graduate College's Office of Academic Affairs or the academic unit head for revisions and updates. The latest version of the *Graduate Bulletin* is maintained on the Graduate College's Web site at www.grad.iit.edu/bulletin/.

Right of Appeal by Petition

A student should attempt first to resolve any departure from the stated rules with his or her adviser and academic unit head whenever possible. Questions regarding theses must be referred to the thesis examiner. If necessary, the student may submit a written petition signed by the academic adviser and the academic unit head to the Graduate College's Office of Academic Affairs explaining any extenuating circumstances and requesting a specific solution (waiver) with appropriate additional requirements that may develop. Petitions will not be accepted without a prior approval of the academic adviser and the academic unit head, unless the conflict is unresolved between the student and the adviser or the academic unit head. The graduate dean's decision regarding the unresolved conflicts is final.

Change of Records Information

Students must promptly advise the Graduate College, Student Services Center and their respective academic units if they change their name, Social Security Number, mailing address or telephone number. Students may update their local, work, next-of-kin and e-mail addresses online at www.enrollment.iit.edu—go to Student Services/Personal Information. Any changes requested for name, permanent address or student identification number must be done in writing. Change of Information Forms are available at www.enrollment. iit.edu—go to Forms.

Standards of Conduct

Students are responsible for their own conduct; university regulations and requirements are published in the *Student Handbook*. Graduate students are subject to the rules and regulations published in this handbook. IIT reserves the right to terminate a student's enrollment or to deny enrollment when it is judged to be in the best interest of the student or the university. *The Student Handbook* is available online at www.iit.edu/~osa.

Code of Academic Honesty

Illinois Institute of Technology expects students to maintain high standards of academic integrity. Students preparing for the practice of a profession are expected to conform to a code of integrity and ethical standards commensurate with the high expectations that society places upon the practitioners of a learned profession.

No student may seek to gain an unfair advantage over another. It shall be a violation of this code for students to engage in conduct that violates the standards of their major academic discipline, the standards of the academic discipline in which they are engaged, the standards of a profession in which they are training, or the standards of the university set forth here.

It is a violation for a matriculated or nonmatriculated student, whether or not currently enrolled in the university, to knowingly engage or attempt to engage in:

1. Misrepresenting any work submitted for credit as the product of a student's sole independent effort, such as using the ideas of others without attribution and other forms of plagiarism.

2. The use of sources beyond those authorized by the instructor in any work submitted for credit.

3. The use of any unauthorized assistance in taking quizzes, tests or examinations.

4. The acquisition, without permission, of tests, answer sheets, problem solutions or other academic material before such material is revealed or distributed by the instructor.

5. Failure to abide by the instructions of an instructor or exam-proctor.

6. Hindering any member of the IIT community in his or her studies, research, or academic work.

7. Making material misrepresentation in any submission to or through any office of the uni-

versity to a potential employer, professional society, meeting, or organization.

8. Knowingly making false accusation concerning academic honesty or giving false information to any authority investigating a violation of this code.

Note: Students in the Chicago-Kent College of Law are subject to the Chicago-Kent College of Law Code of Conduct.

Expenses and Financial Assistance

All University mandatory and non-mandatory charges are published regularly in official University publications including electronic mail and web site postings. For a complete listing of current tuition, fees, and other charges go to www.enrollment.iit.edu, then select Tuition and

Fees. The University regrets that continually rising costs do not permit it to guarantee that published charges will not change. Students and parents should anticipate periodic increases in the future.

Admission Application Fee

All first time applications for graduate admission must be accompanied by a non-refundable fee. Any applicant who has attended IIT previously, or who has already paid an

application fee to IIT, does not have to pay a second application fee. Please contact the appropriate program admissions office for any applicable fee.

Graduate Tuition

Graduate level enrollments are generally charged at a per credit hour tuition rate. This rate applies to all courses for which a graduate student registers whether at the graduate or undergraduate level.

Some programs particularly at Chicago Kent School of Law and at Stuart School of Business charge different rates depending on the program. Consult the official University publications including electronic mail and web site postings for the latest charges.

No charge is made for seminars carrying no credit hours. For review or other noncredit courses, tuition is computed by considering the number of class meetings per week as equivalent to the number of credit hours.

Graduate students registered for nine (9) credit hours or more are considered full time. Graduate students registered for less than nine (9) credit hours are considered part time.

Enrollment Deposit

Each student admitted as a full-time degree-seeking graduate student to certain programs is required to make a non-refundable enrollment deposit, which is credited

toward the student's cost of attendance and holds a place in class for the initial semester of enrollment.

Orientation Fee

First time graduate students are charged a one time fee to cover the costs of orientation activities for their first term of enrollment.

Other Fees & Charges

A student may incur other fees and charges that are both mandatory and non-mandatory. For a complete current

listing of all charges and fees go to www.enrollment.iit.edu, then select Tuition and Fees.

Books and Supplies

Books and supplies are available at the University book-stores. Costs for books and supplies can differ significantly depending upon the field of study. Students in the College of Architecture may spend less on books but substantially more on supplies

Payment of Tuition, Room and Board, and Other Fees and Charges

Payment of all term charges to the University is due on the first day of classes of each term. For those unable to complete payment by that deadline there are several payment plan options available that incur additional plan fees. The latest information and costs and payment plan enrollment forms are at www.enrollment.iit.edu, select Student Accounts. Failure to adhere to any payment plan schedule of payments will result in late fees in addition to any plan administrative fee.

Payments may be made by cash, check, money order, or credit card. Credit card payments may be made at www.enrollment.iit.edu, select IIT Web for Students, select Student & Credit Card Payment. Payment may also be made in person at the IIT Cashier's Office in the Main Building, Main Campus or at the Bursar's Office at the Downtown Campus. Payment by mail may be made by contacting the Bursar's Office at bursar@iit.edu; or at www.enrollment.iit.edu, select Student Accounts for the current mailing address and contact information regarding any questions about bills and payments.

Outstanding Debts

A restrictive hold is placed on a student's record when that student is delinquent in fulfilling his or her financial obligation to the University. A student will be considered delinquent when his or her account is not current according to established University policies and payment due dates. Students with outstanding University debts may be suspended from current term classes. Students whose accounts are not current will not be allowed to register or attend classes for any subsequent term. No diploma, certificates of attendance, letters of completion, or transcripts of academic records will be issued until all financial obligations have been met.

University Refund Policy

Under exceptional circumstances, such as withdrawal for involuntary military service, serious illness or injury, or action by the university, consideration may be given by the University for a refund or credit for unused tuition upon written request to the applicable program administrative office. Payments for other charges incurred may be the responsibility of the student at the determination of the University.

Students should consult www.enrollment.iit.edu for the approved University refund schedule.

Expenses and Financial Assistance

Student Health Insurance

All students who are either registered for 9 or more credit hours or occupants of IIT residence halls are required to purchase the basic student health insurance policy or to submit proof of equivalent insurance before the end of the first week of classes. All students who are here on an F1 or J1 visa and are registered for at least 1 class, participants in the co-op program, research or teaching assistants or occupants of IIT residence halls are required to purchase the basic student health insurance. The premium for the basic insurance will be added to student tuition and fees as a charge. To avoid this charge, submit proof of comparable coverage online at www.enrollment.iit.edu/ssc/insurance/. F1 and J1 students may only waive IIT's coverage with proof U.S. employer provided insurance. Once a waiver is accepted it will be valid through the student's continued enrollment at IIT. Other students, spouses, and dependents of students may participate in the student health program, if desired. Students should consult the Student Health Service in Farr Hall, at 312.808.7100, for further details.

Parking Fee

All students parking in campus parking lots must register their cars with IIT Parking Services and pay a parking fee at the beginning of the semester. For current fees, students should contact Parking Services at www.parking.iit.edu or 312-567-8968. Students authorized to park in IIT lots will receive a parking hangtag.

Housing

How to apply

The university offers two types of Housing: Residence Halls (furnished dormitories) for undergraduates and single graduate students and Family Housing – unfurnished apartments for married and single graduate students.

Applications are processed in the order in which they are received and will only be processed if the application is accompanied with the appropriate non-refundable deposit (accepted in the form of an international money order, personal check or Visa, Discover or Master Card credit card.)

Please do not assume that sending an application with a deposit, or a fax, or an e-mail will guarantee a space. Only students who have actually received a room assignment confirmation will be guaranteed housing.

If you arrive without a housing confirmation, you may have to contact Hostelling International to make arrangements for temporary housing while you wait for room to become available.

Residence Halls

Although residence hall rooms are furnished with twin-size beds, desks, desk chairs, dressers, etc., students are required to provide their own blankets, pillows, towels, and bed linens.

McCormick Student Village (MSV)
Traditional dormitory style residence halls of approximately 20 rooms per floor share a centrally located common washroom facility. The average room is 10'9" x 15'9" and is double occupancy. Single occupancy rooms are not guaranteed.

MSV Room Rates for the 06-07
academic year range from $4,212 to $6,086.

MSV Board Rates for the 06-07
academic year range from $1,284 for a 5-meal plan to
$4,038 for a 19-meal plan.

Participation in the university food program is required.

MSV contracts do not cover winter break or summer housing. Students who wish to reside over the winter break and/or summer may apply for this option at an additional cost. See contract for details.

State Street Village (SSV)
State Street Village, a new, state-of-the-art residence complex, offers two types of furnished living arrangements - quad suites and apartments. The apartments are equipped with refrigerators, ranges and microwaves. Residents in quad suites are required to purchase meal plans. Participation in the university food program is optional for the SSV apartment residents.

SSV Room Rates for the 06-07
academic year range from $6,914 to $11,418.

SSV Board Rates for the 06-07
academic year range from $1,284 for a 5-meal plan to
$4,038 for a 19-meal plan.

The SSV Academic contract rates include housing over the winter break. Summer housing option is available at an additional cost.

* These rates are subject to change. Please visit http://www.housing.iit.edu for current rates, deadlines and other housing information

Expenses and Financial Assistance

Apartment Housing (Family Housing) – For Graduate Students or Families

University apartments are completely unfurnished, except for a refrigerator, range and window coverings. All units have wireless internet, but any air-conditioning, cable tv, phone service, furniture, linens, etc. must be supplied by the tenant. Heat, gas and electricity are included.

Apartments range in size from a studio (no bedroom) up to three-bedroom units. Monthly rent for a standard 12-month lease ranges from $627 to $1,393.

Prospective tenants must complete an apartment application and pay a non-refundable $50.00 application fee. Units are offered according to date of application. Once an offer is accepted, a reservation fee of $225 is due. This fee will go towards the security deposit and will be forfeited if you fail to move into the apartment reserved for you. Upon move-in, the balance of the security deposit (equivalent to 1 month's rent) and the first month's rent is required.

Graduate students looking for roommates are encouraged to post their information of the Housing web site at http://www.housing.iit.edu. Keep in mind that roommates must be affiliated with the university and approved by Housing. Any irregularities will jeopardize a lease.

Housing is not guaranteed. Units are offered on the basis of availability.

Temporary Off-Campus Housing

Temporary off-campus housing may be available at Hostelling International, 24 East Congress Parkway, three miles north of the university. Contact them at 312.360.0300 or www.hichicago.org for information.

You must have a signed housing contract with IIT in order to stay in university housing. *If you arrive on campus without a room confirmation, housing is not guaranteed.* Contact Hostelling International if you need a place to stay while you complete the housing process.

Financial Aid

Student Eligibility Requirements to Receive Federal Financial Assistance

Students must be U.S. citizens or eligible non-citizens and be enrolled in a degree-seeking program for at least half-time (five credit-hours or more per term).

Comprehensive Financial Aid Program

IIT administers a comprehensive financial aid program, which includes federal and private funds for both full and part-time students. Federal programs include loans and work-study employment. IIT uses the formula established by the U.S. Congress to determine financial need for assistance. IIT offers limited academic scholarship assistance to graduate students. Private loans are also available and are based on credit approval from the lender.

For the most up-to-date information, visit the office of Financial Aid online at http://finaid.iit.edu.

Determining Financial Need for Assistance

Financial need is the difference between a student's total annual cost of attending IIT and the amount the student is expected to contribute toward the cost of attendance. The total cost of attendance at IIT includes tuition and mandatory fees, room and board, books and supplies, transportation and personal expenses. The amount that the student is expected to contribute is called the Expected Family Contribution (EFC) and is calculated by a formula determined by the U.S. Congress. After the EFC is subtracted from the cost of attendance, the remainder is considered to be demonstrated need for financial assistance. One of the principles of need-based assistance is that students are expected to help pay some of the cost of attendance.

Expenses and Financial Assistance

Application Process

All students applying for financial assistance need to complete the Free Application for Federal Student Aid (FAFSA). This application is available after January 1st at www.fafsa.ed.gov and should be filed by the student as soon as possible after January 1st of the academic year in which the student is planning to enroll. (The IIT School Code is 001691). The priority date for campus-based federal aid (Federal Perkins Loan and Federal Work Study) at IIT is April 15th. All financial assistance is awarded on an annual basis. Students interested in receiving federal aid must complete a FAFSA each year, beginning January 1st. The amount of financial aid that a student receives each year depends on demonstrated need and the availability of funds. Students applying for financial aid may be required to submit tax information upon request.

Federal Financial Aid Programs

Federal Work Student Program

Federal Work Study provides opportunities for students to work on or off-campus. Both undergraduate and graduate students with demonstrated financial need may be eligible to participate in this program. Students awarded work study funds can earn money to help pay educational expenses. On campus jobs are advertised at www.cdc.iit.edu. Off-campus jobs will be private, non-profit organizations or public agencies that encourage community service work. Off-campus jobs are also advertised by the Career Development Center. This office assists students in finding summer employment and permanent jobs after graduation.

Students awarded work study are paid at least the current federal minimum wage or higher, depending on the type of work performed. Students are paid hourly and receive a biweekly paycheck. Work study students are strongly encouraged to work 20 hours per week or less during the academic year. Students apply for work study by filing the FAFSA.

Federal Family Education Loan Program (FFELP)

The FFELP loan program includes the Stafford Subsidized and Unsubsidized loan programs for undergraduate and graduate students. The Stafford Loan Program provides low-interest loans to assist students with paying educational costs. The interest rate for new loans is set on July 1 and varies annually, going no higher than 8.25 percent. These loans must be repaid over a period of time after a student leaves school.

The Subsidized Stafford Loan is awarded based on demonstrated financial need, and students do not pay interest on the principal while in school. The Unsubsidized Stafford Loan is not awarded based on demonstrated need; and, interest is charged from the time that the loan funds are disbursed to the student. Students have the option of paying the interest or having the interest added onto the principal. Fees of up to 4 percent are charged on each loan, and are deducted before the funds are applied to the student's account.

Expenses and Financial Assistance

Continued Eligibility for Financial Assistance

All students receiving federal financial aid funds must demonstrate reasonable academic progress toward graduation from IIT. Reasonable academic progress includes satisfactory cumulative grade point average and suffi- cient credit hours earned each semester toward the completion of a degree program. Failure to comply with IIT's Reasonable Academic Progress Policy will lead to the student's losing eligibility for federal financial assistance.

Applying for a Financial Assistantship

A fellowship provides financial support to defray the cost of tuition and a stipend for living expenses. A tuition scholarship (TS) provides all or part of the tuition only. Both are exempt from federal income taxes. Most degree programs provide financial support for teaching assistants (TA) who help with instruction, and research assistants (RA) who work on funded research projects. Graduate assistants (GA) receive partial support in the form of a stipend with no tuition support.

Only full-time students are eligible for assistantships. New students will be considered for fellowships, assistantships and scholarships when they apply for admission and will be notified of the award with the admission decision or shortly thereafter. Continuing students should apply to their major academic unit. The Graduate College administers a number of fellowships and scholarships but does not directly administer assistantships available to students in each academic unit. Acceptance of an award or appointment for the fall semester is considered binding on the student after April 15. If a student's academic work is judged to be unsatisfactory, the award may be canceled at the discretion of the university at anytime during the period covered.

Although an outstanding international student may receive some kind of award from IIT, most students must provide independent finances for their first year of graduate study. International students who are not recommended for an assistantship that would cover both tuition and stipend are required to carry at least nine credit hours per semester in order to maintain their F-1 student visa status.

Additional Information

All financial aid awards for graduate students (excluding law and business students) are processed by the IIT Office of Financial Aid. Students should submit all information regarding financial assistance to: Office of Financial Aid, 3300 South Federal Street, Chicago, IL 60616 (telephone 312.567.7219). The office is open from 8:30 am to 5pm, Monday through Friday, and may be found online at http://finaid.iit.edu/.

Expenses and Financial Assistance

Alumni Tuition Benefit (ALUMED)

ALUMED is a tuition credit program for graduates of Illinois Institute of Technology or Midwest College of Engineering (MCE) registering in regularly scheduled credit courses only. Alumni registering as part-time undergraduate students are permitted to register for one course each semester or quarter at a cost of one-half of the current tuition rate. Alumni registering as part-time graduate students are permitted to register for one course each semester or quarter at a cost of one-third of the current tuition rate. To receive this benefit, students must apply for alumni status upon their initial registra-

tion. Students may apply for alumni status by contacting the Student Services Center at 312.567.3100 or at student.services@iit.edu, or they may submit the electronic request form at www.enrollment.iit.edu, go to Student Services, go to Alumni Vouchers. ALUMED tuition credits may not be applied retroactively. Alumni registering as full-time students or as students in a program at Chicago-Kent or the Rice Campus are not eligible for ALUMED. This benefit may not be used for enrollment in intersession or short courses, special problems, research, thesis and non-credit courses.

Part-Time Employment

Part-time employment opportunities may be available for students, on- and off-campus. Positions may be Federal Work Study jobs or career related co-ops and internships. Co-ops, internships and some on-campus jobs are posted in the Career Development Center (CDC) e-Recruiting database. Other on-campus jobs may be announced directly by individual university departments. Students interested in and eligible for employment off-campus in their field of study can get job search assistance from the CDC and must attend an Introduction to Cooperative Education and Internship workshop conducted by the

CDC. Workshop schedules are posted at www.cdc.iit.edu. Appointments for individual career counseling may be made by calling 312/567-6800.

International students (on F1 visa) are restricted to on-campus employment for their first academic year of study at any school in the United States. After completing one academic year in the country, students on F1 visa may be eligible for opportunities off-campus (only if related to their field of study) through the Cooperative Education or Summer Internship Programs.

Veterans' Educational Benefits

Veterans enrolling for the first time should obtain Veterans Affairs application forms from the Office of Student Records and Registration, Room 104, Main Building 312.567.6742. The university's Veterans Affairs representative processes subsequent enrollment certifications. For further information on veterans benefits, or to request an application, please visit www.enrollment.iit.edu and click on "Registrar's Office." The veteran must also inform the Veterans Affairs

representative of any change in credit hours within a term or of future enrollment plans. If a veteran drops a course or withdraws from school completely, his or her allotment may be reduced or withdrawn. The veteran must report immediately the exact termination date to the Veterans Affairs representative. Veterans must maintain reasonable academic progress according to university standards. Failure to meet minimum-progress criteria can result in a cessation of educational benefits.

Maps for the Downtown, Main and Rice campuses are on page 332. When calling from a campus phone, use last five digits only.

Administrative and Service

Academic Resource Center 312.567.5216

Admission, Undergraduate 312.567.3025

Alumni Relations...312.567.5040

Athletics & Recreation 312.567.3296

Bookstore - Barnes & Noble 312.567.3120

Bursar's Office 312.567.3785

Campus Ministry...312.567.3160

Career Development Center 312.567.6800

Communications & Marketing 312.567.3104

Computing & Network Services 312.567.5963

Counseling Services 312.808.7132

Disability Resources 312.567.5744

Educational Services 312.567.3300

Enrollment Services 312.567.3100

Financial Aid 312.567.7219

Galvin Library (Main Campus) 312.567.3355

Graduate Admission 312.567.3020

Graduate College 312.567.3024

Health Services 312.808.7100

Hermann Union Building 312.567.3075

Housing Office 312.567.5075

IIT Online Technical Services......................................312.567.3345

International Center 312.567.3680

Moffett Campus..708.563.1576

Multicultural Student Services 312.567.5525

Public Safety 312.808.6300

Residence Life Office 312.808.6400

Daniel F. and Ada L. Rice Campus. 630.682.6000

Student Activities & Orientation 312.567.3720

Student Affairs & Greek Life 312.567.3081

Undergraduate College 312.567.3940

Office of the Vice Provost for New Initiatives. 312.567.3163

Women's Outreach and Resource Center....................312.567.5250

Colleges and Academic Units

College of Architecture 312.567.3230

Armour College 312.567.3009

    Biomedical Engineering 312.567.5324

    Chemical & Environmental Engineering 312.567.3040

    Civil & Architectural Engineering 312.567.3540

    Electrical & Computer Engineering 312.567.3400

    Mechanical, Materials & Aerospace Engineering 312.567.3175

Center for Professional Development 360.682.6000

    Information Technology Management...................630.682.6040

    Manufacturing Technology Management 312.567.3650

Institute of Design 312.595.4900

Institute of Psychology 312.567.3500

College of Science & Letters.......................................312.567.3800

    Applied Mathematics 312.567.8980

    Biological, Chemical & Physical Sciences.............312.567.3480

    Computer Science...312.567.5150

    Lewis Department of Humanities.........................312.567.3465

    Mathematics & Science Education 312.567.3661

    Social Sciences 312.567.5128

    MPA (M.S. Public Administration) 312.906.5198

Chicago-Kent College of Law 312.906.5000

Stuart School of Business 312.906.6500

    Center for Law & Financial Markets 312.906.6500

Air Force — Aerospace Studies 312.567.3525

Army — Military Science 312.808.7141

Navy — Naval Science 312.567.3530

Academic Programs

Department of Applied Mathematics

208 Engineering 1 Building
10 W. 32nd St.
Chicago, IL 60616
312.567.8980
312.567.3135 fax
www.math.iit.edu

Chair:
Fred J. Hickernell

Director, Graduate Studies:
Xiaofan Li

The Department of Applied Mathematics puts mathematics to work solving problems in science, engineering and society. Applied mathematicians investigate a wide variety of topics, such as how to construct methods for multi-criteria decision making (requiring discrete mathematics and statistics), predicting how financial markets will behave (requiring probability/statistics, analysis and optimization), and understanding how liquids flow around solids (requiring computational methods and analysis). Our programs focus on four areas of modern applied mathematics: applied analysis, computational mathematics, discrete applied mathematics, and stochastics. More detailed descriptions of these areas follow.

Degrees Offered

Master of Science in Applied Mathematics
Doctor of Philosophy in Applied Mathematics

Master of Mathematical Finance (collaborative program with the Stuart School of Business)

Research Facilities

The department provides students with office space equipped with computers and full access to the university's computer and library resources. The department also has a 18-processor Beowulf cluster for research purposes.

Research and Program Areas

The research and teaching foci of the Department of Applied Mathematics at IIT are primarily in four areas of modern applied mathematics: applied analysis, computational mathematics, discrete applied mathematics, and stochastics. These areas are briefly described in the following subsections; faculty with primary and secondary interests and expertise are listed for each of these areas.

Applied Analysis

Applied analysis is one of the foundations for interdisciplinary applied mathematics. The principles of (functional) analysis are applied to such areas as partial differential equations, dynamical systems and numerical analysis.

The basic framework, concepts and techniques of modern mathematical analysis are essential for modeling, analysis and simulation of complicated phenomena in engineering and science. Applying the ideas and methods of modern mathematical analysis to such problems has been a thoroughly interdisciplinary effort.

Research and teaching within the applied analysis group at IIT concentrates on development and application of new techniques for investigating numerous phenomena in engineering and science. In particular, members of the group do research in nonlinear dynamics, approximation theory, numerical analysis, fluid dynamics, materials science, viscoelastic and polymeric fluid flows, biological science, quantum mechanics and electro-dynamics, solid mechanics, financial engineering and other disciplines.

Primary interests: Abarji, Bielecki, Duan, Edelstein, Frank

Secondary interests: Bernstein, Erber, Fasshauer, Li, Lubin, Nair, Rempfer, Wendland

Department of Applied Mathematics

Computational Mathematics

The use of computation/simulation as a third alternative to theory and experimentation is now common practice in many branches of science and engineering. Many scientific problems that were previously inaccessible have seen tremendous progress from the use of computation (e.g., many-body simulations in physics and chemistry, simulation of semi-conductors, etc.). Researchers and scientists in these areas must have a sound training in the fundamentals of computational mathematics and become proficient in the use (and development) of new algorithms and analytical techniques as they apply to modern computational environments.

Research and teaching within the computational mathematics group at IIT concentrates on basic numerical analysis, as well as development of new computational methods used in the study and solution of problems in the applied sciences and engineering. In particular, members of the group do research on complexity theory, the finite element method, meshfree methods, multiscale and multilevel methods, Monte Carlo and quasi-Monte Carlo methods, numerical methods for deterministic and stochastic ordinary and partial differential equations, computational fluid dynamics, computational materials science, computer-aided geometric design and parallel computation.

Primary interests: Fasshauer, Hickernell, Li, Wendland

Secondary interests: Bernstein, Duan, Fang, McMorris, Rempfer

Discrete Applied Mathematics

Discrete applied mathematics is a fairly young branch of mathematics and is concerned with using combinatorics, graph theory, optimization, and portions of theoretical computer science to attack problems in engineering as well as the hard and soft sciences.

Research interests in the discrete applied mathematics group at IIT are in discrete methods in computational and mathematical biology, intersection graphs and their applications, discrete location theory, voting theory applied to data analysis, graph drawing, random geometric graphs, communication networks, coding theory, low discrepancy sequences, algorithm design and analysis.

Primary interests: Ellis, Kaul, McMorris, Pelsmajer

Secondary interests: Frank, Hickernell

Stochastics

Stochastics at IIT includes traditional statistics (the methods of data analysis and inference) and probability (the modeling of uncertainty and randomness). However, also included are other areas where stochastic methods have been becoming more important in recent years such as finite and infinite dimensional stochastic processes, stochastic integration, stochastic dynamics, stochastic partial differential equations, probabilistic methods for analysis, mathematical finance and discrete mathematics, computational methods for stochastic systems, etc.

The current research and teaching interests in the stochastic analysis group at IIT include asymptotics in statistics, experimental design, computational statistics, stochastic calculus and probability theory, stochastic dynamical systems, stochastic control, stochastic partial differential equations and statistical decision theory.

Primary interests: Adler, Bielecki, Duan, Fang, Heller, Hickernell

Secondary interests: Ellis, Frank, Kaul, McMorris

Faculty

Andre Adler, Associate Professor of Applied Mathematics. Ph.D., University of Florida. Asymptotics in statistics, probability and statistical inference.

Snejana Abarji, Associate Professor of Applied Mathematics. Ph.D., Landau Institute. Applied Mathematics and Applied Analysis (nonlinear partial differential equations, stochastic differential equations, dynamical systems); multi-scale phenomena; Mathematical Biology.

Barry Bernstein, Professor of Applied Mathematics and Chemical Engineering. Ph.D., Indiana University. Mechanical and thermodynamic behavior of materials, material processing problems, such as extrusion and molding of polymer; theory of fluids treating thermodynamics as well as the mechanics of such media; computational work on polymeric fluid flows, finite element formulation known as flucode; tracer analysis of blood circulation and of recycle reactors.

Thomasz R. Bielecki, Associate Professor of Applied Mathematics. Ph.D., Warsaw School of Economics. Mathematical finance, stochastic control, stochastic analysis, probability and random processes, quantitative methods for risk management in finance and insurance.

Jinqiao (Jeffrey) Duan, Professor of Applied Mathematics. Ph.D., Cornell University. Stochastic dynamical systems; stochastic partial differential equations; nonlinear dynamical systems; modeling, analysis, simulation and prediction of random, complex & multiscale phenomena in engineering and science (geophysical and environmental systems, etc.)

Department of Applied Mathematics

Faculty (continued)

Warren Edelstein, Professor of Applied Mathematics. Ph.D., Brown University. Analysis of linear viscoelasticity and nonlinear creep, numerical analysis of flow-induced vibrations in tubes conveying fluids, numerical solution of boundary value problems arising in the quantum mechanics of semiconductors. Computational mechanics and mathematics of finance.

Robert B. Ellis, Assistant Professor of Applied Mathematics. Ph.D., University of California at San Diego. Combinatorics; spectral, random and algebraic graph theory; probabilistic methods; coding theory; and combinatorial algorithms.

Thomas Erber, Distinguished Professor of Applied Mathematics and Physics. Ph.D., University of Chicago. Quantum electrodynamics in intense magnetic fields; classical electrodynamics; the quantum mechanics of single trapped atoms; magnetic and mechanical hysteresis; metal fatigue; structure and evolution of complex physical systems; sonoluminescence.

Kai-Tai Fang, Distinguished Research Professor of Applied Mathematics. Graduate Studies, Academia Sinica. Multivariate analysis, experimental design, distribution theory, applications of number-theoretic methods in statistics, data mining and applications to Chinese medicine.

Gregory Fasshauer, Associate Professor and Associate Chair of Applied Mathematics. Ph.D., Vanderbilt University. Approximation theory, numerical analysis, meshfree methods with applications to multivariate scattered data approximation and the solution of partial differential equations. Computer-aided geometric design and bivariate splines.

Maurice J. Frank, Professor of Applied Mathematics, Ph.D., Illinois Institute of Technology. Functional equations, associativity and related equations, iterative equations and systems; probability distribution theory, probabilistic geometry; iteration, nonlinear dynamics.

Barbara Heller, Research Associate Professor of Applied Mathematics. Ph.D., University of Chicago. Theoretical and applied statistics, data analysis in the physical and biological sciences, goodness-of-fit tests, computer simulations of spatial distributions.

Fred J. Hickernell, Professor and Chair of Applied Mathematics, Ph.D., Massachusetts Institute of Technology. Computational mathematics, numerical approximation of integrals and functions, Monte Carlo and quasi-Monte Carlo methods, low information-based complexity theory, design of laboratory and computer experiments, computational finance.

Hemanshu Kaul, Assistant Professor of Applied Mathematics. Ph.D., University of Illinois at Urbana-Champaign. Graph Theory and Combinatorics, Discrete Optimization and Operations Research, Probabilistic Models and Methods in Discrete Mathematics.

Xiaofan Li, Associate Professor of Applied Mathematics and Director of Graduate Studies, Ph.D., University of California, Los Angeles. Computational fluid dynamics, computational materials science. Boundary integral method, moving-boundary value problems. Suspension of particles, phase transformation in materials science.

Arthur Lubin, Associate Professor of Applied Mathematics. Ph.D., University of Wisconsin, Madison. Commuting contractions in Hilbert space, spectral theory, models for analytic functions, linear system theory.

David Maslanka, Senior Lecturer and Director of Academic Resource Center. B.A., St. Xavier University; M.S., Ph.D., Illinois Institute of Technology.

F. R. McMorris, Professor of Applied Mathematics, Computer Science, and Dean of the College of Science and Letters. Ph.D., University of Wisconsin, Milwaukee. Discrete applied mathematics, computational and mathematical biology, classification theory, location theory.

Sudhakar E. Nair, Professor of Mechanical and Aerospace Engineering and Applied Mathematics, and Associate Dean of Academic Affairs, Graduate College. Ph.D., University of California, San Diego. Solid mechanics, elastic and inelastic behavior of materials, applied mathematics, moving boundary problems, wave propagation in anisotropic media.

Michael J. Pelsmajer, Assistant Professor of Applied Mathematics. Ph.D., University of Illinois, Urbana-Champaign. Graph theory, combinatorics, communication networks.

Dietmar Rempfer, Associate Professor of Mechanical and Aerospace Engineering and Applied Mathematics. Ph.D., Habilitation, Universität Stuttgart. Fluid mechanics, especially theoretical studies of transitional and turbulent shear flows in open systems; numerical fluid mechanics; modeling for environmental and urban fluid mechanics; coherent structures in turbulent flows; control of transitional and turbulent wall layers; nonlinear dynamical systems.

Susan S. Sitton, Assistant Provost for Retention and Senior Lecturer. B.A., Grinnell College; M.S., Northwestern University; Ph.D. Illinois Institute of Technology.

Holger Wendland, Associate Professor of Applied Mathematics. Ph.D., University of Göttingen. Meshless methods, radial basis functions, scattered data approximation, fluid-structure interaction, kernel learning.

Department of Applied Mathematics

Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0
GRE score minimum:
For tests taken prior to Oct.1, 2002, M.S./Ph.D.: 1500 (combined)
For tests taken on or after Oct.1, 2002, M.S.: 1100 (quantitative + verbal) 2.5 (analytical writing)
For tests taken on or after Oct.1, 2002, Ph.D.: 1100 (quantitative + verbal) 3.0 (analytical writing)
TOEFL minimum: 550/213*
At least two letters of recommendation

Admission to the professional master's program in Mathematical Finance requires a bachelor's degree in mathematics, engineering, or equivalent, with a minimum cumulative GPA of 3.0/4.0. TOEFL scores (if required) must have a minimum score of 600/213*. A professional statement of goals/objectives (2 pages) and a curriculum vitae must be submitted. Two letters of recommendation are required (at least two must be from academia, the third may be from industry). An interview may also be required.

Typically, admitted students score at least 700 on the quantitative portion of the GRE and at least 3.0 on the analytical portion. However, meeting the minimum or typical GPA test-score requirements does not guarantee admission. GPA and test scores are just two of several important factors considered for admission to the program, including grades in mathematics courses, letters of recommendation and the student's overall record of achievements.

Admission to the Master of Science and the Ph.D. program normally requires a bachelor's degree in mathematics or applied mathematics. Candidates whose degree is in another field (for example, computer science, physics, or engineering) and whose background in mathematics is strong are also eligible for admission and are encouraged to apply. Candidates in the Ph.D. program must also have demonstrated the potential for conducting original research in applied mathematics. Students must remove deficiencies in essential undergraduate courses that are prerequisites for the degree program, in addition to fulfilling all other degree requirements.

The director of graduate studies serves as temporary academic adviser for all newly admitted graduate students until an appropriate faculty member is selected as the adviser. Students are responsible for following all departmental procedures as well as the general requirements of the Graduate College.

* Paper-based test score/computer-based test score.

Master of Mathematical Finance (MMF)

(Collaborative Program with the Stuart School of Business)
21.6 quarter credits
18 semester credits

The objective of the MMF program is to provide individuals interested in pursuing careers in financial risk management with advanced education in theoretical, computational and business aspects of relevant quantitative methodologies. This is a collaborative program between the Stuart School of Business (Stuart GSB) and the Applied Mathematics Department (AM) and as such, it will give the students the chance to benefit from the strength of both units.

Required Courses

MSF 571	Computational Finance I	3.6 Qtr. Credits
MSF 572	Computational Finance II	3.6 Qtr. Credits
MSF 551	Futures, Options and OTC Derivatives	3.6 Qtr. Credits
MATH 542	Stochastic Processes	3 Sem. Credits
MATH 548	Mathematical Finance I	3 Sem. Credits
MATH 565	Monte-Carlo Methods in Finance	3 Sem. Credits
MATH 582	Mathematical Finance II	3 Sem. Credits
MATH 586	Theory and Practice of Fixed Income Models	3 Sem. Credits

Total 10.8 Quarter Credits and 15 Semester Creditss

Elective Courses

A Minimum of four additional courses including: a minimum of one MATH or CS class must be selected and a minimum three FM or MSF courses must be selected.

FM 530	Visual Basic and Databases for Financial Markets	3.6 Qtr. Credits
MSF 522	Financial Modeling I	3.6 Qtr. Credits
MSF 523	Financial Modeling II	3.6 Qtr. Credits
MSF 561	Financial Time Series Analysis	3.6 Qtr. Credits
MSF 562	Econometric Analysis	3.6 Qtr. Credits
MSF 573	Computational Finance III	3.6 Qtr. Credits
MATH 512	Partial Differential Equations	3 Sem. Credits
MATH 513	PDE's for Finance	3 Sem. Credits
MATH 543	Stochastic Analysis	3 Sem. Credits
MATH 544	Stochastic Dynamics	3 Sem. Credits
MATH 583	Quantative Modeling of Derivative	3 Sem. Credits
MATH 589	Numerical Methods for PDEs	3 Sem. Credits
CS 522	Data Mining	3 Sem. Credits

Minimum Total for Elective Courses 10.8 Quarter Credits and 6 Semester Credits

Total Minimum Credits 21.6 Quarter Credits and 18 Semester Credits

A student can transfer a maximum of 2 graduate courses from other institutions in equivalent courses.

Note: 3.6 Quarter Credits is equivalent to 2.4 Semester Credits.

Department of Applied Mathematics

Master of Science in Applied Mathematics

32 credit hours
Thesis
Comprehensive exam (Certification)

The M.S. degree program provides a broad background in the fundamentals of the advanced mathematics that is applied to solve problems in the other fields. The goal is to prepare students for careers in industry and for the doctoral program.

Required courses

A Master's thesis (up to 5 credit hours of MATH 594), under the supervision of a faculty member, and at least two of the basic sequences in the four core areas of study:

Applied Analysis

MATH 500   Applied Analysis I
MATH 501   Applied Analysis II

Discrete Applied Mathematics

MATH 553   Discrete Applied Mathematics I
MATH 554   Discrete Applied Mathematics II

Computational Mathematics

MATH 577   Computational Mathematics I
MATH 578   Computational Mathematics II

Stochastics

MATH 543   Stochastic Analysis
MATH 544   Stochastic Dynamics

Elective courses

The remaining courses in each student's program are selected in consultation with, and approval of, the Director of Graduate Studies. The program may include at most three courses at the 400-level and at most two courses outside the department.

The comprehensive examination requirement is fulfilled by achieving certification in two of the core areas of study. For procedures governing the certification process, the student should consult the current department regulations.

Doctor of Philosophy in Applied Mathematics

84 credit hours beyond the bachelor's degree
Qualifying exam
Comprehensive exam
Dissertation and Defence

The Ph.D. program provides advanced education through coursework (including independent study) and original, creative research in order to prepare students for careers in industrial research and academia. The program requires a total of 84 credit hours (approximately 52 for students entering with a master's degree).

The qualifying examination requirement is fulfilled by achieving better than a 3.5/4.0 GPA on the courses taken in three of the core areas of study listed under the M.S. degree and passing an oral examination within the first five semesters of study (within the first three semesters for students entering with a master's degree). The exam covers three of the four core areas, which can be chosen by the student. The comprehensive examination consists of an oral examination based on the student's research proposal. The exam aims to ensure that the student has

the background to carry out successful research in his/her chosen area and the proposed research has sufficient scholarly merit. Exceptions to these general rules require approval by the departmental Graduate Studies Committee.

Besides the courses in the core areas of study, the remaining courses in the program are selected in consultation with the student's academic adviser. The program must include at least three (but no more than five) courses in an area of concentration outside of the department, as approved by the director of graduate studies; these may include 400-level courses.

The dissertation (thesis) is expected to contain a distinct and substantial, original and publishable contribution to the field of study. The credit hours devoted to thesis research (MATH 691) must total between 24 and 32. An oral examination in defense of the thesis constitutes completion of the degree.

Department of Applied Mathematics

Course Descriptions

Numberes in parentheses represent class, lab and total credit hours, respectively.

MATH 400
Real Analysis
Real numbers, continuous functions; differentiation and Riemann integration. Functions defined by series. Prerequisite: MATH 251 or instructor's consent. (3-0-3)

MATH 401
Analysis II
Functions of several variables, partial differentiation, and multiple integrals. Prerequisite: MATH400. (3-0-3)

MATH 402
Complex Analysis
Analytic functions, conformal mapping, contour integration, series expansions, singularities and residues, applications. Intended as a first course in the subject for students in the physical sciences and engineering. Prerequisite: MATH 251. (3-0-3)

MATH 405
Introduction to Iteration and Chaos
Functional iteration and orbits, periodic points and Sharkovsky's cycle theorem, chaos and dynamical systems of dimensions one and two. Julia sets and fractals, physical implications. Prerequisites: MATH 251, MATH 252 and one of the following: MATH 332, MATH 333 or instructor's consent. (3-0-3) (C)

MATH 410
Number Theory
Divisibility, congruences, distribution of prime numbers, Diophantine equations, applications to encryption methods. Prerequisite: MATH 230 or instructor's consent. (3-0-3)

Math 420
Geometry
The course is focused on selected topics related to fundamental concepts and methods of Euclidean geometry in two and three dimensions and their applications with emphasis on various problem-solving strategies, geometric proof, visualization, and interrelation of different areas of mathematics. Prerequisites: consent of the instructor. (3-0-3)

MATH 426
Statistical Tools For Engineers
Descriptive statistics and graphs, probability distributions, random sampling, independence, significance tests, design of experiments, regression, time-series analysis, statistical process control, and introduction to multivariate analysis. Prerequisite: Junior standing. Same as CHE 426. (Credit not given for both MATH 426 and CHE 426. (3-0-3)

Math 430
Applied Algebra
Relations; modular arithmetic; group theory: symmetry, permutation, cyclic, and abelian groups; group structure: subgroups, cosets, homomorphisms, classification theorems; rings and fields. Applications to crystallography, cryptography, and check-digit schemes. Prerequisite: MATH 230 or MATH 332. (3-0-3)

MATH 453
Combinatorics
Permutations and combinations; pigeonhole principle; inclusion-exclusion principle; recurrence equations and generating functions; enumeration under group action. Prerequisite: MATH 230. (3-0-3)

MATH 454
Graph Theory and Applications
Graph theory is the study of systems of points with some of the pairs of points joined by lines. Sample topics include: paths, cycles and trees; adjacency and connectivity; directed graphs; Hamiltonian and Eulerian graphs and digraphs; intersection graphs. Applications to the sciences (computer, life, physical, social) and engineering will be introduced throughout the course. Credit will not be granted for both MATH 454 and MATH 553. Prerequisite: MATH 230, MATH 251 or MATH 252. (3-0-3)

MATH 461
Fourier Series and Boundary-Value Problems
Fourier series and integrals. The Laplace, heat, and wave equations: Solutions by separation of variables. D'Alembert's solution of the wave equation. Boundary-value problems. Prerequisites: MATH 251, MATH 252. (3-0-3)

MATH 471
Numerical Methods
Number representation, errors, iterative methods for nonlinear equations, polynomial interpolation, differentiation, integration, Gauss elimination. Prerequisites: MATH 251, MATH 252. Corequisite: MATH 332 or MATH 333. (3-0-3)

MATH 474
Probability and Statistics
Elementary probability theory including discrete and continuous distributions; sampling, estimation, confidence intervals, hypothesis testing, and linear regression. Prerequisite: MATH 251. Credit not granted for both MATH 474 and MATH 475. (3-0-3)

MATH 475
Probability
Elementary probability theory; combinatorics; random variables; discrete and continuous distributions; joint distributions and moments; transformations and convolution; basic theorems; simulation. Prerequisite: MATH 251. Credit not granted for both MATH 474 and MATH 475. (3-0-3)

MATH 476
Statistics
Estimation theory; hypothesis tests; confidence intervals; goodness-offit tests; correlation and linear regression; analysis of variance; nonparametric methods. Prerequisite: MATH 475. (3-0-3)

MATH 477
Numerical Linear Algebra
Fundamentals of matrix theory, least squares problems, computer arithmetic, conditioning and stability, direct and iterative methods for linear systems, eigenvalue problems

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Credit may not be granted for both MATH 477 and MATH 473.. Prerequisite: MATH 471 or consent of the instructor. (3-0-3)

MATH 478
Numerical Methods for Differential Equations

Polynomial interpolation; numerical integration; numerical solution of initial value problems for ordinary differential equations by single and multi-step methods, Runge-Kutta, Predictor-Corrector; numerical solution of boundary value problems for ordinary differential equations by shooting method, finite differences. Credit may not be granted for both MATH 478 and MATH 472. Prerequisite: MATH 471 or consent of instructor. (3-0-3)

MATH 481
Introduction to Stochastic Processes

This is an introductory course in stochastic processes. Its purpose is to introduce students into a range of stochastic processes, which are used as modeling tools in diverse fields of applications, especially in the business applications. The course introduces the most fundamental ideas in the area of modeling and analysis of real World phenomena in terms of stochastic processes. The course covers different classes of Markov processes. It also presents some aspects of stochastic calculus with emphasis on the application to financial modeling and financial engineering. Prerequisite: MATH 332 or MATH 333, MATH 475. (3-0-3)

MATH 482
Introduction to Markov Processes

Random walks, discrete time Markov chains; Poisson processes, continuous time Markov chains; renewal theory. Prerequisite: MATH 475. (3-0-3)

MATH 483
Design and Analysis of Experiments

Principles of estimation; hypothesis tests, confidence intervals. Contingency tables; goodness-of-fit. Analysis of variance; linear regression. Hierarchical and split plot designs; analysis of covariance.

Multiple regression. Prerequisites: MATH 476. (3-0-3)

MATH 485
Introduction to Mathematical Finance

This is an introductory course in mathematical finance. Technical difficulty of the subject is kept at a minimum by considering a discrete time framework. Nevertheless, the major ideas and concepts underlying modern mathematical finance and financial engineering will be explained and illustrated. Prerequisite: MATH475 or equivalent.(3-0-3)

MATH 486
Mathematical Modeling I

A general introduction to optimization problems. Linear programming: the simplex method. Elements of graphs and networks. Introduction to game theory. Applications. Prerequisite: MATH 475 or instructor's consent. (3-0-3) (C)

MATH 487
Mathematical Modeling II

The formulation of mathematical models, solution of mathematical equations, interpretation of results. Selected topics from queueing theory and financial derivatives. Prerequisite: MATH 252. (3-0-3) (C)

MATH 488
Ordinary Differential Equations and Dynamical Systems

Boundary-value problems: Green's functions, Sturm-Liouville theory, eigenfunction expansions. Linear and nonlinear systems: existence and uniqueness, Floquet theory, stability concepts. Phase-plane analysis; critical points, limit cycles. Prerequisites: MATH 252. (3-0-3)

MATH 489
Partial Differential Equations

First-order equations, characteristics. Classification of second-order equations. Laplace's equation; potential theory. Green's functions, maximum principles. The wave equation: characteristics, general solution. The heat equation: Use of integral transforms. Prerequisite: MATH 461. (3-0-3)

MATH 491
Reading and Research

(Credit: Variable)

Math 500
Applied Analysis I

Metric and Normed Spaces; Continuous Functions; Contraction Mapping Theorem; Topological Spaces; Banach Spaces; Hilbert Spaces; Eigenfunction expansion. Prerequisites: MATH 400 or consent of the instructor. (3-0-3)

Math 501
Applied Analysis II

Bounded Linear Operators on a Hilbert Space; Spectrum of Bounded Linear Operators; Linear Differential Operators and Green's Functions; Distributions and the Fourier Transform; Measure Theory, Lebesgue Integral and Function Spaces; Differential Calculus and Variational Methods. Prerequisites: MATH 500 or consent of the instructor. (3-0-3)

Math 512
Partial Differential Equations

Basic model equations describing wave propagation, diffusion and potential functions; characteristics, Fourier transform, Green function, and eigenfunction expansions; elementary theory of partial differential equations; Sobolev spaces; linear elliptic equations; energy methods; semigroup methods; applications to partial differential equations from engineering and science. Prerequisites: MATH 461 or MATH489 or consent of the instructor. (3-0-3)

Math 515
Ordinary Differential Equations and Dynamical Systems

Basic theory of systems of ordinary differential equations; equilibrium solutions, linearization and stability; phase portraits analysis; stable, unstable and center manifolds; periodic orbits, homoclinic and heteroclinic orbits; bifurcations and chaos; nonautonomous dynamics; and numerical simulation of nonlinear dynamics. Prerequisites: MATH 252 or consent of the instructor. (3-0-3)

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MATH 519
Complex Analysis
Analytic functions, contour integration, singularities, series, conformal mapping, analytic continuation, multivalued functions. Prerequisite: MATH 402 or instructor's consent. (3-0-3)

MATH 530
Algebra
Axiomatic treatment of groups, rings and fields, ideals and homomorphisms; field extensions, modules over rings. Prerequisite: MATH 332 or MATH 430. (3-0-3)

Math 532
Linear Algebra
Matrix algebra, vector spaces, norms, inner products and orthogonality, determinants, linear transformations, eigenvalues and eigenvectors, Cayley-Hamilton theorem, matrix factorizations (LU, QR, SVD). Prerequisites: MATH 332 or consent of the instructor. (3-0-3)

MATH 540
Probability
Random events and variables, probability distributions, sequences of random variables and limit theorems. Prerequisite: MATH 400 or instructor's consent. (3-0-3)

MATH 542
Stochastic Processes
This is an introductory course in stochastic processes. Its purpose is to introduce students to a range of stochastic processes, which are used as modeling tools in diverse fields of applications, especially in the business applications. The course introduces the most fundamental ideas in the area of modeling and analysis of real world phenomena in terms of stochastic processes. The course covers different classes of Markov processes: discrete and continuous-time Markov chains, Brownian motion and diffusion processes. It also presents some aspects of stochastic calculus with emphasis on the application to financial modeling and finanacial engineering. Credits cannot be given to both Math 481 and Math 542.

Prerequisite: MATH332 or MATH333 and MATH475. (3-0-3)

Math 543
Stochastic Analysis
This course will introduce the student to modern finite dimensional stochastic analysis and its applications. The topics will include: a) an overview of modern theory of stochastic processes, with focus on semimartingales and their characteristics, b) stochastic calculus for semimartingales, including Ito formula and stochastic integration with respect to semimartingales, c) stochastic differential equations (SDE's) driven by semimartingales, with focus on stochastic SDE's driven by Levy processes, d) absolutely continuous changes of measures for semimartingales, e) some selected applications. Prerequisite: MATH 475 or consent of an instructor. (3-0-3)

MATH 544
Stochastic Dynamics
This course is about modeling, analysis, simulation and prediction of dynamical behavior of complex systems under random influences. The mathematical models for such systems are in the form of stochastic differential equations. It is especially appropriate for graduate students who would like to use stochastic methods in their research, or to learn these methods for long term career development. Topics include white noise and colored noise, stochastic differential equations, random dynamical systems, numerical simulation, and applications to scientific, engineering and other areas. Prerequisite:MATH 474, MATH 475 or MATH 543 or equivalent.

MATH 545
Stochastic Partial Differential Equations
This course introduces various methods for understanding solutions and dynamical behaviors of stochastic partial differential equations arising from mathematical modeling in science and engineering and other areas. It is designed for graduate students who would like to use stochastic methods in their research or

to learn such methods for long term career development. Topics include: Random variables, Brownian motion and stochastic calculus in Hilbert spaces; Stochastic heat equation; Stochastic wave equation; Analytical and approximation techniques; Stochastic numerical simulations via Matlab; Dynamical impact of noises; Stochastic flows and cocycles; Invariant measures, Lyapunov exponents and ergodicity; and applications to engineering and science and other areas.Prerequisites: MATH 543 or MATH 544 or consent of instructor. (3-0-3)

MATH 546
Introduction to Time Series
Properties of stationary, random processes; standard discrete parameter models, autoregressive, moving average, harmonic; standard continuous parameter models. Spectral analysis of stationary processes, relationship between the spectral density function and the autocorrelation function; spectral representation of some stationary processes; linear transformations and filters. Introduction to estimation in the time and frequency domains. Prerequisite: MATH 475 or ECE 511. (3-0-3)

Math 548
Mathematical Finance I: Discrete Time
This is an introductory course in mathematical finance. Technical difficulty of the subject is kept at a minimum by considering a discrete time framework. Nevertheless, the major ideas and concepts underlying modern mathematical finance and financial engineering will be explained and illustrated. Credits cannot be given to both Math 485 and Math 548. Prerequisite: MATH474 or MATH475 and MATH481 or MATH542. (3-0-3)

MATH 550
Topology
Topological spaces, continuous mappings and homoeomorphisms, metric spaces and metrizability, connectedness and compactness, homotopy theory. Prerequisite: MATH 556. (3-0-3)

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MATH 553
Discrete Applied Mathematics I
Graph theory is the study of systems of points with some of the pairs of points joined by lines. Sample topics include: paths, cycles and trees; adjacency and connectivity; directed graphs; Hamiltonian and Eulerian graphs and digraphs; intersection graphs. Applications to the sciences (computer, life, physical, social) and engineering will be introduced throughout the course. This course runs concurrently with Math 454 but projects and homework are at the graduate level. Credits cannot be given to both MATH 553 and MATH 454. Prerequisite: Math 453 or instructor's consent. (3-0-3)

Math 554
Discrete Applied Mathematics II
Graduate level treatment of applied combinatorics; posets: product and dimension, lattices, extremal set theory and symmetric chain decomposition; combinatorial designs: block designs, Latin Squares, finite fields, block designs and Steiner systems, finite projective planes; coding theory: error-correcting codes, Hamming and sphere bounds, linear codes, codes from liar games and adaptive coding. Prerequisite: MATH 453, MATH 454, or MATH 553. (3-0-3)

MATH 555
Tensor Analysis
Development of the calculus of tensors with applications to differential geometry and the formulation of the fundamental equations in various fields. Prerequisites: MATH 332 and either MATH 400 or instructor's consent. (3-0-3)

MATH 556
Metric Spaces
Point-set theory, compactness, completeness, connectedness, total boundedness, density, category, uniform continuity and convergence, Stone-Weierstrass theorem, fixed-point theorems.
Prerequisite: MATH 400. (3-0-3)

Math 557
Probabilistic Methods in Combinatorics
Graduate level introduction to probabilistic methods, including linearity of expectation, the deletion method, the second moment method and the Lovász Local Lemma. Many examples from classical results and recent research in combinatorics and graph theory will be included throughout, including from Ramsey Theory, random graphs, coding theory, and number theory. Prerequisite: graduate status or consent of instructor. (3-0-3)

MATH 563
Statistics
Theory of limiting distributions; interval and point estimation, sufficient statistics. Bayesian procedures, hypothesis testing, nonparametric methods. Prerequisite: MATH 475. (3-0-3)

MATH 564
Applied Statistics
Linear regression and correlation models, regression parameters, prediction and confidence intervals, time series, analysis of variance and covariance. Prerequisites: MATH 332 and MATH 475, or instructor's consent. (3-0-3)

Math 565
Monte Carlo Methods in Finance
In addition to the theoretical constructs in financial mathematics, there are also a range of computational/simulation techniques that allow for the numerical evaluation of a wide range of financial securities. This course will introduce the student to some such simulation techniques, known as Monte Carlo methods, with focus on applications in financial risk management. Monte Carlo and Quasi Monte Carlo techniques are computational sampling methods which track the behavior of the underlying securities in an option or portfolio and determine the derivative's value by taking the expected value of the discounted payoffs at maturity. Recent developments with parallel program-

ming techniques and computer clusters have made these methods widespread in the finance industry. Prerequisite: MATH474. (3-0-3)

MATH 566
Multivariate Analysis
Random vectors, sample geometry and random sampling, generalized variance, multivariate normal and Wishart distributions, estimation of mean vector, confidence region, Hotelling's T2, covariance, principal components, factor analysis, discrimination, clustering. Prerequisites: MATH 532, MATH 563, MATH 564. (3-0-3)

MATH 567
Design and Analysis of Experiments
Analysis of variance, fixed, random, and mixed effects models, analysis of covariance, randomized designs, randomized blocks, nested designs, Latin square and related designs. Prerequisite: MATH 476. (3-0-3)

MATH 568
Topics in Statistics
Categorical data analysis, contingency tables, log-linear models, nonparametric methods, sampling techniques. Prerequisite: MATH 563. (3-0-3)

MATH 577
Computational Mathematics I
Fundamentals of matrix theory, least squares problems, computer arithmetic, conditioning and stability, direct and iterative methods for linear systems, eigenvalue problems. Credits cannot be given to both Math477 and Math577. Prerequisite: MATH 471 or instructor's consent. (3-0-3)

Math 578
Computational Mathematics II
Polynomial interpolation; numerical integration; numerical solution of ordinary differential equations by single and multi-step methods, Runge-Kutta, Predictor-Corrector; numerical solution of boundary value problems for ordinary differential equations by shooting methods, finite

Department of Applied Mathematics

differences and spectral methods. Credits cannot be granted for both MATH 578 and MATH 478. Prerequisite: MATH 471 or instructor's consent. (3-0-3)

Math 579
Complexity of Numerical Problems
This course is concerned with a branch of complexity theory. It studies the intrinsic complexity of numerical problems, that is, the minimum effort required for the approximate solution of a given problem up to a given error. Based on a precise theoretical foundation, lower bounds are established, i.e. bounds that hold for all algorithms. We also study the optimality of known algorithms, and describe ways to develop new algorithms if the known ones are not optimal. Prerequisite: MATH471. (3-0-3)

MATH 581
Theory of Finite Elements
The geometry of the various elements, the element matrices, assembly of stiffness matrices, analysis of error estimates and convergence proofs. Applications. Prerequisite: MATH 400 or instructor's consent. (3-0-3)

Math 582
Mathematical Finance II: Continuous Time
This course is a continuation of Math 485/548. It introduces the student to modern continuous time mathematical finance. The major objective of the course is to present main mathematical methodologies and models underlying the area of financial engineering, and, in particular, those that provide a formal analytical basis for valuation and hedging of financial securities. Prerequisite: MATH 485/548; MATH 481/542, or consent of an instructor. (3-0-3)

Math 586
Theory and Practice of Fixed Income Modeling
The course covers basics of the modern interest rate modeling and fixed income asset pricing. The main goal is to develop a practical understand-

ing of the core methods and approaches used in practice to model interest rates and to price and hedge interest rate contingent securities. The emphasis of the course is practical rather than purely theoretical. A fundamental objective of the course is to enable the students to gain a hand-on familiarity with and understanding of the modern approaches used in practice to model interest rate markets. Prerequisite: MATH543 and MATH485 or consent of the instructor. Corequisite: MATH582. (3-0-3)

Math 589
Numerical Methods for Partial Differential Equations
Introduction to numerical methods especially finite difference methods for solving partial differential equations including parabolic, hyperbolic and elliptic equations. Topics include convergence, stability, iterative methods for elliptic problems, various finite difference methods for parabolic, hyperbolic PDEs and Navier-Stokes equations and their properties, introduction to finite volume method and finite element method. Prerequisites: Math 471 and Math 489 or instructor consent. (3-0-3)

Math 591
Research and Thesis for M.S. Degree
(Credit: variable)

MATH 593
Seminar in Mathematics
(Credit: Variable)

MATH 594
Special Projects
(Credit: Variable)

MATH 596
Math For Teachers: Elementary
An in-service workshop for precollege teachers emphasizing the phenomenological approach to the teaching of mathematics. Prerequisite: Certification as mathematics teacher or approval of the instructor. (Credit: Variable)

MATH 597
Reading and Special Projects
(Credit: Variable)

MATH 598
Math For Teachers: High School
An in-service workshop for precollege teachers emphasizing the phenomenonological approach to teaching of integrated mathematics and science at the high school level. Prerequisite: Certification as teacher or approval of instructor. (Credit: Variable)

MATH 601
Advanced Topics in Combinatorics
Course content is variable and reflects current research in combinatorics. Prerequisite: MATH 554 or instructor's consent. (3-0-3)

MATH 602
Advanced Topics in Graph Theory
Course content is variable and reflects current research in graph theory. Prerequisite: MATH 554 or instructor's consent. (3-0-3)

MATH 603
Advanced Topics in Computational Mathematics
Course content is variable and reflects current research in computational mathematics. Prerequisite: MATH 578 or instructor's consent. (3-0-3)

MATH 604
Advanced Topics in Applied Analysis
Course content is variable and reflects current research in applied analysis. Prerequisite: MATH 501 or instructor's consent. (3-0-3)

MATH 605
Advanced Topics in Stochastic Analysis
Course content is variable and reflects current research in stochastic analysis. Prerequisite: MATH 564 or instructor's consent. (3-0-3)

MATH 691
Research and Thesis Ph.D.
(Credit: Variable)

College of Architecture

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**Assistant Dean for
Graduate Academic Affairs:**
Nicole X. Osborne

Assistant Dean for Buildings and Operations
Rob Jones, B.Arch

**Director, Doctor of Philosophy (Ph.D.)
in Architecture Program:**
Mahjoub Elnimeiri, Ph.D.

**Director of Thesis and Master of Architecture
Post-Professional Degree Program (Program 1):**
David Sharpe

**Director of Master of Architecture
Professional Degree Program (Program 2 and 3):**
TBD

Mission

The College of Architecture's graduate degree programs emphasize investigations in architectural design and technology, while expanding the significance of such investigations through rigorous, critical thought. The College draws strength from its Mies van der Rohe heritage, its key position in the legacy of Modernism, its location in Chicago, and its connections to progressive practitioners and emerging global architectural practices. Our students, faculty and alumni are intellectually serious, professional and international.

Architectural education at IIT offers unique combinations, intertwining design and technology to produce advanced architecture. Our commitment includes the needs of our South Side Chicago neighborhood, our city and its inhabitants. Our perspective is inclusive of architecture's allied disciplines and committed to the highest quality in our students' professional preparation. Our mission relies on certain guiding values: design excellence, technical expertise, advanced professional practice, and respect for the architect in society today as an ethical, thoughtful and informed producer not only of buildings, but also of all visual and physical environments. The College of Architecture is a force for quality built environments and society's advancement through a humane use of technology, materials, space and form.

Curriculum

In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accreditation Board (NAAB), which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes two types of degrees: the Bachelor of Architecture and the Master of Architecture. A program may be granted a six-year, three-year or two-year term of accreditation, depending on its degree of conformance with established educational standards.

Master's degree programs may consist of a pre-professional undergraduate degree and a professional graduate degree, which, when earned sequentially, comprise an accredited professional education. However, the pre-professional degree is not, by itself, recognized as an accredited degree.

In the professional degree, the Master of Architecture (Program 3 or Program 2), our tenets operate throughout the architectural studio curriculum from the beginning to the most advanced stages of architectural production. At every level of studio instruction, the architecture faculty emphasizes the unique integration of building technology studies and design. Supplementary core coursework gives a basis in visual studies, structures, building systems, professional practices, planning and architectural history theory. Related elective courses and a diverse lecture series center on specific topics, such as advanced construction technology, sustainable design, urbanism, computer applications, and architectural concepts of the 20th and 21st centuries and their intersection with modern culture.

The post-professional degree program, also named a Master of Architecture (Program 1), emphasizes extended research in architectural topics, allowing students who already possess the Bachelor of Architecture degree to develop further their special expertise. Thesis projects done at IIT have made major theoretical contributions to contemporary architecture and global practice, while other projects have directly enriched the architectural legacy of Chicago.

Curriculum continued

Our Doctor of Philosophy (Ph.D.) in Architecture program, requiring at least three years of study beyond the M.Arch., advances knowledge through highly specific architectural research and doctoral dissertations. Recent areas of study include high-rise and long-span buildings, energy-conscious design, emerging urbanisms, housing and advanced computer applications.

The College of Architecture at IIT has much to offer in providing students a rich and challenging academic atmosphere, while preparing them to meet their professional responsibilities. Situated in Mies van der Rohe's masterpiece, S.R. Crown Hall, amid the seminal campus of 20th-century architecture, graduate study offers a powerful connection every day to the best values in archi-

tecture and to some of the most diverse and interesting students anywhere. From the perspective of the emergent 21st century, the history of 20th-century American architecture is visible in Chicago and its surrounding suburbs. With many significant buildings by Frank Lloyd Wright, Daniel H. Burnham and other internationally significant architects, the city takes great pride in this heritage, which offers incomparable opportunities for study. Chicago also offers numerous avenues to gain valuable professional experience during the summer months in leading architectural firms. The College of Architecture has a long, established tradition of retaining practicing architects and engineers from these firms to participate actively in the graduate programs as faculty, consultants and staff members.

Degrees Offered

Master of Architecture (Professional Degree)
   (M. Arch. Program 3)
Master of Architecture (Professional Degree
   with Advanced Standing) (M. Arch. Program 2)

Master of Architecture (Post-Professional Degree)
   (M. Arch. Program 1)
Master of Landscape Architecture
   (Professional Degree M.L.A.)
Doctor of Philosophy in Architecture (Ph.D.)

Research Facilities

The College of Architecture's research materials are housed primarily on the lower level of S.R. Crown Hall with satellite and additional collections available in 3410 S. State and the Metals and Machinery Building. The Graham Resource Center (GRC) is a branch of the Galvin Library that serves the College of Architecture and houses 11,000 books, 52 journals, 40,000 images, maps, on-line electronic resources and architecture-related special collections. The GRC maintains the College of Architecture Archives and assists with administration of the College's Dark Room and a growing Materials collection. The GRC is found on the lower level of S.R. Crown Hall and can be reached via telephone at 312.567.3256, on the web at www.gl.iit.edu/grc, or via e-mail at architecturelibrary@iit.edu.

The Materials Lab is a 4200 square foot facility that includes a complete set of tools and machinery for working with wood, metal and plastic. It includes assembly space and a paint spray booth. Additionally, the College of Architecture has a Universal Laser Cutter, a Bridgeport CNC Mill, and a CNC Router Table for 3D digital modeling projects.

The Multimedia Lab has 34 PCs for use in conjunctions with studio projects and related advanced computer design courses. All computers have advanced AutoCAD, graphics and 3D Modeling applications, as well as standard productivity software. In 2001, Crown Hall was equipped with a wireless network for unlimited access throughout the studios to the Internet. Providing hard-wire access to the internet, individual network ports have been installed at every design studio drawing table, permitting students to work with digital technology alongside their drafting projects. Recent equipment acquisitions include 33 new PCs in the Crown Hall computer lab, a new and fully equipped computer lab for 30 students in the 3410 building, a large format 42-inch scanner, and supporting color laser printers.

With recent increases in enrollment, the College of Architecture has expanded its research, studio, and administrative facilities to two additional buildings adjacent to Crown Hall, 3410 South State St. and the minerals and Metals Building.

Research Areas

Faculty and doctoral candidates conduct research on a wide range of important topics related to the practice of architecture and the construction of significant buildings at all scales. Thesis students investigate projects involving the design, planning and structure of high-rise buildings; the research, planning and design of large-scale projects such as stadiums, airports, convention centers, institutional buildings and commercial facilities; technological applications such as new materials, composites, prefabricated

applications, systems of building enclosure, and other methods of construction; emerging urbanisms, including global practices of architecture and new urban cultures; the influence of climate and environment upon building form, sustainable design and energy efficiency; computer applications such as 3-D modeling, multimedia and graphic image presentations, concepts of animation, and 3-D modeling techniques and approaches; and housing, including high-density, low-density and affordable housing.

College of Architecture

Faculty

Peter Beltemacchi, Associate Professor and Associate Dean. B.S., M.S., Illinois Institute of Technology. Urban design and city and regional planning.

Charles Braucher, Instructor. B.F.A., School of the Art Institute of Chicago; B. Arch., Illinois Institute of Technology. Freehand drawing and architectural design.

Thomas Brock, Assistant Professor. B.Arch. University of Cincinnati; M. Arch., University of Pennsylvania. Architectural design, construction technologies and digital media.

Tim Brown, Studio Associate Professor. B.S.Arch., Clemson University; M.Arch., University of Illinois, Chicago. Architectural design and theory.

Susan Conger-Austin, Assistant Professor. B.A., Stanford University; M.Arch., Princeton University. Architectural design and theory.

Blake Davis, Instructor. B.A., M.A. City and Regional Planning, Illinois Institute of Technology. Sustainable design and building systems, rural planning.

Dirk Denison, Assistant Professor. B.Arch., M.B.A., Illinois Institute of Technology; M.Arch., Harvard University. Architectural design and community design.

John Durbrow, Assistant Professor. B.Arch., B.A. Fine Arts, Rice University. Architectural design, materials and technologies, planning, furniture design.

Mahjoub Elnimeiri, Professor and Director of Ph.D. in Architecture Program. B.S., University of Khartoum; M.S., University of London, Imperial College; Ph.D., Northwestern University. Structural engineering, architectural design theory.

Martin Felsen, Studio Associate Professor. B.Arch., Virginia Polytechnic Institute; M.S., Columbia University. Architectural design and digital technolgies.

Frank Flury, Assistant Professor. M.Arch. Diplom, University of Karlsruhe. Architectural design, design and build.

Thomas Gentry, Assistant Professor. B.Arch., University of Arizona; M.Arch., Illinois Institute of Technology. Design and theory, design build, housing, environmental sustainability, building systems.

Isabela Gould, Instructor. B.Arch., Ion Mincu Institute of Architecture; M.S.Arch, University of Cincinnati. Architectural design and theory.

Gerald Horn, Studio Professor. Architectural design, mixed-use development, design analysis.

David Hovey, Associate Professor. B.Arch., M.S.Arch., Illinois Institute of Technology. Architectural design, medium- and high-density housing, design analysis, real estate development.

Chris Karidis, Studio Professor. B.Arch., Illinois Institute of Technology. Architectural design and building technology.

Thomas Kearns, Assistant Professor. B.Arch., Iowa State University. Architectural design and theory, digital technologies.

Randall Kober, Visiting Assistant Professor. B.A., University of Wisconsin, Madison; M.Arch., University of Illinois, Chicago. Architectural design, and theory.

Robert Krawczyk, Assistant Professor. B.Arch., University of Illinois, Chicago. Computer-aided design and advanced digital applications.

Ron Krueck, Studio Professor. B.Arch., Illinois Institute of Technology. Architectural design and theory.

Eva Kultermann, Assistant Professor. B.Arch., University of Arkansas; M.S., Oxford Brookes University. Design and theory, design build, sustainability.

Peter Land, Professor. Dipl. Arch., Architectural Association; M.Arch., Carnegie Institute of Technology; M.C.P., Yale University. Innovative structures, building technologies and materials. Low-energy design; high-density, low-rise housing; urbanism and planning.

Harry Francis Mallgrave, Assistant Professor. B.E.S., MArch., University of Detroit; Ph.D., University of Pennsylvania. History and theory of architecture.

Kathleen Nagle, Studio Associate Professor. B.A., Williams College; M.Arch., Harvard University. Architectural design.

Paul Pettigrew, Instructor. B.S.Arch., University of Illinois, Champaign-Urbana; M.Arch., Massachusetts Institute of Technology. Architectural design and theory.

Benjamin R. Riley, Assistant Professor. B. Arch., Illinois Institute of Technology. Architectural design, building technology, visual training.

Donna V. Robertson, Associate Professor and Dean. B.A., Stanford University; M.Arch., University of Virginia. Architectural design and practice. Preservation, case study methodology.

College of Architecture

Faculty continued

Peter Roesch, Studio Associate Professor. Ingenieur fur Hochbau, Staatsbauschule Coburg (Germany); M.S.Arch., Illinois Institute of Technology. Architectural design, medium- and high-density housing, and urban design.

John Ronan, Assistant Professor. B.S., University of Michigan; M.Arch., Harvard University Graduate School of Design. Architectural design and material investigation.

Mark Schendel, Visiting Assistant Professor. B.S., Florida State University; B.S.Arch., Florida A&M University; M.Arch., Harvard University Graduate School of Design. Architectural design and research.

George Schipporeit, Associate Professor. Building technology and systems, high-rise design, medium- and high-density housing.

David Sharpe, Associate Professor. B.S.Arch., Tuskegee Institute; B.Arch., M.S.Arch., Illinois Institute of Technology. High-rise buildings, long-span structures, urban design, and design analysis.

Arthur Takeuchi, Associate Professor. B.Arch., M.S.Arch., Illinois Institute of Technology. Architectural design, visual training, and building technology.

Catherine Wetzel, Assistant Professor. B.Arch., University of Cincinnati; M.Arch., University of Pennsylvania. Architectural design and practice.

College of Architecture

Admission Requirements for Master of Architecture

Completed application form
Cumulative Undergraduate GPA: minimum 3.0/4.0
Portfolio
Three letters of recommendation
Statement of intent
Official transcripts
GRE scores
TOEFL scores
Application Fee

Requirements for graduate admission vary according to what degrees applicants have previously completed. The Master of Architecture Professional Degree Program (Program 3) requires a bachelor's degree in any discipline. Advanced standing in the M.Arch. Professional Degree Program (Program 2) requires a Bachelor of Science in Architecture or in a closely related field (from a U.S. pre-professional program or an architecture professional degree from an international program). Admission to the M.Arch. Post-Professional Degree Program (Program 1) requires completion in high standing of a professional Bachelor of Architecture degree from a NAAB-accredited U.S. architecture program. All programs require a minimum undergraduate grade point average of 3.0 on a 4.0 scale.

Applicants must submit a portfolio of previous academic or professional work in a portable and professionally acceptable format (approximately 8.5 by 11 inches), three letters of recommendation from individuals able to appraise the applicant's achievement and potential,

a statement of intent describing academic or professional objectives, and GRE scores, which are less than five years old.

International applicants from non-English speaking countries are required to submit TOEFL scores of 550/213/80 (paper-based test score scale/computerized test score scale/internet-based) or above. Admitted international students with TOEFL scores between 550/213/80 and 600/250/100 will be required to take an English proficiency exam upon arrival at IIT; in addition, they may be required to take additional courses to develop their language skills. English language courses required for international students do not apply to program credit hours. Admitted international students must submit an affi-davit of financial support confirming adequate funding for their entire term of study. An I-20 cannot be issued unless the financial affidavit is on file with the Office of Graduate Admission.

Although we encourage early submission, completed applications and all supporting documents must be received no later than January 15. Candidates will be accepted only for the fall semester.

For the graduate programs to achieve their objectives, it is necessary to restrict the number of students admitted. Admission to the graduate programs is limited by College requirements. All applicants are considered on a competitive basis, with every effort being made to select outstanding candidates.

Master of Architecture — Professional Degree (Program 3)

The three-year Master of Architecture professional degree program (Program 3) serves those students seeking a consummate professional education. The degree is accredited by the National Architectural Accreditation Board (NAAB) and is a necessary component for licensure in the profession of architecture. The curriculum addresses principles of design concepts, materials, construction, sys-

tems, planning, history and visual judgment, principles that remain fundamental for the development of the creative process. The required core coursework offers foundation knowledge, skills and vocabulary, while upper-level study seeks to instill a broader understanding of architecture by combining theoretical exploration with practical considerations.

Curriculum and Admission Requirements

For holders of a B.A. or B.S. degree who satisfy the prerequisites for admission, the course of study will be three years (six semesters) in length. To be admitted without conditions to the professional degree program, an applicant is required to possess the following: 1) an understanding of basic systems and analytical procedures, including mechanics, heat transfer, light and sound, as demonstrated through the successful completion of a college- level physics course equivalent to IIT's PHYS 211 and PHYS 212; 2) an understanding of basic mathematical principles and analytical procedures, including algebra, geometry and trigonometry, as demonstrated through successful completion of college-level

mathematics equivalent to IIT's MATH 119 and MATH 122; 3) a basic ability to produce freehand drawings of architectural forms and spaces, as demonstrated by the successful completion of one college-level drawing course or by portfolio submissions; and 4) an equivalent of 20 credit hours of liberal arts and humanities courses.

Candidates admitted with deficiencies in any of these prerequisites must fulfill them before matriculation. These prerequisite courses do not apply to program credit hours. Applicants must have a college grade point average of 3.0/4.0.

College of Architecture

M.Arch. Program 3 Curriculum

First year

Fall Semester		Credit Hours
ARCH 425	Digital Architectural Media I	3
ARCH 541	Studio I: Materials & Applications	6
ARCH 500	History of Architectural Ideas I	3
ARCH 567	Architectural Drawing and Model Making	3
ARCH 431	Visual Training I	2
Total		**17**

Spring Semester		Credit Hours
ARCH 485	Structural Design I	3
ARCH 542	Studio II: Architecture I	6
ARCH 443	Ecology, Sustainability, Site	3
ARCH 501	History of Architectural Ideas II	3
ARCH 432	Visual Training II	2
Total		**17**

Second year

Fall Semester		Credit Hours
ARCH 543	Studio III: Architecture II	6
ARCH 486	Structural Design II	3
ARCH 502	Advanced Topics in History and Theory I	3
ARCH 403	Building Systems I	3
ARCH 426	Computer-Aided Design in Practice	3
Total		**18**

Spring Semester		Credit Hours
*ARCH 544	Studio IV: Architecture III	6
ARCH 503	Advanced Topics in History and Theory II	3
ARCH 404	Building Systems II	3
ARCH 427	Digital Architectural Media II	3
Elective	Architecture related	3
Total		**18**

Third year

Fall Semester		Credit Hours
ARCH 545	Studio V: Advanced Architectural Design	6
CRP 519	City Planning I: Housing and Housing Types	3
ARCH 423	Programming and Technical Writing	3
ARCH 509	Topics in Advanced Architecture Technologies	3
Elective	Architecture related	3
Total		**18**

Spring Semester		Credit Hours
**ARCH 546	Studio VI: Comprehensive Building Design II	6
CRP 520	City Planning II: Neighborhood and Community Planning	3
ARCH 413	Architectural Practice	3
Elective	Architecture related	3
Total		**15**

Degree Total		**103**

A total of 103 credit hours will be required for graduation as established by each student's individual program of study. Some students, with undergraduate degrees in architecture, may be admitted to the program with advanced standing.

There is a wide variety of electives available not only in the College of Architecture, but also in Armour College, Institute of Design, and the Stuart School of Business. If the student has previously taken courses that duplicate curriculum requirements, appropriate electives may be substituted. English language courses required for international students do not apply to program credit hours.

A thesis is not an option for students in this program. Due to the compressed time allowed for comprehensive professional studies, students cannot undertake the extended research required for thesis work. It is only the exceptionally prepared student who might be able to petition successfully to conduct a master's thesis at IIT within the M.Arch. Program 3.

* Advanced Studio Option (Comprehensive Building Design)—ARCH 544
** Advanced Studio Option—ARCH 546

College of Architecture

Master of Architecture — Professional Degree with Advanced Standing (Program 2)

Candidates who hold a B.A. or B.S. in Architecture (a pre-professional degree from an NAAB-recognized school) in a four-plus-two program, and who have completed the equivalent of the first year's technology, history and studio courses, may qualify for up to one year of advanced standing in the professional degree program. Admission to Program 2 may allow the candidate to complete the Master of Architecture degree in as few as two years (four semesters), depending on prior preparation. Candidates will be notified upon admission as to their exact program of study, depending on their prior preparation.

Candidates who hold **professional** degrees from international institutions not accredited by NAAB will be placed in the professional degree program and must complete two or three years of study depending on their previous studies, experience and accomplishments.

Students with advanced standing are required to take the thesis option in their second year of study. The thesis requirements are outlined in the Program 1 description.

M.Arch. Program 2 Sample Curriculum

First year

Fall Semester		Credit Hours
ARCH 543	Studio III: Architecture II	6
ARCH 403	Building Systems I	3
CRP 519	City Planning I: Housing & Housing Types	3
ARCH 426	Computer-Aided Design in Practice	3
Total		**15**

Spring Semester		Credit Hours
*ARCH 544	Studio IV: Architecture III	6
ARCH 404	Building Systems II	3
CRP 520	City Planning II: Neighborhood and Community Planning	3
ARCH 503	Advanced Topics in History and Theory II	3
Total		**15**

Second year

Fall Semester		Credit Hours
ARCH 591	Thesis	6
ARCH 423	Programming & Technical Writing	3
ARCH 509	Topics in Advanced Architecture Technologies	3
Elective	Architecture related	3
Total		**15**

Spring Semester		Credit Hours
ARCH 591	Thesis	6
ARCH 413	Architectural Practice	3
Elective	Architecture related	3
Elective	Architecture related	3
Total		**15**

Degree Total	**60**

A total of 60 credit minimum hours will be required for graduation as established by each student's individual program of study. There is a wide variety of electives available not only in the College of Architecture, but also in Armour College, Institute of Design, and Stuart School of Business. If the student has previously taken courses that duplicate curriculum requirements, electives may be substituted. However, the electives should be in the designated area. For example, if a student petitions successfully with the program director or their adviser to have the building systems course waived, then the student must choose an appropriately similar elective course. English language courses required for international students do not apply to program credit hours.

* Advanced Studio Option (Comprehensive Building Design)—ARCH 544

College of Architecture

Master of Architecture — Post-Professional Degree (Program 1)

The one-year program, two or three semesters in duration, typically lasts a full calendar year. The program is open to applicants holding accredited Bachelor of Architecture (B.Arch.) degrees as first professional degrees from NAAB-accredited institutions. Program 1 offers advanced architectural study that builds upon knowledge acquired from the Bachelor of Architecture degree; it combines courses and in-depth research concerning a specific area of concentration. The program pursues a high level of architectural research, analysis and synthesis through thesis work in design, structures, systems, digital media and other topics. Areas of faculty excellence in the thesis program include: a) high-rise and long-span design; b) environmentally conscious design; c) advanced information systems; d) innovative design methodologies and architecture; e) advanced programming issues in housing, airport design, and other topics; and f) critical and theoretical assessments pertaining to construction and the built environment.

Admission and Curriculum Requirements

In addition to the standard requirements for graduate admission, a personal interview with the director of the degree program is highly recommended.

The program of study includes a minimum of 32 credit hours, of which at least eight are in ARCH 591 (Research and Thesis). Students entering the post-professional degree program should develop a detailed outline of their thesis project for approval by the director of thesis programs and their thesis adviser. The program of study for each student is developed individually with the thesis adviser. Study begins with investigation and analysis for the thesis under the direction of the adviser. By the second semester, a thesis committee of three faculty members oversees the work being produced. Students are required to take advanced courses related to their specialized areas of interest.

The final semester of study concludes the entire thesis project in writing, analysis, programming and design. Thesis studies should offer the graduate a higher level of professionalism, significantly evolving one's career and the ability to make special contributions to the field.

M.Arch. Program 1 Curriculum

Fall Semester		Credit Hours
ARCH 590	Research and Analysis	6
ARCH 588	Pre-Thesis Seminar	3
Elective	Architecture related	3
Elective	Architecture related	3
Total		**15**

Summer or Fall		Credit Hours
ARCH 591	Research and Thesis	2
Total		**2**

Spring Semester		Credit Hours
ARCH 591	Research and Thesis	6
ARCH 589	Thesis Seminar	3
Elective	Architecture related	3
Elective	Architecture related	3
Total		**15**

Degree Total		32

College of Architecture

Master of Landscape Architecture

The new three-year Master in Landscape Architecture is intended to educate generations of innovative landscape designers to benefit the profession and a "green" Chicago. The College has had an investment in landscape issues, and their influence on architectural education, ever since the charged partnership of Mies van der Rohe (architect) and Alfred Caldwell (landscape architect), who collaborated on the IIT Architecture curriculum and on Mies' buildings. Key areas in the curriculum will be shared with the Master of Architecture program.

The underlying principle of the program is to equip students with knowledge of the tools, materials and resources of the field. This includes development of the environmental and visual judgment, taste, and the ability to respond to and interpret contemporary culture. The degree's coursework centers in the design studios, framed to reintroduce the technique and art of landscape and gardens as serious forces for environmental and human progress. The subjects should have vision, be meaningful and inventive, and address the pressing contemporary problems of the human-made environment.

The program serves the needs of urban habitats, and use our city setting as a laboratory of critical inquiry; landscapes and gardens can offer an antidote to the stress-inducing character of modern urban life, and combat urban pollution, while serving as macro/micro climate modulators. The Prairie School tradition in landscape architecture is a guiding precedent, with an emphasis on indigenous plant materials and plant configurations inherent to a given context. The history of landscape architecture is comprehensively addressed, along with the history of architecture. Particular attention addresses the History of Modern Thought in landscape architecture, looking at the Modern movement in landscape design.

Emphasis on landscape craft includes serious study of the materials and infrastructures that make design of the land possible. This extends beyond design and construction, into plant maintenance, water conservation and site management. Students will understand the processes behind landscapes, including ecology, botany, geology, structural engineering, physical forces, etc. Landscape technologies are studied in studios intertwining both design and construction, exploring the tools of landscape creation and the role of materials to generate forms. Most importantly, the Landscape program continues the College's commitment to design excellence, defining the trajectory of Modernism for the 21st century.

To be admitted without conditions to the Master of Landscape Architecture program, an applicant is required to have prior coursework in the following: Freehand Drawing, Biology, Geology. Candidates will be notified upon admission as to their exact program of study, depending on their prior preparation.

College of Architecture

Master of Landscape Architecture Program3 Curriculum

First Year

Fall Semester		Credit Hours
ARCH 541	Studio I: Visual & Mat'l Training	6
ARCH 500	History of Architectural Ideas I	3
CRP 465	Ecological Basis of Planning	3
LA 441	Plants and Plant Materials:	
	Field Studies	3
TOTAL		**15**

Spring Semester		Credit Hours
LA 542	Studio II: Landscape Architecture I:	
	Ecology	6
ARCH 501	History of Architectural Ideas II	3
ARCH 485	Structures I: Concepts,Systems	3
ARCH 425	CAD I - Digital Media	3
TOTAL		**15**

Second Year

Fall Semester		
LA 543	Studio III: Landscape Architecture II:	
	Landscape Biology & Materials Tech.	6
ARCH 502	Advanced Topics in History and Theory I:	
	Landscape Architecture	3
LA 443	Forests, Preserves, Parks	
	& Urbanscapes	3
ARCH 426	CAD II - 3-D Modeling	3
TOTAL		**15**

Spring Semester at CBG/Morton		
LA 544	Studio IV: Landscape Architecture III:	
	Plants and Plant Materials: Advanced	6
LA 444	Earthworks & Infrastructures	3
ARCH 503	Advanced Topics in History and Theory II	
	Contemporary Practices	3
LA Elective	Landscape Related	3
TOTAL		**15**

Third Year

Fall Semester		
LA 545	Studio V: Comprehensive	
	Landscape Design	6
ARCH 423	Programming & Technical Writing	3
LA 445	Topics in Advanced Landscape	
	Technologies and Horticulture	3
LA Elective	Landscape Related	3
TOTAL		**15**

Spring Semester		
LA 546	Studio VI: Spatial Investigations	6
CRP 520	City Planning II: Neighborhood	
	& Community Planning	3
LA 414	Professional Practice	3
LA Elective	Landscape Related	3
TOTAL		**15**

Degree Total	**90 Credit Hours**

College of Architecture

Doctor of Philosophy in Architecture

The Doctor of Philosophy in Architecture (Ph.D.) program is for those advanced graduate students who plan to pursue careers in the academic and research fields and/or in the area of advanced professional practice within the domain of architecture. The rigor of study required for the Ph.D. degree extends the discipline of advanced research and design beyond the master degree and is oriented toward professional applications and academic advancement.

The program requires a comprehensive knowledge of architecture, a deep understanding of its accomplishments and developments, and critical inquiry that extends its frontiers.

The program combines course-work and research, culminating in a Ph. D. dissertation of extensive and independent, original investigation which could also lead to a design development. The research in some cases may be an extension of work done in the preparation of a Master of Architecture degree in the College of Architecture. Each student's program of study will include seminars, specialized and elective course-work, research and design as preparation for the dissertation.

Admission Requirements

An applicant to the doctoral program must hold a professional Master of Architecture degree (M. Arch.) from an NAAB accredited U.S. university or the equivalent. Candidates who have not completed the required professional M.Arch. degree may apply for the Master of Architecture program at IIT to fulfill that requirement, as a non-terminal program of studies preparatory for the doctoral program.

The applicant should meet all entrance requirements of lIT's Graduate College, plus a minimum cumulative grade point average of 3.5 on a 4.0 scale; a TOEFL score of at least 550; and at least three letters of recommendations, from immediate supervising professors plus additional list of references. The applicant should also submit a statement of purpose indicating a subject of study or research work and should provide a portfolio demonstrating the qualities of his or her accomplishments and expertise.

Degree Requirements

The program requires a minimum of 58 credit hours usually completed in three-and-a-half to four years beyond the MArch degree, which will include a minimum of 26 credit hours of course-work, The course-work will be comprised of seminars, specialty courses, and electives. The majority of the course-work will be selected from the curriculum within the College of Architecture, though students are encouraged to have their research find connections to other doctoral programs at the university.

Upon completion of the first academic year, the candidate will be required to pass a qualifying examination before he or she will officially be admitted to Ph.D. candidacy. At the end of the program, the candidate will take a final examination which will consist of an oral presentation and defense of the dissertation. Current areas of study include high-rise and long-span buildings, technology applications, energy conscious design, emerging urbanisms, housing and advanced computer applications. Work for the Ph.D. must be completed within six years after admission to doctoral candidacy.

Course Descriptions

Numbers in parentheses after course descriptions indicate weekly class/lecture hours and lab hours, and total credit hours for the course, respectively.

Architecture

ARCH 403, 404
Mechanical and Electrical Building Systems for Architects I, II
Selection and design of building support systems: heating, ventilating, air conditioning, water supply, sanitary and storm drainage, power distribution, lighting, communications and vertical transportation. Systems are analyzed for their effect on building form, construction cost and operating efficiency. ARCH 403 is prerequisite for ARCH 404. (3-0-3); (3-0-3)

ARCH 408
Freehand Drawing
A multi-purpose drawing course offering students a chance to develop on-site sketching skills and creative expression in drawing through a combination of sketching field trips and in-class drawing assignments. (0-3-3)

ARCH 409
Advanced Freehand Drawing
Advanced development of freehand drawing skills in various media; still life, human figure, the natural and built environment; studio and field settings. Prerequisites: Arch 408 or permission of the instructor. (1-4-3)

ARCH 413
Architectural Practice
Lectures and practical problems dealing with specifications, specification writing, administration of construction, contracts, building law and professional practice. (3-0-3)

ARCH 414
Professional Practice: Building Case Studies
Case study analysis of buildings; including the design process, building detailing, construction methods, government regulation, owner satisfaction, and post-construction forensics. (3-0-3)

ARCH 421, 422
Energy Conscious Design I, II
The application of energy conservation methods and renewable energy sources, such as wind power and passive solar systems, will be examined in the development of building energy budgets for a variety of building types. ARCH 421 is a prerequisite for ARCH 422. (3-0-3); (3-0-3)

ARCH 423
Architectural Programming
Study of the principles of problem definition and problem solving related to the decision-making process of design. Review of skills of collecting, reviewing and presenting quantities of information, along with the relevant computer-aided methods and techniques. Applications include identifying a client's needs, considering project constraints, and developing a building program through resolution of problem requirements. (3-0-3)

ARCH 424
Construction Management
Survey of the techniques and procedures of construction management as it relates to architectural practice. The organization of the building team, the collaboration of this team in the design process, cost control, project scheduling, purchasing, accounting and field observation are described and documented. (3-0-3)

ARCH 425
Digital Architectural Media I
The class introduces concept development, design thinking and problem solving related to architectural representation and production technique (digital and analogue). The class will look critically at recent digital design developments, as well as introduce students to the history of each "type" of computer program; and the class will introduce students to the basic skills required to productively work with a variety of practice-based software programs. The class will also introduce 3-D "craft-based" thinking/working. Prerequisite: Graduate Standing. (1-2-3)

ARCH 426
Computer-Aided Design in Practice
This course reviews drafting, modeling and rendering computer hardware and software used in the practice of architectural design. Design and management issues are explored with the extensive use of PC CAD systems. Prerequisite: ARCH 425. (2-1-3)

ARCH 427
Digital Architectural Media II
A review of 3-D modeling concepts, computer-aided rendering concepts, and methods in the development of architectural design. Extensive use of PC CAD software is expected. Prerequisite: ARCH 125, ARCH 425, AutoCAD or consent of instructor. (3-0-3)

ARCH 428
3-D Animation in CAD Presentations
Review 3-D modeling concepts for animation, preparing camera movements, lighting conditions, special effects, and the digital editing of animation sequences. Extensive use of PC animation and editing software. Prerequisites: ARCH 427. (1-4-3)

ARCH 429
Digital Form Generation
Review programming in CAD systems; programming basics in AutoCAD, extensive creation of 2-D and 3-D objects, data interrogation, manipulation, and extraction, and 2-D and 3-D parametric- and rule-based design. Investigation of form creation, based on mathematical relationships and random generation. Prerequisite: ARCH 427. (1-3-3)

ARCH 430
Networked Technologies
Study of the relationship between the built environment and networked technologies. Students will learn principals of designing for networked digital space, ways of augmenting physical space through digital technologies, and how networks and web based communication have transformed the practice of architecture and our daily lives. Prerequisite: ARCH 427. (1-2-3)

College of Architecture

ARCH 431, 432
Visual Training I, II
The development of visual acuity through the analysis of fundamental elements of form. Aesthetic expression as experience. Exercises in the study of form, proportion and rhythm, texture and color, mass and space. Exercises in visual perception and aesthetic judgment. Isolation and analysis; interdependence and integration of sensuous qualities. Aesthetic unity under restrictive conditions. (0-2-3)

ARCH 441, 442
Landscape Architecture I, II
The natural landscape as a basis of landscape work. Ecozones and their relation to vital habitats, including plant materials, their selection and installation. The focus will be on housing with its associated planting, including various gardens both formal and informal. ARCH 441 is prerequisite for ARCH 442. (2-2-3); (2-2-3)

ARCH 443
Ecology, Sustainability, Site
The role of natural systems in meeting human needs; climate, geology, landforms, soils, vegetation and animal populations as the basis of agricultural and industrial technologies. Competing demands on natural systems and the necessity for integration and coherence. Ecological sustainability as a basis of architectural works. Site forming and reforming, soils and drainage, grading, orientation, microclimate development and plant materials will be emphasized. (3-0-3)

ARCH 454
Contemporary Chicago Architecture: Case Studies
Contemporary architecture and urban design projects in Chicago present an invaluable opportunity to learn about some of the most advanced applications in practice today. By examining significant projects currently under way, this course will investigate project execution, design concepts and the various forces affecting projects' definitions and results. Close scrutiny of all the components and personnel will give a better understanding of the complex synergies, advanced technologies, and adept project teams necessary for successful innovative architecture and urban planning. (3-0-3)

ARCH 456
Topics in Modernism
Historical and critical study of a significant cultural and intellectual shift that occurred in Modern architecture in Europe in the immediate post-World War II period. This seminar will discuss the relation of this new agenda within the development of Modern architecture from the ethically based Modernism of Ruskin and Morris in the 19th century to the creation of the "Modern Movement" in the inter-war years. Examination of the manner in which this theoretical position has been expressed in architectural practice since the 1950s. (3-0-3)

ARCH 467
Advanced Materials Workshop
This course involves students with the architectural craft of materials that can be applied to model and prototype construction. Included will be industrial tours and a product of the student's own choosing. (1-4-3)

ARCH 468
Drawing from Travel
A studio drawing course for the development of perceptual and technical skills critical to drawing in the field. Emphasis on the freehand travel sketch and its capacity to evoke both the physicality and character of a place. Production of a comprehensive drawn record of travels of a journal/sketchbook is required. Various media will be explored. Requisite: Semester Abroad Program. (0-6-3)

ARCH 469
Urban Design in Europe
This seminar course will explore current notions of urbanism as observed in the built environment of European cities. Projects and discussions will complement the design work undertaken in the architecture design studio. Assignments will focus on documentation and analysis of the systems, organizations, policies and rituals of habitation. Requisite: Semester Abroad Program. (3-0-3)

ARCH 470
Image City: Mediation of Space
This seminar surveys the interaction between media and the city from the 19th century to the present. A history of the technological innovations of the past 200 years as part of the development of the contemporary city. No account of contemporary urban issues can be considered complete without taking into account the role played in our lives by the media. Accordingly, every space we encounter or create has to be considered "mediated." (3-0-3)

ARCH 473
Conflict & Time
This seminar employs comparative studies of other arts, in particular cinema, to illuminate architectural esthetics and the creative process. (3-0-3)

ARCH 474
Production/Design
This seminar examines aspects of design in motion pictures. The premise underlying the course is that the act of perception constitutes an act of design; we produce and design the world we perceive. This becomes particularly evident through analysis of the artificially constructed, illusory reality of films. (3-0-3)

ARCH 475
Spatial Stories
This course will examine the "spatial story" as it appears in diverse media: short fiction, films, everyday discourse, the media, architecture, etc. The coursework will consist of reading and writing assignments, as well as the viewing of films and other visual artifacts. The course has two goals to offer students: to improve their study and communication skills and to examine the social, cultural and historical aspects of spatial practices such as architecture. (3-0-3)

ARCH 485
Structures I: Concepts
Examination of the basic and vast range of structural concepts and solutions, in an illustrated and summary format. Examples include historic as well as contemporary structures. Statics and strength of materials, beam theory, shear and bending moment diagrams, deflection analysis. Overview of systems choices in architectural applications. History of strength of materials. (3-0-3)

ARCH 486
**Structures II: Design
of Wood and Steel**
Analysis, design and detailing of
tectonic systems (steel and wood).
Design of compression, tension, and
flexural members. Design of timber
beams and columns. Design of steel
beams and columns. The behavior of
structures under static and dynamic
loads. Analysis, design and detailing
of concrete and masonry systems.
Theory of reinforced concrete applied
to beams and slabs. Prerequisite:
ARCH 485. (3-0-3)

ARCH 488
Long-Span and Special Structures
Introduction of structural systems
for long spans and special structures.
The structural behavior will be
discussed and the required strength
and stiffness will be evaluated.
Individual projects will be assigned
to students to be presented at the
end of the course. (3-0-3)

ARCH 489
**Structural Systems for Tall
Buildings and Long-Span Structures**
This course reviews the historical
development of the interaction of the
structure with architecture and
explores future trends and directions.
The suitability of different materials
and systems will be studied, with
emphasis placed on efficiency. (3-0-3)

ARCH 495
Technology as Design
Since the development of cast iron as
a viable construction material in the
mid-1800s, there has been a path of
architecture exploring open-ended
possibilities of technology. Integrated
within the culture, this determina-
tion to use the technology of one's
time as the creative generator of a
new evolving architecture is the the-
sis of this course. (3-0-3)

ARCH 500
**History of Architectural Ideas:
Vitruvius to 1900**
This first of a two-semester survey
encompasses both the history and
theory of architecture and landscape
architecture. Readings from primary
documents will supply the social and
intellectual context for designed
form. Lectures and visual documen-
tation will focus on the historical
embodiment of these ideas within the

panorama of changing styles, tech-
niques, and attitudes. The objective
of this course is to convey to the stu-
dent the great complexity of cultural
and intellectual forces affecting
design and to hone critical reasoning
with respect to the meaning of form.

ARCH 501
**History of Architectural Ideas:
1900 to Present**
The ever-intensifying architectural
discourse and accelerated pace of
change of the twentieth century only
expand the parameters of this second
of a two-part survey of design ideas.
The course, which will complement
work in the design studio, begins
with the consolidation of modern
architecture and avant-gardism but
advances to high modernism and its
counter-critiques in the 1950s, post-
modernism, and issues of urbanism,
digital technology, globalism, ecology,
and sustainability.

ARCH 502
**Advanced Topics in History
and Theory I**
One of two required courses, this
seminar will focus on important theo-
retical topics relevant to professional
practice and architectural produc-
tion. In consultation with faculty,
students may integrate this course
with their thesis or a special area of
interest. Students will be able to
choose from a range of topics, which
might include global architectural
trends of the 21st century, urbanism,
sustainable design theory, or post-
modern theory.

ARCH 503
**Advanced Topics in History and
Theory II**
The second of two required courses,
this seminar will focus on important
theoretical topics relevant to profes-
sional practice and architectural
production. In consultation with fac-
ulty, students may integrate this
course with their thesis or a special
area of interest. Students will be able
to choose from a range of topics,
which might include global architec-
tural trends of the 21st century,
urbanism, sustainable design theory,
or postmodern theory.

ARCH 509
Topics in Advanced Technology
This research seminar examines
advances in the technologies that
affect the practice of architecture.
The course examines leading tech-
nologies, processes and applications
and their role in building design and
production. The course will navigate
the broad and varied materials
related to advanced technologies in
architecture by focusing on specific
applications for specific projects.
(3-0-3)

ARCH 541
**Studio I: Materials
and Applications**
Introduction to building materials
through studio exercises exploring
the physical properties and charac-
teristics of wood, metal, masonry and
concrete, with emphasis on their use
and assembly. Initial abstract exer-
cises sequentially introduce the basic
architecture vocabulary, materials
and principles, through analysis of
historic precedents and materials
research. Introduction of a basic
building system utilizing a "kit of
parts" for investigation of load, span,
enclosure and minimal program.
(0-12-6)

ARCH 542
Studio II: Architecture I
The study and application of wood
and masonry construction systems
and their architectural expression.
Studio exercises focus on the design
and construction of small-scale struc-
tures. Study of major elements of a
building from the roofing to design,
the work will emphasize fundamen-
tal architectural issues: natural
light, building orientation and pro-
tection from the elements. Further
investigation of the manufacture,
construction, assembly and historical
development of wood and masonry as
building materials. Prerequisite:
ARCH 541. (0-12-6)

ARCH 543
Studio III: Architecture II
The development of architectural
principles through the study and
application of steel utilizing simple
skeleton construction systems.
Studio exercises focus on the design
and construction of a small-scale
steel structure, investigating mater-
ial properties and architectural

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expression. Study investigates a coherent structural system and the computational definition of its members and their aesthetic consequences. The characteristics of steel, its manufacture, construction, assembly and historical development of its use will be covered. Prerequisite: ARCH 542. (0-12-6)

ARCH 544
Studio IV: Architecture III
The development of architectural principle through the study and application of various concrete structural systems. Studio exercises focus on the design and construction of a medium-scale concrete structure. The properties of concrete, its characteristics, physical composition, manufacture, formwork design and construction, and historical development of its use as a building material will be covered. Prerequisite: ARCH 543. (0-12-6)

ARCH 545
Studio V: Comprehensive Building Design I
The development of a moderate-scale building with special emphasis on the formulation and articulation of space. Studio exercises focus on development of spatial mass and scale, structure as an architectural factor, proportion as a means of architectural expression, lighting, program, display and the expressive value of materials. As a comprehensive building projects of a smaller scale, studio work covers a complete and expressive presentation of the project's intentions and its spatial and materials qualities. Prerequisite: ARCH 544. (0-12-6)

ARCH 546
Studio VI: Comprehensive Building Design II
The development of an architectural project with an emphasis on comprehensive building design: advanced site development, spatial relationships between interior and exterior landscape, zoning and code analysis, programming, and fully integrated building systems. Study focuses on environmental concerns in building design. Studio work includes a comprehensive set of architectural documents, articulated model(s), and architectural details representative of the building's concepts. Prerequisite: ARCH 545. (0-12-6)

ARCH 551, 552
Design of Energy-Efficient Buildings I, II
Design criteria for achieving human performance goals in energy-efficient buildings, criteria for the exterior/interior environment, and criteria for architectural, mechanical, electrical and building system components. Building upon the fall course, various energy-conserving strategies shall be evaluated for achieving cost effective, energy-efficient design of a specific building type. (3-0-3); (3-0-3)

ARCH 553, 554
High Rise Building Technology I, II
The course consists of presentations by specialists in the various technologies of high-rise building, including planning, financing, code reinforcement, materials, architecture, engineering, project management, construction, building management services, safety and maintenance. (3-0-3)

ARCH 567
Architectural Drawing and Model Making
Development of drafting and modeling skills. Coordination of hand and eye for qualities of lines, aggregates of lines, textures. Freehand exercises in geometric, axonometric and perspective drawing. Development of skills in model making in wood, metal and plastic. Development of critical evaluation of quality and craftsmanship of work. (0-3-1)

ARCH 588
Thesis Preparation Seminar
Seminars are conducted on thesis development and preparation with emphasis placed on language, the written form, thesis manual requirements, drawing and model presentation, and the oral presentation for jury examination. (3-0-3)

ARCH 589
Pre-Thesis Seminar
An introduction to the architecture faculty through a discussion of current issues and future directions of the profession. These concerns are then related to the specific student's interest and the specialized experience of the faculty. By the end of the semester, a Thesis Advisory Committee, with a thesis chairman and two additional faculty members,

is assigned to each thesis student. Together, they identify the thesis project, program, its scope and objective and, most important, budget time for each phase. (3-0-3)

ARCH 590
Specialized Research and Thesis Development
Each thesis project must demonstrate an intellectual objective and an in-depth study that will contribute to the practice of architecture. The formulated problem should combine a theoretical search with the practical considerations of the profession. Research methods are identified that will provide the resources and information necessary for the design process. Post-occupancy building evaluations of similar problems are used to analyze technical assumptions, functional response, and social reaction. (Credits: Variable)

ARCH 591, 592
Research and Thesis
A thesis project is developed in depth by the student under the direction of the adviser and an advisory committee of other architecture faculty and/or professional members. Specialized research and design within a wide range of architectural problems include site selection, consideration of architectural context and environmental impacts, development of user function and space programs, and architectural planning and design. Aesthetic and visual aspects and the intellectual foundations of the problem are carefully considered, as well as the technical aspects in the selection and integration of structural and environmental systems. After final acceptance of the presentation materials by the advisory committee, the text, reductions of the drawings, and model photographs are bound together in a hard-cover volume, which is deposited in the GRC and the university's library.

ARCH 601
Doctoral Methodology Pro-Seminar
This course provides a foundation for doctoral students to the diversity of research paradigms in architecture. The first component is an introduction to the philosophy of knowledge with an emphasis on architecture. The second component entails a critical review and evaluation of diverse

research methodologies in current doctoral architectural research, with substantial information on research methodologies not covered in undergraduate and graduate education. Students will write a series of papers that critically review the course readings and discussions. (3-0-3)

ARCH 651
Advanced Topics in Integrated Building Engineering Design

This class will address advanced energy-conservation techniques in the building delivery process. Exceptional building energy performance requires more than simple dependence on the efficient performance of individual building components, such as mechanical equipment or window systems. In order to cost effectively reduce operating costs, increase comfort, boost indoor air quality, and reduce environmental pollutant emission, a synergistic effect between all building systems must be accounted for in the design process. (3-0-3)

City and Regional Planning

CRP 425, 426
History and Architecture of Cities I, II

Selected topics in the history and development of human settlements. Examination of the forces affecting city development in history. These courses are taught as seminars and meet for one three-hour period per week. (3-0-3); (3-0-3)

CRP 465
The Ecological Basis of Planning

The role of natural systems in meeting human needs. Climate, geology, landforms, soils, vegetation and animal populations as the bases of agricultural and industrial technologies. Competing demands on air, water and land. Limiting factors. (3-0-3)

CRP 519
Principles of City Planning I

This course explores the problems of housing from the scale of the single dwelling to larger residential buildings. Examination of the internal functions of a housing unit, the relationship of one unit to another, and of the overall structure and development of settlement units. (3-0-3)

CRP 520
Principles of City Planning II/ Urban Design

This course explores principles of urban design. Applications will make analyses of urban issues such as the integration of urban elements into an organic whole, the town center, the interrelationship of built forms to open spaces and the varying components of the urban fiber. Prerequisite: CRP 519. (3-0-3)

CRP 521
Advanced Planning I, II

Advanced work in city and regional planning. Analysis. Structure. Clarification of principle and idea in planning. Varied problems. Prerequisite: CRP 519, CRP 520, or consent of instructor. (Credit: Variable)

CRP 531
Advanced Housing

Advanced work. The dwelling and groups of dwellings as a planning and architectural problem. Variations. Site. Clarification of principle in working out specific solutions. Prerequisites: CRP 519, CRP 520 or consent of instructor. (3-0-3)

CRP 532
Community Development

Advanced work. Consideration of entire community and its elements. Density. Spatial development. Varied problems to clarify principles. Prerequisites: CRP 519, CRP 520 or consent of instructor. (3-0-3)
Master of Landscape Architecture

Master of Landscape Architecture

LA 414
Professional Practice

An introduction to landscape architecture as a profession. Topics addressed include areas of practice, project management, office operations, career development, governmental regulations, licensure, and professional ethics.

LA 441
Plants and Plant Materials: field studies

Study of the identification, uses, and basic horticulture of the basic woody plants commonly available in the Midwest, as applied in designed landscapes. Criteria for appropriate selection of trees, shrubs, vines, and

ground covers for a given site; nonnative species and herbaceous perennials will be introduced. Provides a working knowledge of the woody plants used as a primary element in design applications.

LA 443
Forests, Preserves, Parks and Urbanscapes

The growing need for these public site types in America in the 1800s gave rise to the landscape architecture profession. More necessary now than ever, the planning and design approach to these sites is undergoing major change. In this course students will investigate the historical and contemporary environmental and cultural relationships of the American landscape. Themes include landscape use and ecological change, regional and national landscapes, the roles of the National Park Service, state and county park and forest systems, and municipal green spaces. Case studies and analyses of specific sites.

LA 444
Earthworks and Infrastructures

Land grading, drainage, pedestrian and vehicular circulation systems, and the landscape tools and techniques used in site engineering. Study focuses on grading for the purpose of infrastructure design by analyzing differences in landform, topography, climate, and soil structure, and focuses on drainage characteristics as a primary element for understanding a site. Water flow, storm water issues, swales, and other water management practices, and utility planning. Case studies of larger scale projects with an emphasis on developing students' ability for designing elegant and functional three-dimensional land forms.

LA 445
Topics in Advanced Landscape Technologies & Horticulture

Topics vary: Advanced Landscape Construction, Green Roofs, Brown Field Reclamation, Soils, Wetlands, Native Plant Intensive, Ecological Design, Landscape Management without Chemicals, Site Analysis, and other special subjects

College of Architecture

LA 542
Studio II: Landscape Architecture 1: Ecology
Introduction to ecosystems and how human interaction affects them. Emphasis on the Midwestern prairie and forest biome's wildlife, vegetation, climate, water, and aquatic ecosystems. Effects of human land use patterns on the land and on plant communities, and how they can be altered. Techniques and terms used by environmentalists and instruction in conducting a baseline ecosystem study.

LA 543
Studio III: Landscape Architecture II: Biology & Materials Technology
Basic biological principals of plant growth and horticultural production methods for plants used in landscape design. Study of the interdependence between technology and biological systems in landscape architecture. Topics include an introduction to botanical nomenclature as used in the industry and experience with construction materials (concrete, masonry, wood, and metals), their properties, and applications. Studio semester project combines plantings and constructed elements. Field trips.

LA 544
Studio IV: Landscape Architecture III: Plants & Plant Materials: Advanced
Continuing investigation of native woody species as a major element in the landscape and traditional plant configurations such as bosques and allees in the built environment. Further study of native perennials and appropriate non-natives. Segment on use of annual and tropical plants within a design; container plantings as accents. Criteria for development of a planting design and plant list, as well as plant selection, and technical aspects including hardiness zones, and soil requirements.

LA 545
Studio V: Comprehensive Landscape Design
Integration of large-scale site, programming, planting design, ecology of site, and other design elements and problems into a cohesive design solution. Practical application of the relationship among sites, drawings, and the making of landscape architectural projects. The semester is sequenced: site analysis; programming decisions; site modeling; development of design; representation and defense of design graphically (plan and elevation views), model, and materials and planting list. design of environments which are responsive to human need and expressive of physiographic conditions.

LA 546
Studio VI: Spatial Investigations
A primary motive for landscape architects is spatial configuration. In this studio students explore both three-dimensional space and digital and hand-drawn representations of space. Exercises include explorations of how seeing, visualizing, and drawing interrelate, and how form, light/shadow, volume and space—basic elements of composition—affect the built environment. An introduction to the methods and use of GIS (Geographic Information System) introduces students to the opportunities this tool provides for land planners and designers.

Undergraduate Course Prerequisites

The courses described below and at right are undergraduate courses, some or all of which are prerequisites to graduate study in the College of Architecture. For the class entering the program in Fall 2006, applicants to the College's degree programs must demonstrate proficiency in the undergraduate-level courses or their equivalents listed in the "Admission Requirements" and individual program descriptions sections.

For applicants to the College's degree programs seeking admission for Fall 2007 and after, please note that changes to admission and prerequisite requirements are likely. Please visit the College of Architecture Web site or call the Assistant Dean for Graduate Academic Affairs for up-to-date information.

MATH 119
Geometry for Architects
Basic analytic geometry in two and three dimensions; trigonometry. Equations of lines, circles and conic sections; resolution of triangles; polar coordinates. Equations of planes, lines, quadratic surfaces. Applications. (3-0-3)

MATH 122
Introduction to Mathematics II
Basic concept of calculus of a single variable; limits, derivatives, integrals, applications. (3-0-3)

PHYS 211, 212
Basics Physics I, II
Intended to give students in the liberal arts, architecture and design an understanding of the basic principles of physics and an appreciation of how physics influences contemporary society. Prerequisites: Math 122. (3-0-3); (3-0-3)

Department of Biological, Chemical and Physical Sciences

Life Sciences Building
3101 S. Dearborn St.
Chicago, IL 60616
312.567.3480
www.iit.edu/bcps

Chair:
John Zasadzinski

Associate Chairs:
Howard A. Rubin, Physics
Benjamin C. Stark, Biology
Rong Wang, Chemisty

The Department of Biological, Chemical and Physical Sciences offers B.S., M.S. and Ph.D. degrees in the fields of chemistry, biology, physics, and molecular biochemistry and biophysics. Within the department, there are many opportunities for interdisciplinary education and research experiences; students in any of the disciplines have easy access to the expertise that the full faculty brings. In addition, the department offers several professional masters degrees and related certificate programs for part-time students, both on campus and through distance learning.

Degrees Offered

Master of Biology
Master of Science in Biology with specialization in:
    Biochemistry
    Biotechnology
    Cell and Molecular Biology
    Microbiology
Master of Science in Molecular Biochemistry and
    Biophysics
Master of Chemistry
Master of Chemistry in Analytical Chemistry

Master of Chemistry in Materials and Chemical
    Synthesis
Master of Science in Chemistry
Master of Health Physics
Master of Science in Physics
Doctor of Philosophy in Biology
Doctor of Philosophy in Chemistry
Doctor of Philosophy in Molecular Biochemistry and
    Biophysics
Doctor of Philosophy in Physics

Certificate Programs

Analytical Methods Development
Analytical Spectroscopy
Characterization of Inorganic and Organic Materials
Chromatography

Radiological Physics
Synthesis and Characterization of Inorganic Materials
Synthesis and Characterization of Organic Materials

Research Centers

Center for Synchrotron Radiation Research and
    Instrumentation

Center for Accelerator and Particle Physics

Research Facilities

The department has state-of-the-art computer and laboratory equipment and conducts research in the areas of biochemistry, biotechnology, cell and molecular biology, microbiology, molecular biophysics and biochemistry; analytical chemistry, inorganic chemistry, solid-state and materials chemistry, organic chemistry, polymer chemistry, surface chemistry, physical chemistry and theoretical chemistry; and high-energy physics, accelerator and plasma physics, condensed-matter physics, biological physics, x-ray optics, x-ray imaging and quantum theory. The department constructs and operates facilities for x-ray scattering, spectroscopy and imaging at the Advanced Photon Source at Argonne National Laboratory. Additional research facilities include on-campus x-ray diffraction facilities, thin-film growth facilities,

a high-field nuclear magnetic resonance facility, state-of-the-art inorganic-, organic- and polymer synthesis and characterization laboratories, Fourier transform infrared spectrometers, atomic force microscope, mass spectrometers, and facilities for high-pressure liquid chromatography and gas chromatography. Laboratories for experimental research in biophysics, low-temperature, solid-state physics and particle physics are active. Collaborative programs are carried on with Fermi National Accelerator Laboratory, Argonne National Laboratory, and the Advanced Photon Source. The department hosts the Center for Accelerator and Particle Physics (CAPP) and the Center for Synchrotron Radiation Research and Instrumentation (CSRRI).

Department of Biological, Chemical and Physical Sciences

Faculty

Biology

Martin Cole, Research Professor and Director of the National Center for Food Safety and Technology. B.S., Manchester Metropolitan University; Ph.D., University of East Anglia (England). Studies of issues related to food safety technologies and policies.

Douglas J. Cork, Professor. B.S., M.S., Ph.D., University of Arizona. Biotechnology and bioremediation, microbial metabolism of xenobiotics, informatics.

Michael Cummings, Research Professor. B.S., St. Mary's University; Ph.D., Northwestern University. Research on human chromosome organization and the development of innovative methods for teaching biology.

Andrew Howard, Associate Professor and Director of the Health Physics Program. B.A., Pomona College; Ph.D., University of California, San Diego. Structure and function of immune system proteins, macromolecular crystallography.

Thomas C. Irving, Professor and Director of the Biophysics Collaborative Access Team. B.Sc., M.Sc., Ph.D., University of Guelph (Canada). Structure and biophysics of macromolecular systems, muscle structure and physiology, synchrotron radiation instrumentation.

David L. McCormick, Professor, and Senior Vice President and Director of the IIT Research Institute B.A., Middlebury College; Ph.D., New York University. Preclinical development of drugs for the prevention and therapy of cancer.

Rajendra Mehta, Professor and Assistant Vice President of the IIT Research Institute. B.Sc., Gujurat Univeristy; Ph.D., University of Nebraska-Lincoln. Efficacy and mechanism of action of chemopreventive agents in experimental carcinogenesis of breast, colon, lung and prostate.

Nick Menhart, Assistant Professor. B.Sc., Ph.D., University of Waterloo (Canada). Spectroscopic techniques for the study of multi-domain proteins.

Joseph Orgel, Assistant Professor. B.Sc., Ph.D., University of Stirling (Scotland). Study of fundamental structural biochemistry problems that have direct links to the understanding and treatment of disease, primarily of the extra cellular matrix of mammals.

Sadhana Ravishankar, Research Associate Professor. B.S., M.S., Tamilnadu Agricultural University; Ph.D., University of Georgia. Stress tolerance responses of foodborne pathogens, control of foodborne pathogens by non-thermal technology, biofilm formation and control, natural antimicrobials, control of foodborne pathogens by multiple hurdle approach.

Peter Slade, Research Associate Professor. B.S., University of Leeds; Ph.D., University of Guelph (Canada). Antimicrobial treatments applied to seeds, vegetable sprouts, and ready-to-eat meat products, novel processing technologies, development of rapid methods for the detection of food borne pathogens, hygienic design of food processing facilities and equipment.

Kathryn M. Spink, Senior Lecturer. B.S., Michigan Technological University; Ph.D., Michigan State University. Molecular genetics of mammalian viruses.

Benjamin C. Stark, Professor, Associate Chair of the Department, and Director of the Master of Biology Program. B.S., University of Michigan; M.Ph., Ph.D., Yale University. Biochemistry and molecular biology of bacterial respiration, fermentation, bioremediation.

Cynthia Stewart, Research Assistant Professor. B.S., University of Delaware; PhD, Rutgers University. High pressure and other nonthermal technologies, such as cold pasteurization or commercial sterilization processes, to improve the quality and safety of foods.

Stuart Taylor, Research Professor. B.A., Cornell University; Ph.D., New York University. Optical and biophysical methods to study how contractile function follows molecular form.

Dale A. Webster, Emeritus and Research Professor. B.S., University of Michigan; Ph.D., University of California, Berkeley. Biochemistry and molecular biology of bacterial respiration, biotechnology and bioremediation.

Jialing Xiang, Assistant Professor. M.D., Xuzhou Medical College; Ph.D. University of Alabama, Birmingham. Molecular mechanisms of cancer and cancer gene therapy.

Chunbo Zhang, Assisitant Professor. B.S., Ningbo Univeristy; Ph.D., University of Manitoba (Canada). Use of molecular genetics, biophysics, immunohistochemistry, pharmacology, and behavior to study olfactory transduction in the mouse.

Wei Zhang, Assistant Professor. B.S., Huazhong Agricultural University; Ph.D., Pennsylvania State University. Molecular detection, genotyping, epidemiology, virulence and pathogenesis of foodborne bacteria.

Yu-Zhu Zhang, Assistant Professor, B.S. Zhengzhou University; Ph.D., University of Pennsylvania. Structure and function of biomolecular processes involved in cell cycle control, dim1 protein structure.

Department of Biological, Chemical and Physical Sciences

Chemistry

Sandra Whaley Bishnoi, Assistant Professor of Chemistry. B.S., Ph.D., University of Texas at Austin. Synthesis and analysis of inorganic nanoparticles, bio-molecular recognition, surface science, analytical chemistry, nanobiotechnology, development of nanoparticle delivery methods, and surface enhanced Raman scattering.

William Buttner, Research Professor of Chemistry. B.S., Loyola University of Chicago; Ph.D., Michigan State University. Basic and applied research in analytical chemistry, environmental chemistry, and electrochemistry; understanding and developing chemical sensors and sensor array instrumental devices with novel structures and new materials for industrial and medical applications.

Hyun-soon Chong, Assistant Professor. B.S., M.S. Kyung Hee University; Ph.D. University of North Texas. Synthetic and mechanistic organic chemistry, macrocyclic chemistry, cancer therapeutics and diagnostics, medicinal chemistry, bioorganic and bioinorganic chemistry, biologically active synthetic and natural products, heterocyclic chemistry, molecular recognition studies, nanobiotechnology.

Walter C. Eisenberg, Emeritus Professor of Chemistry and Director of the Analytical Chemistry Program. B.S. University of Toronto (Canada); M.S., Rochester Institute of Technology; Ph.D., University of Buffalo. Organic-, oxidant- and single oxygen chemistry, biochemistry, air pollution, polycyclic aromatic hydrocarbon transformation, analytical methods development, professional graduate education.

Mohamed El-Maazawi, Senior Lecturer of Chemistry. B.S., University of Alexandria; Ph.D., Pennsylvania State University.

Robert Filler, Emeritus Professor of Chemistry, Senior Research Fellow. B.S., City College of New York; Ph.D., University of Iowa. Heterocyclic compounds, effects of fluorine in fluorine-containing compounds.

Peter Y. Johnson, Professor of Chemistry. B.S., University of Illinois, Urbana-Champaign; Ph.D., Massachusetts Institute of Technology. Syntheses of penicillin related compounds; photochemical and/or transannular reactions.

M. Ishaque Khan, Professor of Chemistry, Associate Dean of the College of Science and Letters, and Director of the Materials and Chemical Synthesis Program. Ph.D., Indian Institute of Technology (India). Synthesis, characterization and properties of inorganic and organic-inorganic hybrid materials of current technological, environmental and fundamental interest. Fabrication of nanostructured materials with desirable catalytic, electronic, magnetic and conducting properties that could be controlled and rationalized at the molecular level. Spectroscopy, x-ray crystallography and synchrotron radiation-based methods.

Peter Lykos, Professor of Chemistry. B.S., Northwestern University; Ph.D., Carnegie Institute of Technology. Physical chemistry, standards for undergraduate chemistry and chemistry curricula, combination theoretical (Hartree Fock) and experimental (synchrotron radiation) determination of correlation energy, semi-empirical methods in quantum chemistry, computer applications in chemistry.

Braja K. Mandal, Professor of Chemistry. B.Sc., University of Calucutta (India); M.Sc., M.Tech., Ph.D., Indian Institute of Technology (India). Polymer science and engineering, electroactive materials, phthalocyanines and porphyrins, solid polymer electrolytes, lithium battery materials.

Kenneth Schug, Professor of Chemistry. B.S., Stanford University; Ph.D., University of Southern California. Chemical education, coordination compounds of transition metals emphasizing chemical reactivity of ligands, enhancement programs for K–12 teachers, minority medical students programs, research opportunities for high school students.

Kenneth W. Stagliano, Associate Professor of Chemistry. B.S., Ph.D., Temple University. Organic chemistry, development of new chemical reactions for solving regiochemical and stereochemical problems for the total synthesis of biologically active natural products, medicinal chemistry, chemistry of the quinonoid compounds, new synthetic methods.

Joseph R. Stetter, Research Professor of Chemistry. B.S., Ph.D., State University of New York, Buffalo. Electroanalytical chemistry, environmental analytical chemistry, chemical sensors, detectors, development of new analytical methods.

Rong Wang, Associate Professor of Chemistry. B.S., Julin University; Ph.D., University of Tokyo (Japan). Examination of biological systems (living cells, e.g., neural cells, stem cells; bacterial spores; cancer tissues) in natural environments on the nanometer scale using molecular characterization methods such as probe scanning microscopy, surface engineering with new bio-conjugate chemistry, and molecular manipulation via photochemistry and nano-processing; fabrication of nanoscale devices via nano-manipulation.

Department of Biological, Chemical and Physical Sciences

Physics

Grant Bunker, Professor. B.A., Evergreen State College; Ph.D., University of Washington. X-ray absorption spectroscopy, biophysics, synchrotron radiation research, computational physics/chemistry.

Ray A. Burnstein, Emeritus and Research Professor. B.S., University of Chicago; M.S., University of Washington; Ph.D., University of Michigan. Experimental elementary particle physics, interactive teaching and technology.

Liam Coffey, Associate Professor. B.A., Trinity College (Ireland). Ph.D., University of Chicago. Condensed matter theory.

Thomas Erber, Distinguished Professor. B.S., Massachusetts Institute of Technology; M.S., Ph.D., University of Chicago. Electrodynamics, magnetism, fatigue, complex systems.

Laurence Friedman, Senior Lecturer and co-Director of the Health Physics program. B.S., University of Wisconsin; Ph.D. Rensselaer Polytechnic Institute. Health Physics, regulatory affairs.

Porter W. Johnson, Professor. B.S., Case Institute of Technology; M.A., Ph.D., Princeton University. Elementary particle theory, science education.

Daniel Kaplan, Professor and Director of the Center for Accelerator and Particle Physics. B.A., Haverford College; Ph.D., State University of New York, Stony Brook. Experimental high-energy physics, especially symmetry violation and rare decays of hyperons and charm and beauty hadrons, electronics for high-speed triggering and data acquisition.

Leon Lederman, Pritzker Professor of Physics, 1988 Nobel Laureate in Physics; Fermilab Director Emeritus. B.A., City College of New York; Ph.D., Columbia University. Experimental elementary particle physics.

James Longworth, Associate Professor. B.S., Ph.D., Sheffield University.

Timothy Morrison, Professor, Director of the Center for Synchrotron Radiation Research and Instrumentation. B.A., Western Michigan University; Ph.D., University of Illinois, Urbana-Champaign. Solid-state physics, catalysts, x-ray absorption, x-ray optics.

Ivan Nesch, Research Associate Professor, M.S., Sofia University; Ph.D., Moscow State University (Russia).

Howard A. Rubin, Professor, Associate Chair of the Department, and Director of Graduate Affairs. B.S., Massachusetts Institute of Technology; Ph.D., University of Maryland. Experimental elementary particle physics.

H. Larry Scott, Professor of Physics. B.S., Purdue University; Ph.D., Purdue University. Theoretical modeling and computer simulation of lipid bilayers and model biological membranes.

Carlo U. Segre, Professor, Associate Dean of Special Projects for the Graduate College, and Associate Director of the Materials Research Collaborative Access Team. B.S. in Physics, B.S. in Chemistry, University of Illinois, Urbana-Champaign; M.S., Ph.D., University of California, San Diego. Experimental condensed-matter physics, superconductivity, x-ray structural studies of complex materials.

Harold N. Spector, Emeritus Professor. B.A., M.S., Ph.D., University of Chicago. Solid-state theory, electronic and optical processes and semi-conducting nanostructures.

Linda Klamp Spentzouris, Assistant Professor. B.A., Colorado College; Ph.D., Northwestern University. Accelerator physics.

Jeff Terry, Assistant Professor. B.S., University of Chicago; Ph.D., Stanford University. Synchroton radiation techniques.

Christopher White, Associate Professor. B.S., University of Illinois, Urbana-Champaign; Ph.D., University of Minnesota. Experimental elementary particle physics.

John Zasadzinski, Professor and Chair of the Department. B.S., Illinois Benedictine College; Ph.D., Iowa State University. Solid state physics.

Earl Zwicker, Emeritus Professor of Physics. B.S., University of Wisconsin; Ph.D., Illinois Institute of Technology. Physics education.

Department of Biological, Chemical and Physical Sciences

Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0

TOEFL minimum: 550/213*

The Graduate Record Examination (GRE) is required for M.S., Ph.D., and all international applicants. The GRE is also required for all domestic applicants with an undergraduate GPA below 3.0. The GRE minimum scores are:

For tests taken prior to Oct. 1, 2002: 1200 (combined)
For tests taken on or after Oct. 1, 2002, Ph.D.:
    1200 (quantitative + verbal), 3.0 (analytical writing)
For tests taken on or after Oct. 1, 2002, M.S.:
    1100 (quantitative + verbal), 2.5 (analytical writing)
For tests taken on or after Oct. 1, 2002, MAS and MCH:
    900 (quantitative + verbal), 2.5 (analytical writing)

Applicants to the doctoral program in chemistry are strongly encouraged to submit the subject-area GRE score (Subject No. 27). Applicants to the doctoral program in physics are strongly encouraged, but not required, to take the subject-area GRE exam in physics. Applicants to the doctoral program in molecular biochemistry and biophysics are strongly encouraged to take one of the subject exams in biology, molecular biology, chemistry or physics.

Meeting the minimum GPA and test score requirements does not guarantee admission. Test scores and GPA are just two of several important factors considered.

Applicants to one of the department's programs (Biology, Chemistry, Physics or Molecular Biochemistry and Biophysics) are expected to have a bachelors degree from an accredited institution with a major in that same discipline, or a closely allied major with additional coursework that prepares the student for graduate study in the chosen program. Students who have not completed all required courses may be accepted for general admission and can begin coursework, but must remove any deficiencies before the MCH, MAS, and M.S. comprehensive/Ph.D. qualifying examination.

* Paper-based test score/computer-based test score.

Departmental Graduate Examinations

All full-time students in the M.S. and Ph.D. programs are required to take and pass the written M.S. comprehensive/Ph.D. qualifying examination by the end of their fourth semester of study. Part-time students must pass this examination by a comparable stage of their programs. The examination is offered twice each academic year. A student may sit for the examination a maximum of four times. Students passing this examination at the Ph.D. level are judged to be qualified to continue in the Ph.D. program. Students passing at the Master of Science level or above may obtain their masters degree after completing the requirements described in the following sections. All students in the Ph.D. program who have passed the written qualifying examination must take and pass a comprehensive examination before the end of the sixth semester of full-time study. Part-time students must pass this examination by a comparable stage of their programs. This examination consists of a written proposal, an oral presentation and a defense of the proposal before a faculty committee. A student may take this examination a maximum of two times. Students passing this examination may continue with their research and will receive a Ph.D. upon satisfactory completion of all other required courses and general requirements of the Graduate College, a written dissertation and final oral thesis defense.

All students in the professional master degree programs are required to take and pass a written comprehensive exam. Students may sit for the exam a limited number of times, depending upon the individual program.

Department of Biological, Chemical and Physical Sciences

Biology

The department offers graduate programs leading to Master of Biology and to M.S. and Ph.D. degrees in biology, concentrating educational and research activities in the areas of biochemistry, biotechnology, cell and molecular biology, and microbiology. Graduate education in biology is available on either a full- or a part-time basis. Masters degree programs are designed so that they may be completed by part-time students. Doctoral-level courses are usually available in the evenings or on Saturdays. Each new graduate student is assigned a graduate student adviser and must obtain the approval of the adviser each semester before registering for any graduate classes.

Master of Biology

30–31 credit hours
Comprehensive examination

The Master of Biology is a course-only, professional masters degree program designed for professionals who seek advanced and specialized study in the field without the requirement of a thesis or project.

This program is also available on the Web, and at televised viewing sites throughout the Chicago area. Students should consult www.iit-online.iit.edu for more information.

Students must pass the written M.S. comprehensive examination (see "Departmental Graduate Examinations") in their respective areas of specialization: biochemistry, cell and molecular biology, or microbiology. Students in biotechnology may choose any of the three examinations.

The program consists of 30–31 hours of coursework as follows (credit hours in parentheses); 22-23 hours are in the selected area of specialization:

Cell and Molecular Biology
BIOL 504   Biochemistry (4)
BIOL 445   Cell Biology (3)
BIOL 515   Molecular Biology (3)
BIOL 526   Developmental Biology (3)
BIOL 562   Functional Genomics (3)
Two biology electives (6)

Microbiology
BIOL 503   Virology (3)
BIOL 504   Biochemistry (4)
BIOL 515   Molecular Biology (3)
BIOL 542   Advanced Microbiology (3)
BIOL 550   Bioinformatics and Biotechnology (3)
BIOL 562   Functional Genomics (3)
Biology elective (3)

Biochemistry
BIOL 513   Advanced Biochemistry (5)
BIOL 515   Molecular Biology (3)
BIOL 562   Functional Genomics (3)
CHEM 455   Advanced Organic Chemistry (3)
CHEM 538   Biophysical Chemistry (3)
Two electives (biology, chemistry or physics) (6)

Biotechnology
BIOL 504   Biochemistry (4)
BIOL 515   Molecular Biology (3)
BIOL 542   Advanced Microbiology (3)
BIOL 550   Bioinformatics and Biotechnology (3)
BIOL 562   Functional Genomics (3)
Two biology electives (6)

Students in each area of specialization also take the following three courses:

COM 421   Technical Communication (3)
CHEM 513   Statistics for Analytical Chemists (3)
AND
BIOL 511   Project Management (2) **OR**
CHEM 524   Synthesis and Intellectual Property (2)

Department of Biological, Chemical and Physical Sciences

Master of Science in Biology

33-34 credit hours
Comprehensive examination
Option 1: Thesis
Option 2: Library research project

A Master of Science student must complete a minimum of 33 credit hours of approved graduate work in one of the areas of specialization detailed below. This will include 25–29 credit hours of coursework and two credit hours of BIOL 595 Colloquium. Two options are available to com-plete the M.S. degree requirements: a thesis option and a non-thesis option.

Students must pass the written M.S. comprehensive examination (see "Departmental Graduate Examinations") in their respective areas of specialization: biochemistry, cell and molecular biology, or microbiology. Students in biotechnology may choose any of the three examinations.

Thesis Option

The thesis option is designed for individuals planning careers as experimental biologists, including those who may wish to pursue a Ph.D. Students choosing the thesis option must complete six credit hours of thesis research (BIOL 591). Students must also prepare a written thesis based on laboratory research.

Non-Thesis Option

The non-thesis option is intended as a terminal degree to meet the needs of teachers, science administrators, policy makers in the life sciences, patent attorneys and others.

Students who elect the non-thesis option must complete a library research project in one of the following courses:

BIOL 572 (Literature in Biochemistry), BIOL 574 (Literature in Biotechnology), BIOL 576 (Literature in Cell and Molecular Biology), or BIOL 578 (Literature in Microbiology).

Master of Science in Biology with specialization in Biochemistry

34 credits

Students in this program complete 34 credits of graduate work, including the following courses (credit hours in parentheses):

BIOL 513   Advanced Biochemistry (5)
BIOL 515   Molecular Biology (3)
BIOL 519   Biochemistry Laboratory (3)
BIOL 520   Advanced Biochemistry Laboratory (3)
CHEM 538   Physical Biochemistry (3)

In addition, students must take one of the following classes.

CHEM 455   Advanced Organic Chemistry (3)
CHEM 500   Advanced Analytical Chemistry (3)
CHEM 553   Advanced Chemical Thermodynamics (3)

In addition to the basic sequence, students must take six to nine credit hours of approved electives, two credit hours of BIOL 595 (Colloquium), and either six credit hours of Research (BIOL 591 or CHEM 591) or BIOL 572. Other requirements are identical to those described previously for all M.S. students in biology. The requirements for admission to this program include one year of physical chemistry in addition to the usual requirements for admission to graduate study in biology.

Department of Biological, Chemical and Physical Sciences

Master of Science in Biology with specialization in Biotechnology

Students in this program complete 33 to 34 credits of graduate work, including the following (credit hours in parentheses):

BIOL 504	Biochemistry Lectures (4) **OR**
BIOL 513	Advanced Biochemistry (5)
AND	
BIOL 515	Molecular Biology (3)
BIOL 519	Biochemistry Laboratory (3)
BIOL 533	Laboratory in Cell and Molecular Biology (3)
BIOL 542	Advanced Microbiology Lectures (3)
BIOL 550	Bioinformatics and Biotechnology (3)
BIOL 562	Functional Genomics (3)

In addition to three to six credits of appropriate electives, students specializing in biotechnology are required to take two credit hours of BIOL 595 (Colloquium) and either six hours of BIOL 591 (Research) or BIOL 574 (Literature in Biotechnology). Other requirements for the degree and for admission are identical to those for all M.S. students in biology.

Master of Science in Biology with specialization in Cell and Molecular Biology

Students in this program must complete 33-34 credit hours of graduate work, including the following (credit hours in parentheses):

BIOL 504	Biochemistry Lectures (4) **OR**
BIOL 513	Advanced Biochemistry (5)
AND	
BIOL 445	Cell Biology (3)
BIOL 515	Molecular Biology (3)
BIOL 526	Developmental Biology (3)
BIOL 533	Laboratory in Cell and Molecular Biology (3)
BIOL 539	Advanced Cell Biology Laboratory (3)
BIOL 562	Functional Genomics (3)

In addition to three to six credits of approved electives, students specializing in cell and molecular biology must take two credit hours of BIOL 595 (Colloquium) and either six credit hours of BIOL 591 (Research) or BIOL 576 (Literature in Cell and Molecular Biology). Other requirements for the degree and requirements for admission are identical to those described previously for all M.S. students in biology.

Master of Science in Biology with specialization in Microbiology

Students in this program must complete 33-34 credit hours of graduate work, including the following (credit hours in parentheses):

BIOL 503	Biochemistry Lectures (4) **OR**
BIOL 513	Advanced Biochemistry (5)
AND	
BIOL 503	Virology (3)
BIOL 533	Laboratory in Cell and Molecular Biology (3)
BIOL 542	Advanced Microbiology Lectures (3)
BIOL 562	Functional Genomics (3)

In addition to nine to 12 additional credit hours in approved microbiology electives, students specializing in microbiology must take two credit hours of BIOL 595 (Colloquium) and either six credit hours of BIOL 591 (Research) or BIOL 578 (Literature in Microbiology). Other requirements for the degree are identical to those described previously for all M.S. students in biology.

Department of Biological, Chemical and Physical Sciences

Doctor of Philosophy in Biology

84 credit hours
Written qualifying examination
Comprehensive examination
Dissertation and oral defense

A minimum of 84 credit hours is required for the Ph.D. degree in biology. Students should consult the section "Transfer Credits" on page 33 for rules on how many credit hours may be transferred from another institution. Completion of an M.S. degree is not normally required for admission to the full-time program for the Ph.D. degree but may be required of part-time students. Students must pass the Ph.D. qualifying examination in their respective areas of specialization: biochemistry, cell and molecular biology, or microbiology (see "Departmental Graduation Examinations").

Each student, in addition, will be required to pass a comprehensive examination (which serves partly as an oral defense of the thesis proposal) taken prior to performing the major portion of the dissertation research, and in any event, prior to the sixth semester of study and at least one year before oral defense of the thesis. The final examination for the Ph.D. degree consists of an oral presentation and defense of the dissertation.

The Ph.D. program is tailored to fit the student's background and goals and is subject to approval at the time of filing of the program of study (Form #401). Programs of study may be designed in any of the three areas of concentration. However, all programs of study must include at least 36 credit hours in formal courses (exclusive of BIOL 591 and BIOL 691).

Formal courses must include the classes listed below (credit hours in parentheses):

BIOL 445   Cell Biology (3)
BIOL 513   Advanced Biochemistry (5)
BIOL 515   Molecular Biology (3)
BIOL 526   Developmental Biology (3)
BIOL 542   Advanced Microbiology Lectures (3)
BIOL 550   Bioinformatics and Biotechnology (3)
BIOL 562   Functional Genomics (3)
BIOL 595   Colloquium (4)

In addition, Ph.D. candidates take the following two pairs of laboratory courses (credit hours in parentheses):

BIOL 519   Biochemistry (3)
BIOL 520   Advanced Biochemistry (3)
AND
BIOL 533   Cell and Molecular Biology (3)
BIOL 539   Advanced Cell Biology (3)

All research for the dissertation must be carried out under the direct supervision of a faculty research adviser. The faculty research adviser will also act as the candidate's academic adviser. Students must have passed the written qualifying examination before registering for BIOL 691 (Ph.D. Thesis Research). Students may complete all formal course requirements for the Ph.D. degree as either full-time or part-time students.

Department of Biological, Chemical and Physical Sciences

Molecular Biochemistry and Biophysics (MBB)

The department offers interdisciplinary programs leading to M.S. and Ph.D. degrees in molecular biochemistry and biophysics. New advances in our understanding of biological function can be expected from a synthesis of molecular genetics, biochemistry and insights gained from molecular structural information. Individuals with a quantitative, physical approach will be best placed to be innovators in the field. MBB programs complement more traditional graduate programs in biology, chemistry and physics by offering an integrated, molecular-based approach to understanding biological problems, taking insights from all three disciplines.

A major focus of the program is on biophysical approaches to determining the structure of macromolecules and macromolecular assemblies. Faculty advisers are chosen from any of the participating departmental faculty regardless of their affiliation to a particular discipline; a particular strength of the participating faculty is in exploiting synchrotron x-ray sources for biological structural studies. MBB students will have access to state-of-the-art x-ray facilities at the nearby Advanced Photon Source, currently one of the most intense x-ray sources in the world.

Master of Science in Molecular Biochemistry and Biophysics

32 credit hours
Comprehensive examination
Thesis

A master's student must complete a minimum of 32 credit hours of approved graduate work, including a core of 21 credit hours, a minimum of five credits of approved electives, and six credit hours of research toward the thesis (BIOL, CHEM or PHYS 591)

The electives are chosen from course offerings in the areas of genetics and genetic engineering, structural biophysics, or biochemistry and cellular biophysics. Specific electives are chosen in consultation with an academic adviser. Research for the dissertation must be carried out under the direct supervision of a participating faculty member; this faculty research adviser also acts as the candidate's academic adviser.

Core courses (credit hours in parentheses)
BIOL 513   Advanced Biochemistry (5)
BIOL 515   Molecular Biology (3)
BIOL 445   Cell Biology (3)
CHEM 538   Physical Biochemistry (3)
CHEM 550   Chemical Bonding (3)
BIOL 584   Graduate Seminar (1)
BIOL 595   Colloquium (1)
BIOL 580   Laboratory Rotation in Molecular Biochemistry and Biophysics (2)

Department of Biological, Chemical and Physical Sciences

Doctor of Philosophy in Molecular Biochemistry and Biophysics

84 credit hours
Written qualifying examination
Comprehensive examination
Dissertation and oral defense

A minimum of 84 credit hours of instruction is required for the MBB Ph.D. Students should consult the section "Transfer Credits" on page 33 for rules on how many credit hours may be transferred from another institution. Completion of an M.S. degree is not normally required for admission to the Ph.D. program. Students must complete the 25 to 27 credit hours of core courses and at least four additional courses from the approved lists.

Each graduate student must take and pass the written Ph.D. qualifying examination in order to enter into candidacy for the doctorate. Each student, in addition, will be required to pass a comprehensive examination (which serves partly as an oral defense of the thesis proposal) taken prior to performing the major portion of the dissertation research, and in any event, prior to the sixth semester of study and at least one year before oral defense of the thesis. The final examination for the Ph.D. degree consists of an oral presentation and defense of the dissertation.

All students will be required to take the following courses, or have equivalent background (credit hours in parentheses).

Core courses
BIOL 513   Advanced Biochemistry (5)
BIOL 515   Molecular Biology (3)
BIOL 445   Cell Biology (3)
CHEM 538   Physical Biochemistry (3)
CHEM 550   Chemical Bonding (3)
BIOL 584   Graduate Seminar in Biology (1)
BIOL 684   Graduate Seminar in Biology (1)
BIOL 595   Colloquium (4)
BIOL 580   Laboratory Rotation in Molecular
            Biochemistry and Biophysics (2)

BIOL 584 must be taken by all Ph.D. students in their first year of full-time graduate study, while BIOL 684 must be taken after having passed the Ph.D. qualifying examination. BIOL 595 must be taken four times. BIOL 580 may be taken two times. MBB students, in consultation with their academic adviser, choose the remainder of their formal coursework from those courses in the areas listed below (credit hours in parentheses):

Genetics and Genetic Engineering
BIOL 562   Functional Genomics (3)
BIOL 526   Developmental Biology (3)

Structural Biophysics
PHYS 570   Introduction to Synchrotron Radiation (3)
BIOL 555   Macromolecular Structure Determination (3)
CHEM 505   Spectroscopic Methods I (3)
PHYS 561   Radiation Biophysics (3)
CHEM 454   Computer Applications in Chemistry (3)

Biochemistry and Cellular Biophysics
BIOL 519   Biochemistry Laboratory (3)
BIOL 533   Cell and Molecular Biology Laboratory (3)
CHEM 531   Tactics in Organic Synthesis (3)
CHEM 630   Special Topics in Organic Chemistry (2)
PHYS 410   Molecular Biophysics (3)

Other courses may be prescribed by the adviser/thesis committee according to the student's individual needs for the program of study. All research for the dissertation must be carried out under the direct supervision of a faculty research adviser who will also act as the candidate's academic adviser.

Department of Biological, Chemical and Physical Sciences

Chemistry

The department offers graduate programs leading to M.S. and Ph.D. degrees in chemistry. In addition, the department offers two professional master's programs designed for the part-time student and available through distance learning. The aim of these programs is to develop chemists who are able to think creatively and critically. Each student's program is planned individually to meet individual needs, interests and capabilities. In recognition of the value of teaching experience in strengthening an individual's understanding of his or her field of study and as an aid in making career decisions, the department requires all full-time students to participate in instructional activities.

Each new graduate student is assigned a graduate student adviser and must obtain the approval of the adviser each semester before registering for any graduate classes.

Master of Chemistry in Analytical Chemistry

32 credit hours
Comprehensive examination

The professional masters program in analytical chemistry is a part-time program for analytical chemists seeking to broaden their backgrounds in analytical chemistry. The specific goals of the program of study are to broaden and deepen knowledge of state-of-the-art analytical techniques, to learn how to design and manage projects, to gain an overview of statistical methods, and to improve communication skills. Candidates must possess a bachelor's degree (ideally in science or engineering) with two semesters of physical chemistry, two semesters of organic chemistry, and one semester of analytical chemistry. Candidates' advisers assist them in determining if any further prerequisites are necessary. A final comprehensive examination is required for graduation.

This program is also available on the Web, and at televised viewing sites throughout the Chicago area. Students should consult www.iit-online.iit.edu for more information.

The program of study consists of the following classes:

CHEM 500	Advanced Analytical Chemistry
CHEM 501	Liquid Chromatography
CHEM 502	Gas Chromatography
CHEM 503	Chromatographic Techniques
CHEM 505	Spectroscopic Methods I
CHEM 506	Sampling and Sample Preparation
CHEM 508	Analytical Methods Development
CHEM 509	Physical Methods of Characterization
CHEM 511	Project Management for Chemists
CHEM 512	Spectroscopic Methods II
CHEM 513	Statistics for Analytical Chemistry
COM 421	Technical Communication

Department of Biological, Chemical and Physical Sciences

Master of Chemistry

32 credit hours
Comprehensive examination option
Project with oral examination option

The Master of Chemistry program is designed for professionals pursuing advanced study on a part-time basis. It does not include a research requirement. Candidates for the Master of Chemistry degree must meet the requirements of the Graduate College for a professional master's degree. Students are required to complete satisfactorily six of the M.S. core courses (CHEM 500, CHEM 505, CHEM 518, CHEM 520, CHEM 521, CHEM 530, CHEM 531, CHEM 535, CHEM 550, CHEM 553). These must include either CHEM 550 (Chemical Bonding) or CHEM 505 (Spectroscopic Methods).

The student must additionally complete a specialized interdisciplinary program consisting of at least 12 credit hours in a coherent area of chemistry. The selection of the student's program must be made in consultation with an adviser and may be chosen from the suggested programs listed below or designed to suit the student's interests. This interdisciplinary program specialization may include chemistry and/or related coursework from other departments—for example, mathematics and physics, computer science, biology, law, business, environmental or chemical engineering. (The credits in law may not be applied toward the J.D. degree at Chicago-Kent College of Law.) Students must pass either one M.S. comprehensive examination as for the M.S. degrees described previously, or an oral final examination based primarily on the area of specialization. This may include defense of a project. Some of the possible areas of specialization are listed along with suggested courses:

Biochemistry/Biotechnology
BIOL 445	Cell Biology
BIOL 403	General Biochemistry
BIOL 404	Biochemistry Laboratory
BIOL 514	Toxicology
BIOL 515	Molecular Biology
BIOL 550	Industrial and Computational Biology

Environmental Chemistry
ENVE 401	Introduction to Water Resources Engineering
ENVE 410	Environmental Health Engineering
ENVE 463	Introduction to Air Pollution Control
ENVE 501	Environmental Chemistry
ENVE 506	Chemodynamics

Polymer Chemistry
CHE 450	Principles of Polymer Science and Engineering
CHE 538	Polymerization Reaction Engineering
CHE 555	Polymer Processing
CHEM 542	Characterization of Polymers
MMAE 580	Structure and Properties of Polymers
MMAE 581	Theory of Mechanical Behavior of Polymers

Department of Biological, Chemical and Physical Sciences

Master of Chemistry in Materials and Chemical Synthesis

31 credit hours
Comprehensive examination

The professional master's program in materials and chemical synthesis is a part-time program designed for scientists who wish to broaden their background in synthesis of new materials. The specific goals of the program of study are to broaden and deepen knowledge of state-of-the-art synthesis, purification, separation and characterization techniques; to learn how to design and manage projects; to sharpen intellectual property management techniques; to learn how to operate under regulatory constraints; and to improve communications skills. Candidates must have a bachelor's degree (ideally in science or engineering).

Advisers assist students in determining whether any prerequisites are necessary. A final comprehensive examination is required for graduation.

This program is also available on the Web, and at televised viewing sites throughout the Chicago area. Students should consult www.iit-online.iit.edu for more information.

The program of study consists of the following classes:

CHEM 454	Computer Applications in Chemistry
CHEM 505	Spectroscopic Methods I
CHEM 511	Project Management for Chemists
CHEM 521	Structural Inorganic and Solid-State Chemistry
CHEM 522	Efficient Chemical and Materials Synthesis
CHEM 524	Synthesis and Intellectual Property Management
CHEM 531	Tactics of Organic Synthesis
CHEM 535	Polymer Synthesis
CHEM 539	Introduction to Pharmaceutical Chemistry
ENVE 545	Environmental Regulations and Risk Assessment
COM 421	Technical Communication

Master of Science in Chemistry

32 credit hours
Comprehensive examination
Thesis and oral defense

Students seeking the M.S. degree must pass the written M.S. comprehensive examination in their respective areas of specialization: analytical, inorganic, organic, polymer or physical chemistry. The student must also write a thesis based on original research, which should be submitted no later than one calendar year after passing the qualifying examination.

An M.S. student must complete a minimum of 32 credit hours of approved coursework. This includes two credits of CHEM 585 (Colloquium) and the courses listed below:

CHEM 505	Spectroscopic Methods I
CHEM 550	Chemical Bonding
CHEM 584	Graduate Seminar

The student must also complete one of the two core courses in inorganic chemistry:

CHEM 520	Advanced Inorganic Chemistry **OR**
CHEM 521	Structural Inorganic and Solid-State Chemistry

AND one of the two core courses in organic chemistry:

CHEM 530	Organic Reaction Mechanisms **OR**
CHEM 531	Tactics of Organic Synthesis

The remainder of the program can consist of additional graduate courses and up to 12 credit hours of CHEM 591 (Thesis Research). Students are strongly encouraged to choose additional courses from those listed above or from the following classes:

CHEM 500	Advanced Analytical Chemistry
CHEM 518	Electrochemical Methods
CHEM 535	Polymer Synthesis
CHEM 553	Introduction to Chemical Thermodynamics

Department of Biological, Chemical and Physical Sciences

Doctor of Philosophy in Chemistry

84 credit hours
Written qualifying examination
Comprehensive examination
Dissertation and oral defense

A minimum of 84 credit hours is required for the Ph.D. in chemistry. Students should consult the section "Transfer Credits" on page 33 for rules on how many credit hours may be transferred from another institution. A student must pass the Ph.D. qualifying examination in the area of specialization. Examinations are given in the areas of analytical, inorganic, organic, polymer and physical chemistry. The Ph.D. program is tailored to fit the student's background and goals and is subject to approval at the time of filing of the Program of Study (Form #401).

The curriculum includes two credits of CHEM 585 (Colloquium) and the following required courses:

CHEM 505   Spectroscopic Methods I
CHEM 550   Chemical Bonding
CHEM 584   Graduate Seminar
CHEM 684   Graduate Seminar
CHEM 685   Colloquium

Additional required coursework includes a minimum of three courses chosen from the following core course list, including one course in inorganic chemistry and one course in organic chemistry.

CHEM 500   Advanced Analytical Chemistry
CHEM 518   Electrochemical Methods
CHEM 520   Advanced Inorganic Chemistry
CHEM 521   Structural Inorganic and Solid-State Chemistry
CHEM 530   Organic Reaction Mechanisms
CHEM 531   Tactics of Organic Synthesis
CHEM 535   Polymer Synthesis
CHEM 553   Introduction to Chemical Thermodynamics

The remainder of the program of study will be chosen in consultation with the student's adviser. All research for the dissertation must be carried out under the direct supervision of a faculty research adviser. The faculty research adviser also will act as the candidate's academic adviser. Students must have passed the written qualifying examination before registering for CHEM 691 (Ph.D. Thesis Research).

Department of Biological, Chemical and Physical Sciences

Physics

The department offers programs leading to M.S. and Ph.D. degrees in physics. The M.S. degree is not a prerequisite for the Ph.D. The department also offers a professional master's program in health physics designed for the part-time student and available through distance learning. Research is organized into small groups of faculty members, post-doctoral associates, graduate students and undergraduate students working on closely related projects. The principal active areas include experimental and theoretical condensed matter physics, experimental and theoretical elementary particle physics, synchrotron radiation physics, accelerator physics, structural and computational biophysics, magnetism and electrodynam-

ics. Classes are generally small and informal, and thesis research is carried out in close collaboration with the faculty adviser.

In recognition of the value of teaching experience in strengthening an individual's understanding of his or her field of study and as an aid in making career decisions, the department requires full-time students to participate in instructional activities. Each new graduate student is assigned a graduate student adviser and must obtain the approval of the adviser each semester before registering for any graduate classes.

Master of Health Physics

30 credit hours
Comprehensive examination

Designed primarily for working professional health physicists in government, medicine, research and industry, this program combines technical depth with the interdisciplinary viewpoints of law, management and communications. The degree can be completed in four semesters and two summer sessions of part-time study. Applicants must have completed coursework in calculus through differential equations and a calculus-based general physics sequence. A course in modern physics, including some basic quantum mechanics, is strongly recommended.

This program is also available on the Web, and at televised viewing sites throughout the Chicago area. Students should consult www.iit-online.iit.edu for more information.

Required courses

PHYS 561	Radiation Biophysics
PHYS 571	Health Physics I
PHYS 572	Health Physics II
PHYS 573	Standards, Statutes and Regulations
PHYS 575	Case Studies in Health Physics
PHYS 576	External Dosimetry
PHYS 577	Internal Dosimetry
PHYS 770	Instrumentation for Radiation Health Physics
COM 421	Technical Communication
PSYC 556	Organizational Psychology
MATH 474	Probability and Statistics

Master of Science in Physics

32 credit hours
Comprehensive examination
Thesis and oral defense

For those interested in research, seven to nine credit hours of PHYS 591 (Thesis Research) may be applied to the 32-credit-hour requirement. The basic program of coursework must include two credits of PHYS 585 (Colloquium) and the M.S. core:

PHYS 501	Methods of Theoretical Physics I
PHYS 505	Electromagnetic Theory
PHYS 508	Analytical Dynamics
PHYS 509	Quantum Theory I

The remaining course requirements may be satisfied by additional graduate or advanced undergraduate electives.

Department of Biological, Chemical and Physical Sciences

Doctor of Philosophy in Physics

84 credit hours, approved by faculty adviser
Written qualifying examination
Comprehensive examination
Dissertation and oral defense, supervised by faculty
member and approved by thesis committee

The requirements for the degree consist of a program of
84 credit hours approved by the faculty adviser; passing
the Ph.D. qualifying and comprehensive examinations;
and the completion of a research thesis supervised by
a faculty member and approved by a thesis committee.
Students should consult the section "Transfer Credits"
on page 33 for rules on how many credit hours may
be transferred from another institution. The required
coursework includes 2 hours of PHYS 585 (Colloquium)
and the graduate core:

PHYS 501   Methods of Theoretical Physics I
PHYS 505   Electromagnetic Theory
PHYS 508   Analytical Dynamics
PHYS 509   Quantum Theory I
PHYS 515   Statistical Mechanics

and at least three specialized or advanced physics gradu-
ate courses chosen from the following:

PHYS 502   Methods of Theoretical Physics II
PHYS 507   Electrodynamics
PHYS 510   Quantum Theory II
PHYS 511   Advanced Quantum Mechanics I
PHYS 512   Advanced Quantum Mechanics II
PHYS 533   Group Theory in Physics
PHYS 537   Physics of the Solid State I
PHYS 538   Physics of the Solid State II
PHYS 545   Elementary Particle Physics
PHYS 553   Quantum Field Theory
PHYS 561   Radiation Biophysics
PHYS 570   Introduction to Synchrotron Radiation

The remaining course requirements may be satisfied by
additional graduate or advanced undergraduate electives
and research. Students are encouraged to participate in
faculty research programs and seminars early in their
graduate careers. Thesis work may follow from these
activities. All research for the dissertation must be car-
ried out under the direct supervision of a faculty research
adviser. Students must have passed the written qualify-
ing examination before registering for PHYS 691 (Ph.D.
Thesis Research).

Department of Biological, Chemical and Physical Sciences

Certificate Programs

Analytical Methods Development

Required courses

CHEM 506   Sampling and Sample Preparation
CHEM 508   Analytical Methods Development

AND two courses selected from the list of electives below.

Analytical Spectroscopy

Required courses

CHEM 505   Spectroscopic Methods I
CHEM 512   Spectroscopic Methods II

AND two courses selected from the list of electives below.

Chromatography

Required courses

CHEM 501   Liquid Chromatography
CHEM 502   Gas Chromatography

AND two courses selected from the list of electives below.

Electives for Analytical Methods Development, Analytical Spectroscopy and Chromatography

CHEM 500   Advanced Analytical Chemistry
CHEM 501   Liquid Chromatography
CHEM 502   Gas Chromatography
CHEM 503   Chromatographic Techniques
CHEM 505   Spectroscopic Methods
CHEM 506   Sampling and Sample Preparation
CHEM 509   Physical Methods of Characterization
CHEM 510   Electronics and Interfacing
CHEM 511   Project Management
CHEM 512   Spectroscopic Methods II
CHEM 513   Statistics for Analytical Chemists
COM 421   Technical Communications

Characterization of Inorganic and Organic Materials

Required courses

CHEM 505   Spectroscopic Methods I
CHEM 509   Physical Methods of Characterization
CHEM 512   Spectroscopic Methods II

AND

CHEM 502   Gas Chromatography **OR**
CHEM 542   Polymer Characterization and Analysis

Radiological Physics

12 total credits selected from:

PHYS 561   Radiation Biophysics
PHYS 571   Health Physics I
PHYS 572   Health Physics II
PHYS 573   Standards, Statutes and Regulations
PHYS 575   Case Studies in Health Physics
PHYS 576   Internal Dosimetry
PHYS 577   External Dosimetry
PHYS 770   Instrumentation for Radiation Health Physics

Synthesis and Characterization of Inorganic Materials

Required courses

CHEM 505   Spectroscopic Methods I
CHEM 521   Structural Inorganic and Solid-State Chemistry
CHEM 522   Efficient Chemical and Materials Synthesis

AND one additional course selected from:

CHEM 502   Gas Chromatography
CHEM 509   Physical Methods of Characterization
CHEM 512   Spectroscopic Methods II
CHEM 535   Polymer Synthesis
CHEM 542   Polymer Characterization and Analysis

Synthesis and Characterization of Organic Materials

Required courses

CHEM 505   Spectroscopic Methods I
CHEM 531   Tactics in Organic Synthesis
CHEM 539   Introduction to Pharmaceutical Chemistry

AND one course from the following:

CHEM 502   Gas Chromatography
CHEM 509   Physical Methods of Characterization
CHEM 512   Spectroscopic Methods II
CHEM 535   Polymer Synthesis
CHEM 542   Polymer Characterization and Analysis

Department of Biological, Chemical and Physical Sciences

Course Descriptions

Numbers in parentheses represent class, lab and total credit hours, respectively.

Biology

BIOL 503
Virology
This course will cover topics related to animal viruses, including the cycle of major viral classes, viral pathogenesis, emergence, and control. Recent advances in these areas will be discussed in conjunction with readings from the original literature. Prerequisite: BIOL 504 or equivalent or instructor's consent. BIOL 214 and BIOL 445 recommended. (3-0-3)

BIOL 504
Biochemistry Lectures
Molecules of biological significance; reaction thermodynamics and kinetics; metabolism; cellular localization of biochemical function; proteins; nucleic acids; transcription; translation. Prerequisites: BIOL 115 and CHEM 237. (4-0-4)

BIOL 513
Advanced Biochemistry
Intensive course that covers the chemical structure and function of biological macromolecules: proteins, nucleic acids, polysaccharides. Biochemical thermodynamics, kinetics, bioenergetics and modern methodology are emphasized. Also, metabolism, photosynthesis, lipids and membranes. Prerequisites: One year of organic chemistry, an undergraduate course in biochemistry, and one semester of physical chemistry recommended, or instructor's consent. (5-0-5)

BIOL 514
Toxicology
Initial lectures cover basic principles in chemical toxicity, such as dose response, indices of numerical toxicity, metabolism and factors influencing toxicity. Mechanisms of organic toxicity will be presented to include central nervous system, liver, kidney, respiratory system, reproductive system and the hematological system. Special topic lectures will emphasize the mechanism of toxicity for specific metals, pesticides, solvents and substances of abuse. (3-0-3)

BIOL 515
Molecular Biology
A survey of topics including structure of nucleic acids, translation, transcription, replication, organization of DNA, RNA processing, genomics, and control of gene expression. Prerequisite: BIOL 504 or equivalent or instructor's consent. (3-0-3)

BIOL 519
Biochemistry Laboratory
Introduction to modern biochemical techniques, including analytical methods for macromolecules, enzyme reactions, spectrophotometry, purifications, centrifugation, chromatography, electrophoresis, structure modeling. Prerequisite: Previous or concurrent enrollment in BIOL 513 or BIOL 504 or instructor's consent. (0-9-3)

BIOL 520
Advanced Biochemistry Laboratory
A continuation of BIOL 519 in which students will undertake individual research projects. Prerequisite: BIOL 519 or instructor's consent. (0-9-3)

BIOL 521
Advanced Micro Genetics Lab
Introduction to independent research in microbial physiology and genetics. Prerequisite: instructor's consent. (0-9-3)

BIOL 526
Developmental Biology
This course covers the cellular and molecular processes involved in generating an embryo, in creating various tissues and organs, and the effect of external stimuli on development. Topics include: genome structure, gene expression and regulation, cell cycle control, pattern formation, signal transduction, gametogenesis, organogenesis, and methods used in studying developmental biology. In addition to studies of model organisms, examples relevant to human diseases are covered. (3-0-3)

BIOL 527
Immunology and Immunochemistry
Basic concepts of immunology, immunochemistry, both biological and molecular. Prerequisite: BIOL 504 or instructor's consent. (3-0-3)

BIOL 533
Laboratory in Cell and Molecular Biology
This course covers a number of essential techniques in cell and molecular biology with emphases on both the methodologies and the experimental details. Laboratory procedures include basic cell culture skills and relevant laboratory equipment usage. Experimental procedures include polymerase chain reaction and human DNA polymorphism, Drosophila polytene chromosome cytology, plasmid DNA preparation, western blot, gene delivery, yeast two-hybrid screens, immunofluorescence, immunoprecipitation, cell cycle arrest and analysis, and cell differentiation. Prerequisite BIOL 445 or instructor's consent. (0-9-3)

BIOL 539
Advanced Cell Biology Laboratory
Introduction to independent research in cell and molecular biology. Prerequisite: BIOL 533. (0-9-3)

BIOL 542
Advanced Microbiology
This course will introduce students to advanced topics in microbial kinetics, genomics and proteomics. Using a variety of Internet tools, the student will be able to compare data from these three areas, and use them to predict biological properties of microorganisms. The kinetics portion (about half of the course) will include the following topics: introduction to zero, first and second order whole microbial cell reactions occurring in batch culture; comparison of batch, fed-batch and chemostat kinetics; yield coefficients; productivity coefficients; material balances; and reaction rate determinations of the four nutritional classes of microbes. (3-0-3)

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BIOL 550
Bioinformatics and Biotechnology
This course will present an historical introduction to bioinformatics as a driving force for biotechnological advances. Topics covered will include: collecting and storing sequences in the lab; alignment of pairs of sequences; multiple sequence alignment; phylogenetic prediction; database searching for similar sequences; gene prediction; protein classification and structure prediction; and genome analysis. (3-0-3)

BIOL 555
Macromolecular Structure Determination
Macromolecular crystallographic methods, including crystallization, data processing, phasing, and structure refinement; multi-dimensional NMR techniques; spectroscopic techniques; structural comparisons and characterizations; fiber diffraction and solution scattering. Prerequisite: instructor's consent. (3-0-3)

BIOL 562
Current Topics in Functional Genomics
This course is designed to give students a foundation in advanced theoretical and applied methods in modern molecular research. It will emphasize both established and novel approaches to solving problems of functional and comparative genomics, and systems biology. It will also focus on applications of advanced molecular techniques in areas of significant economic and biomedical importance. Prerequisite: BIOL 515 or instructor's consent. (3-0-3)

BIOL 572
Literature in Biochemistry
A topic from the current literature in biochemistry is selected by students for preparation of a paper. Prerequisite: instructor's consent. (3-0-3)

BIOL 574
Literature in Biotechnology
A topic from the current literature in biotechnology is selected by students for preparation of a paper. Prerequisite: instructor's consent. (3-0-3)

BIOL 576
Literature in Cell and Molecular Biology
A topic from the current literature in cell and molecular biology is selected by students for preparation of a paper. Prerequisite: instructor's consent. (3-0-3)

BIOL 578
Literature in Microbiology
A topic from the current literature in microbiology is selected by students for preparation of a paper. Prerequisite: instructor's consent. (3-0-3)

BIOL 580
Laboratory Rotation in Molecular Biochemistry and Biophysics
Short, individual research projects under the supervision of departmental faculty. Students will rotate through two to three different faculty laboratories in one semester. This helps ensure a good match between supervisor, project and student, as well as provide a broader technical base to the student than provided by a single laboratory. The course may be taken twice. (0-6-2)

BIOL 584, 684
Graduate Seminar in Biology
To foster scientific communication skills, students are required to present seminars based on the scientific literature. (1-0-1); (1-0-1)

BIOL 591
M.S. Thesis Research
(Credit: Variable)

BIOL 595
Biology Colloquium
Lectures by invited scientists in areas of biology generally not covered in the department. Must be taken two times by M.S. students and four times by Ph.D. students. (1-0-1)

BIOL 691
Ph.D. Thesis Research
(Credit: Variable)

BIOL 695
Biology Colloquium
Lectures by invited scientists in areas of biology generally not covered in the department. For full-time

graduate students who have completed the BIOL 595 requirement. (1-0-0)

Undergraduate Biology Courses Available to Graduate Students

BIOL 410
Medical Microbiology

BIOL 414
Genetics for Engineering Scientists

BIOL 430
Animal Physiology

BIOL 445
Cell Biology

Chemistry

CHEM 500
Advanced Analytical Chemistry
An overview of analytical chemistry with discussions of complex ionic equilibria, electroanalytical techniques including potentiometric, voltametric, coulometric and conductometric methods, ion chromatography, capillary electrophoresis and sensor technology. (3-0-3)

CHEM 501
Liquid Chromatography
Theory and practice of liquid chromatography with an emphasis on high-performance liquid chromatography. (3-0-3)

CHEM 502
Gas Chromatography
Theory and practice of gas chromatography with emphasis in capillary gas chromatograph spectrometry. (2-0-2)

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CHEM 503
Chromatographic Techniques
Theory and practice of separation methods other than gas and highperformance liquid chromatography. Topics to be discussed include size-exclusion chromatography, affinity chromatography, thin-layer chromatography, supercritical fluid chromatography, electrophoresis, high-speed countercurrent chromatography and flow-injection analysis. (3-0-3)

CHEM 504
Electroanalytical Chemistry
Fundamentals including pulse and differential pulse techniques, electrochemical detection for chromatography, flow-injection analysis and remote chemical sensors. (2-0-2)

CHEM 505
Spectroscopic Methods I
Theories of spectroscopic transitions and their applications in structural elucidations and quantitative analysis. Topics include ultraviolet/visible, infrared, Raman and nuclear magnetic resonance spectroscopy and mass spectrometry. (3-0-3)

CHEM 506
Sampling and Sample Preparation
Techniques and devices for sampling in diverse media will be treated, followed by a discussion of sample treatment prior to analysis including isolation, concentration and fractionation of analytes and classes of analytes. (3-0-3)

CHEM 508
Analytical Methods Development
A seminar course presenting analytical methods in complex matrices with emphasis on methods development and validation. (2-0-2)

CHEM 509
Physical Methods of Characterization
A survey of physical methods of characterization including x-ray diffraction and fluorescence surface techniques, including SEM, TEM, AES and ESCA, thermal methods and synchrotron radiation methods. (3-0-3)

CHEM 510
Electronics and Interfacing
Elementary circuit analysis, operational amplifiers, digital electronics, signal processing and interfacing of instruments using modern computer software and hardware. (2-0-2)

CHEM 511
Project Management
Introduction to concepts and techniques used to design and/or analyze a project to develop a set of tasks to accomplish the project, to coordinate and to monitor the work involved in the tasks, and to deliver a final product or service. Budgetary considerations will also be discussed. (2-0-2)

CHEM 512
Spectroscopic Methods II
A continuation of the study of optical methods covering atomic absorption spectroscopy, atomic and flame emission spectroscopy, chemiluminescence, fluorescence, phosphorescence, light scattering and refractometry. (2-0-2)

CHEM 513
Statistics for Analytical Chemists
A survey providing sufficient statistical background for scientists. The topics covered include probability, statistics, sampling estimation, regression analysis, experimental design, data analysis and signal enhancement. (3-0-3)

CHEM 518
Electrochemical Methods
Thermodynamics and potential, charge-transfer kinetics and mass transfer. Potential step and potential sweep methods, including hydrodynamic methods. Bulk electrolysis methods. Electrode reactions coupled with homogeneous chemical reactions. Double-layer structure and absorbed intermediates in electrode processes. Digital simulation of electrochemical processes. Students are expected to have some background in the physical chemistry of solutions and electroanalytical chemistry at the level of CHEM 500. (3-0-3)

CHEM 520
Advanced Inorganic Chemistry
Selective treatment of the chemistries of main group and transition elements with emphasis on coordination complexes, organometallic compounds and inorganic cages and clusters. Discussions of molecular symmetry, stereochemistry, bonding, electronic spectra, magnetic properties, reactions, kinetics and reaction mechanisms are included. (3-0-3)

CHEM 521
Structural Inorganic and Solid-State Chemistry
This course covers structure and bonding and structure-property relationships in inorganic molecules and solids. Descriptions of crystal structures, spectroscopic and x-ray diffraction techniques for structure determination and properties of solids are included. (3-0-3)

CHEM 522
Efficient Chemical and Materials Synthesis
The design and development of environmentally benign chemical pathways: challenges and opportunities. High-yield and zero-waste chemical processes. Representative processes. (3-0-3)

CHEM 524
Synthesis and Intellectual Property Management
This course focuses on the management of intellectual property. Professionals will lead discussions on the control and dissemination of materials concerning intellectual property. This will be combined with technical presentations by students in the classroom. Topics of discussion will include invention disclosures, intellectual property rights, proprietary materials, justification for patents, types of patents, terms of a patent, patents procedure, licensing procedure and security considerations. Access to patented materials and disclosure of materials under patent process will be covered. (2-0-2)

Department of Biological, Chemical and Physical Sciences

CHEM 530
Organic Reaction Mechanisms
A study of important mechanism classes and their relationship to the major reactions of organic chemistry. Emphasis will be placed on the study of reaction intermediates and on the methods used to characterize reaction pathways. Topics will include chemical bonding, aromaticity, stereochemistry, substitution, elimination, carbanion chemistry, free radical reactions, photochemistry and concerted reactions. Prerequisite: CHEM 455 or equivalent is recommended. (3-0-3)

CHEM 531
Tactics in Organic Synthesis
A study of modern synthetic strategies used in the preparation of complex organic molecules. Synthetic planning using the disconnection approach and the selection of reagents to solve regiochemical and stereochemical problems will be the underlying themes. Synthetic strategies to be discussed include tandem reactions, template and chelation effects, biomimetic tactics and the use of chiral terpenes, carbohydrates and amino acids in enantioselective syntheses. Target molecules will include natural products, pharmaceuticals and "smart" organic materials. Prerequisite: CHEM 455 or equivalent is recommended. (3-0-3)

CHEM 535
Polymer Synthesis
In-depth study of polymer synthesis, kinetics of polymerization, solution and thermal properties, processing and characterization techniques and rheological behavior. Selected topics include high-performance polymers, conducting polymers, electrooptical polymers, water-soluble polymers, biopolymers, medicinal polymers, photosensitive polymers and liquid crystalline polymers. Prerequisite: CHEM 470 or instructor's consent. (3-0-3)

CHEM 537
Polymer Chemistry Laboratory
This course will include the synthesis of a variety of polymers and their characterization using instrumental methods. Emphasis will be placed on factors that control polymer formation, methods for obtaining molecular weights and distributions of polymers, as well as thermal and mechanical characteristics of polymers. Prerequisite: CHEM 470 or instructor's consent. (1-6-3)

CHEM 538
Physical Biochemistry
The principles and techniques of physical chemistry applied to proteins, nucleic acids, polysaccharides and lipids. Prerequisites: CHEM 239, CHEM 344 (or equivalent). (3-0-3)

CHEM 539
Introduction to Pharmaceutical Chemistry
Fundamental concepts will be discussed, including modern principles of drug design; drug absorption, distribution and metabolism; theories of drug-receptor interactions; approaches to structure-activity relationships; chemical, physicochemical and structural considerations. The various classes of therapeutic agents will be surveyed with emphasis on possible modes of action. Methods of synthesis will be considered. Prerequisites: CHEM 239. (3-0-3)

CHEM 542
Polymer Characterization and Analysis
Overview of various characterization and analysis techniques in polymer science and technology, such as thermal analysis, mechanical property measurements, chromatographic separations, techniques for the determination of molecular weights and chemical analysis of polymer additives in polymer research, product development, quality control and degradation studies. A general discussion on industrial problem solving using multiple characterization techniques. (3-0-3)

CHEM 548
Electrochemical Methods
Thermodynamics and potential, charge-transfer kinetics and mass transfer. Potential step and potential sweep methods, including hydrodynamic methods. Bulk electrolysis methods. Electrode reactions coupled with homogeneous chemical reactions. Double-layer structure and absorbed intermediaries in electrode processes. Digital simulation of electrochemical processes. Students are expected to have some background in the physical chemistry of solutions and electroanalytical chemistry at the level of CHEM 500. (3-0-3)

CHEM 550
Chemical Bonding
Review of the postulatory basis of quantum mechanics and application to 1-D and 3-D systems. Hydrogenic and symmetry-adapted spin orbitals and bond formation. Ground and excited states. Commonly used semi-empirical molecular orbital methods. Prerequisite: CHEM 344 or equivalent, or instructor's consent. (3-0-3)

CHEM 552
Chemical Kinetics
Types of reactions, reaction order, activation energy, transition states, isotope effects and the mechanism of reactions. Determination of the rates of free radical reactions. Primary processes in thermal, photochemical and other radiation-induced reactions. Prerequisites: CHEM 550, CHEM 553 (or equivalent). (3-0-3)

CHEM 553
Introduction to Chemical Thermodynamics
Fundamental laws of thermodynamics; application to simple chemical systems. Prerequisite: CHEM 344 or equivalent. (3-0-3)

CHEM 560
Advanced Chemistry Projects
Advanced chemistry projects to be carried out under the direction of a faculty member. These projects may involve computational, theoretical, experimental work or a combination of these. Projects based on experimental work may be carried out in the research lab of the instructor. Topics of the advanced projects will be selected by the faculty member offering the course and will not necessarily be related to the dissertation topic of the student. (0-12-4)

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CHEM 584
Graduate Seminar in Chemistry
To foster scientific communications skills, students are required to present seminars based on the scientific literature. Required of all first-year M.S. and Ph.D. students. (1-0-1)

CHEM 585
Chemistry Colloquium
Lectures by invited scientists in areas of chemistry generally not covered in the department. Must be taken two times by M.S. students and four times by Ph.D. students. (1-0-1)

CHEM 591
Thesis Research
(Credit: Variable)

CHEM 594
Special Problems
Designed for non-thesis M.S. only. (Credit: Variable)

CHEM 597
Reading and Special Problems
Independent study to meet the special needs of graduate students in department-approved graduate degree programs. Requires the written consent of the instructor. May be taken more than once. Receives a letter grade. (Credit: Variable)

CHEM 610, 611
Special Topics in Analytical Chemistry
Topics of current interest in analytical chemistry including advanced electrochemistry, surface spectroscopy of electrode surfaces, separations, laboratory automation and new spectroscopic techniques. (2-0-2); (2-0-2)

CHEM 620, 621
Special Topics in Inorganic Chemistry
Topics of current interest in inorganic chemistry, including organometallic chemistry, homogeneous catalysis, inorganic reaction mechanisms, inorganic stereochemistry, materials chemistry, x-ray crystallography, synthetic and physi-cal methods in inorganic and materials chemistry and chemical applications of group theory. (2-0-2);

CHEM 630, 631
Special Topics in Organic Chemistry
Topics of current interest in organic chemistry including photochemistry, fluorine chemistry, heterocyclic chemistry, pharmaceutical chemistry and electrooptical organic chemistry. Prerequisite: CHEM 455 or instructor's consent. (2-0-2); (2-0-2)

CHEM 635
Heterocyclic Chemistry
Of the vast array of structures which organic compounds adopt, many contain ring systems as a component. When the ring is made up of carbon and at least one other element, the compound is classified as a heterocycle. The aims of this course are to identify the effects that the presence of such ring systems have on the chemistry of a molecule; to show how the rings can be made, and to describe some of the uses of the compounds in organic synthesis, in medicine and in other contexts. The chemistry of aromatic five-, six- and seven-membered ring compounds with one or more nitrogen, oxygen and/or sulfur atoms will be emphasized. Prerequisite: CHEM 239, CHEM 455 or instructor's consent. (3-0-3)

CHEM 650, 651
Special Topics in Physical Chemistry
Topics of current interest in physical chemistry, including atmospheric chemistry, ion molecule reactions, laser chemistry, theories of gas phase reactions, scattering theory, interaction of radiation with matter, and time-dependent relaxation methods. (2-0-2); (2-0-2)

CHEM 684
Graduate Seminars in Chemistry
To foster scientific communications skills, students are required to present seminars based on the scientific literature. Required of all Ph.D. students who have passed the written qualifying examination. (1-0-1)

CHEM 685
Chemistry Colloquium
Lectures by invited scientists in areas of chemistry generally not covered in the department. For full-time graduate students who have completed the CHEM 585 requirement. (1-0-0)

CHEM 691
Ph.D. Thesis Research
(Credit: Variable)

Undergraduate Chemistry Courses Available to Graduate Students

CHEM 415
Inorganic Chemistry

CHEM 416
Advanced Chemistry Laboratory

CHEM 451
Modern Techniques in Chemical Literature

CHEM 454
Computer Applications in Chemistry

CHEM 455
Advanced Organic Chemistry

CHEM 470
Introduction to Polymers

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Physics

PHYS 501, 502
Methods of Theoretical Physics I, II
Linear vector spaces. Functions of a complex variable. Fourier series and integrals. Differential and integral equations. Special functions. Green's functions. Group theory. Prerequisite: MATH 252. (4-0-4); (4-0-4)

PHYS 505
Electromagnetic Theory
Maxwell's equations. Electromagnetic waves and radiation. Prerequisites: PHYS 414, MATH 252. (4-0-4)

PHYS 507
Electrodynamics
Covariant formulation of Maxwell's equations. Variational principles of classical field theory. Theory of radiation reactions. Topics in contemporary electrodynamics. Prerequisite: PHYS 505. (4-0-4)

PHYS 508
Analytical Dynamics
Newton's laws. Lagrange's equations. Central forces. Invariance properties and conservation laws. Collections of particles. Rigid body motions. Small vibrations. Hamilton's equations. Canonical transformations. Hamilton-Jacobi theory. Approximation methods. Special theory of relativity. Classical theory of fields. Prerequisites: PHYS 309, MATH 252. Recommended corequisite: PHYS 501. (4-0-4)

PHYS 509, 510
Quantum Theory I, II
Postulates and theory of measurement in quantum mechanics. Momentum eigenstates, wave packets and passage to the classical limit. Angular momentum eigenstates. Stationary states of a particle in central field. Approximation

methods. Identical particles, introduction to second quantization. Transition probabilities. S matrix formalism, approximation methods for decay and scattering problems. The Lorentz group and relativistic wave equations. Dirac particle in a central field. Prerequisites: PHYS 406, PHYS 501, PHYS 508 or instructor's consent. (4-0-4); (4-0-4)

PHYS 511, 512
Advanced Quantum Mechanics I, II
Applications and extensions of basic principles introduced in PHYS 509 and PHYS 510. Typical subject areas include atomic and molecular structure, group-theoretical analysis of spectra, many-body problems, including second quantization, density matrix. Hartree-Fock method. BCS theory. Introduction to quantum fields. Feynman diagrams. Green's functions, quantum electrodynamics. Prerequisites: PHYS 509, PHYS 510. (4-0-4); (4-0-4)

PHYS 515
Statistical Mechanics
Kinetic theory and Boltzmann's H-theorem. Quantum statistics. Fermi-Dirac and Bose-Einstein systems. Density matrix. Fluctuations. Behavior of complex and chaotic systems. Prerequisites: PHYS 304, PHYS 406 and PHYS 508, or instructor's consent. (4-0-4)

PHYS 521
Quantum Electronics
The Schrodinger equation. Matrix formulation. Quantization of lattice vibrations and electromagnetic fields. Optical beams and resonators. The interaction of radiation and atomic systems. Lasers. Optical waveguides and devices. Frequency conversion. Quantum noise. Same as ECE 521. Prerequisite: ECE 307 or instructor's consent. (3-0-3)

PHYS 533
Group Theory in Physics
Development of the theory of finite groups and group representations and application to diverse subjects in physics. Point groups. Introduction to SU(2) and the rotation group. Spinors and tensors. Prerequisite: MATH 252. (4-0-4)

PHYS 537, 538
Physics of the Solid State I, II
Crystal structure and crystal binding. Lattice vibrations and phonons. Free electron model of metals and semiconductors. Energy band theory. Transport phenomena. Magnetic, optical properties of solids. Superconductivity. Prerequisites: PHYS 406, MATH 252. (4-0-4); (4-0-4)

PHYS 545
Elementary Particle Physics
Principal theories of elementary particles and their interactions, including important features of experimental data. Mesons, baryons and leptons. Particle classification schemes. Brief introduction to quantum field theory and Feynman diagrams. Strong, electromagnetic and weak interactions. Scattering matrix. Phenomenological descriptions of high-energy scattering and particle production. Speculations on quarks, magnetic monopoles and other exotic particles. Prerequisite: PHYS 510 or instructor's consent. (4-0-4)

PHYS 553
Quantum Field Theory
Relativistic wave equations. Semiclassical and quantum theories of radiation. Photoelectric effect. Pair production. Bremsstrahlung. Compton scattering. Second quantization of the electron field. Renormalization. Lamb shift. Vacuum polarization. Exact methods for external field problems. Prerequisite: PHYS 505. (4-0-4)

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PHYS 561
Radiation Biophysics
Energy loss by ionizing radiation. Target theory. Direct and indirect action. Radiation effects in iomolecules. Radiation inactivation of enzymes, nucleic acids and viruses. Biological effects of ultraviolet radiation. Photosensitization. Radiation protection and sensitization. Radiation effects in vivo, radiation therapy, phototherapy. Prerequisite: PHYS 410 or instructor's consent. (3-0-3)

PHYS 570
Introduction to Synchrotron Radiation
Production and characterization of synchrotron radiation, dynamical and kinematical diffraction, absorption and scattering processes, x-ray optics for synchrotron radiation, and x-ray detectors. Overview of experimental techniques, including XAFS, XPS, SAXS, WAXS, diffraction, inelastic x-ray scattering, fluorescence spectroscopy, microprobe, tomography and optical spectroscopy. (3-0-3)

PHYS 571
Health Physics I
Fundamentals of health physics will be presented, with an emphasis on problem-solving and computer modeling. Topics covered begin with the physics of radiation production: review of atomic and nuclear structure and quantum mechanics; nuclear structure and radioactivity; production of x-rays. The second part of the course focuses on the interaction of radiation with matter, including energy-loss mechanisms, secondary processes, stopping power and range. Required prerequisites: MATH 252, PHYS 203. Suggested prerequisite: PHYS 348. (3-0-3)

PHYS 572
Health Physics II
Continuation of the basic health physics sequence, including neutron production and interaction with matter; methods of radiation detection; radiation dosimetry; chemical and biological effects of radiation; radiation protection standards; shielding; dosimetric models; accelerator, reactor and medical health physics. Prerequisite: PHYS 571. (3-0-3)

PHYS 573
Standards, Statutes and Regulations
This course studies the requirements of agencies that regulate radiation hazards, their basis in law and the underlying U.S. and international standards. An array of overlapping requirements will be examined. The effect regulatory agencies have upon the future of organizations and the consequences of noncompliance are explored. (3-0-3)

PHYS 575
Case Studies in Health Physics
Issues in operational health physics and regulatory affairs. Students will present problems and solutions drawn from their experience and the literature. Operational problems may include organizational issues, computer applications, measurements and dosimetry. Methods for compliance with EPA, NRC and OSHA and enforcement actions will emphasize technical and management techniques. (3-0-3)

PHYS 576
Internal Dosimetry
Calculation of internal dose from radiation sources. Internal dose is a function of the form of radioactive material, route of intake, biochemistry, metabolic activity and gross and cellular physiology. (2-0-2)

PHYS 577
External Dosimetry
Calculation of external dose from radiation sources. External dose is determined for uniform fields, non-uniform fields, and local deposition. External sources include immersion in a cloud of radioactive gas and skin contamination. (2-0-2)

PHYS 585
Physics Colloquium
Lectures by invited scientists in areas of physics generally not covered in the department. Must be taken twice by M.S. students and four times by Ph.D. students. (1-0-1)

PHYS 591
Thesis Research
(Credit: Variable)

PHYS 597
Reading and Special Problems
Independent study to meet the special needs of graduate students in department-approved graduate degree programs. Requires the written consent of the instructor. May be taken more than once. Receives a letter grade. (Credit: Variable)

PHYS 685
Physics Colloquium
Lectures by invited scientists in areas of physics generally not covered in the department. For full-time graduate students who have completed the PHYS 595 requirement. (1-0-0)

PHYS 691
Ph.D. Thesis Research
(Credit: Variable)

PHYS 770
Instrumentation for Radiation Health Physics
Detecting and measuring radioactive material and radiation levels depends upon many types of detectors and instrumentation. Theory of detectors ranging from chambers operating in pulse and current producing modes to solid-state detectors is applied to measuring and monitoring systems. Electronics ranging from simple-rate meters and scalers to high-speed multichannel analyzers is used. Computer linked instrumentation and computer-based applications are applied to practical problems. (0-6-2)

Department of Biomedical Engineering

116 Engineering 1 Building
10 W. 32nd St.
Chicago, IL 60616
312.567.5100
312.567.5707 fax
www.iit.edu/~biomed

Chair:
Vincent Turitto

The Department of Biomedical Engineering confers a doctoral degree in biomedical engineering (Ph.D. in Biomedical Engineering). Currently, ten faculty members hold tenure-track positions in the department. Several departments at

IIT contribute courses and faculty to the graduate program: Biological, Chemical and Physical Sciences; Chemical and Environmental Engineering; Computer Science; Electrical and Computer Engineering; Mechanical, Materials and Aerospace Engineering; the Institute of Psychology; and the Center for Ethics in the Professions.

An M.D./Ph.D. program is in place whereby students with engineering backgrounds can receive a Ph.D. in Biomedical Engineering at IIT and an M.D. from the University of Chicago. Qualified students are admitted to the MSTP (Medical Scientist Training Program) at the University of Chicago and subsequently apply to the Department of Biomedical Engineering for their Ph.D. studies.

Degree Offered

Doctor of Philosophy in Biomedical Engineering

Research Areas

Cell and Tissue Engineering
Medical Imaging
Neural Engineering

Faculty

Mark Anastasio, Associate Professor. Ph.D., University of Chicago. Development and analysis of tomographic reconstruction algorithms, analytical and numerical analysis of inverse problems in biomedical imaging, theoretical imaging science.

Konstantinos Arfanakis, Assistant Professor. Ph.D., University of Wisconsin-Madison. Magnetic resonance imaging (MRI), MRI acquisition and post-processing, diffusion tensor MRI (DTI), functional MRI (fMRI).

Robert Arzbaecher, Emeritus Professor. Ph.D., University of Illinois, Urbana-Champaign. Instrumentation, signal processing and control.

Eric M. Brey, Assistant Professor. Ph.D., Rice University. Angiogenesis, microvascular models, wound healing, tissue engineering.

Jennifer J. Kang Derwent, Assistant Professor. Ph.D., Northwestern University. Models of thrombotic retinal vessel occlusion, blood flow, electroretinography.

Paul Fagette, Senior Lecturer. Ph.D., University of California, Riverside. History of modern American science, medical science, and technology.

Connie Hall, Assistant Professor. Ph.D., University of Memphis. Inhibition of thrombosis, biomaterials and surface coatings, computational transport analysis.

Thomas C. Irving, Associate Professor. Ph.D., University of Guelph (Canada). Structure and biophysics of macromolecular systems, muscle structure and physiology, synchrotron radiation instrumentation.

Derek Kamper, Assistant Professor. Ph.D., Ohio State University. Neural control, biomechanics and rehabilitative medicine.

David Mogul, Associate Professor. Ph.D., Northwestern University. Neuronal networks, control of epilepsy, brain electrophysiology.

Emmanuel Opara, Research Professor. Ph.D., University of London. Development of a bioartificial pancreas, cell microencapsulation techniques, biocompatibility of biopolymers.

Georgia Papavasiliou, Senior Lecturer. Ph.D., Illinois Institute of Technology. Mathematical modeling, design of polymeric biomaterials for tissue engineering and drug delivery applications.

Philip R.Troyk, Associate Professor. Ph.D., University of Illinois, Chicago. Polymers for electronics, neural implants, solid-state power systems.

Vincent Turitto, Director of Pritzker Institute of Biomedical Science and Engineering and Professor. D.Engr.Sci., Columbia University. Blood flow and thrombosis, atherosclerosis, cellular biodynamics, biomaterials.

Miles Wernick, Professor. Ph.D., University of Rochester. Medical imaging, image processing, pattern recognition.

Yongyi Yang, Associate Professor. Ph.D., Illinois Institute of Technology. Image and signal processing, data compression, applied mathematical and statistical methods.

Department of Biomedical Engineering

Affiliated Program Faculty, IIT

Hamid Arastoopour, Max McGraw Professor of Energy/Environment/Economics and Dean, Armour College of Engineering. B.S., Abadan Institute of Technology (Iran); M.S., Ph.D., Illinois Institute of Technology. Computational multiphase flow, pulverization and agglomeration of particles, fluidization, fluid-particle flow and material processing.

Ali Cinar, Professor of Chemical Engineering, Dean of the Graduate College, and Vice Provost for Research. B.S., Robert College (Turkey); M.S., Ph.D., Texas A & M. Process modeling, monitoring, and control; agent-based systems for process supervision, complexity, AI applications, modeling and simulation of biomedical systems, diabetes.

Victor Perez-Luna, Assistant Professor, Department of Chemical and Environmental Engineering. B.S., M.S., Universidad de Guadalajara (Mexico); Ph.D., University of Washington. Surface analysis and modification, biomaterials, biosensors and tissue engineering.

Benjamin C. Stark, Professor and Associate Chair of Department of Biological, Chemical & Physical Sciences and Director of the Master of Biology Program. B.S., University of Michigan; M.Ph., Ph.D., Yale University. Biochemistry and molecular biology of bacterial respiration, fermentation, bioremediation.

Fouad A. Teymour, Johnson Polymer Professor of Chemical Engineering and Chair of Department of Chemical and Environmental Engineering. B.S., M.S., Cairo University (Egypt); Ph.D. University of Wisconsin, Madison. Polymer reaction engineering, mathematical modeling, nonlinear dynamics.

Admission Requirements

Minimum cumulative undergraduate GPA: 3.2/4.0
GRE minimum scores:
1800 (combined)
1200 (quantitative + verbal) 3.0 (analytical writing)

Meeting the minimum admission standards for GPA and GRE scores does not guarantee admission. Test scores and GPA are just two of several important factors considered. The admissions committee will also consider recommendations from three college faculty members acquainted with the character, research ability, potential, qualifications and motivation of the applicant, and the needs of the depaartmental faculty. Entering graduate students are assigned a temporary academic adviser who will provide initial guidance. As their research and other academic interests become defined, students select a permanent research adviser,who will also guide them through their academic studies.

Department of Biomedical Engineering

Doctor of Philosophy in Biomedical Engineering

84 credit hours
Qualifying examination (written and oral)
Thesis research proposal/comprehensive examination
Dissertation and oral defense

This degree is awarded in recognition of a high level of mastery in subject matter and a significant original research contribution in biomedical engineering. The Ph.D. recipient will be capable of a continuing effort toward the advancement of knowledge and achievement in research and other scholarly activities and may pursue a career in a medical, an industrial or an academic environment.

A minimum of 84 credit hours is required for the Ph.D. in Biomedical Engineering. Students who have received an M.S. degree from another university may petition for transfer of up to 32 credit hours applicable toward the Ph.D. degree. Students must pass the Ph.D. qualifying examination within the first year of full-time Ph.D. studies. This is a written and oral examination intended to explore both the depth and breadth of the student's academic abilities. Within two and one-half years of matriculation, students will be required to defend their thesis research proposal (comprehensive examination). A written dissertation and oral defense are also required for receiving the doctoral degree. Dissertation format and deadlines are established by the Graduate College.

There are no specific courses that are required for the doctoral degree in biomedical engineering. However, a minimum of three courses in life science, three courses in mathematics, and six courses in biomedical engineering or other engineering-related courses are required. The specific courses selected to meet these requirements will depend on the entering qualifications of the student and the nature of the thesis research proposal. In general, the student's thesis committee will determine the specific courses requirements necessary for graduation.

Biomedical engineering courses

BME 500	Introduction to Biomedical Engineering
BME 501	Biomedical Instrumentation
BME 502	Computational Neuroscience I: Single Neuron Computation
BME 503	Mathematics and Statistics for Neuroscience I
BME 504	Neuroethology
BME 505	Mathematics and Statistics for Neuroscience II
BME 506	Computational Neuroscience II: Vision
BME 507	Cognitive Neuroscience
BME 508	Mathematics and Statistics for Neuroscience III
BME 530	Inverse Problems in Biomedical Imaging
BME 532	Medical Imaging Science
BME 533	Biostatistics
BME 535	Magnetic Resonance Imgaing
BME 538	Neuroimaging
BME 551	Physiological Signal Analysis & Control Theory I
BME 552	Physiological Signal Analysis & Control Theory II
BME 570	Engineering Biocompatible Materials
BME 581	Fluid Dynamics for Biomedical Engineers
BME 582	Advanced Mass Transport for Biomedical Engineers
BME 595	Seminar in Biomedical Engineering
BME 597	Wave Physics and Applied Optics for Imaging Scientists
BME 597	Neural Prosthesis
BME 691	Research and Thesis for Ph.D. degree

Life science courses (represenative)

BIOL 403	General Biochemistry
BIOL 414	Genetics for Engineering Scientists
BIOL 430	Animal Physiology
BIOL 445	Cell Biology
BIOL 513	Advanced Biochemistry
BIOL 515	Molecular Biology
BIOL 527	Immunology and Immunochemistry
BIOL 550	Bioinfomatics and Biotechnology
BIOL 565	Vertebrate Physiology

Department of Biomedical Engineering

Doctor of Philosophy in Biomedical Engineering continued

Approved math/applied math courses

MATH 461	Fourier Series and Boundary-Value Problems
MATH 471	Numerical Methods I
MATH 472	Numerical Methods II
MATH 476	Statistics
MATH 489	Partial Differential Equations
MATH 510	Ordinary Differential Equations
MATH 512	Partial Differential Equations
MATH 519	Complex Analysis
MATH 532	Linear Algebra
MATH 542	Stochastic Processes
MATH 546	Introduction to Time Series
MATH 555	Tensor Analysis
MATH 564	Applied Statistics
MATH 577	Computational Mathematics I
MATH 578	Computational Mathematics II
MATH 581	Theory of Finite Elements

Engineering or physics courses (representative) that may count toward math requirement

MMAE 501	Engineering Analysis 1b
MMAE 502	Engineering Analysis II
MMAE 503	Advanced Engineering Analysis
MMAE 505	Numerical Methods in Engineering
MMAE 506	Computational Methods in Engineering Analysis
MMAE 517	Computational Fluid Mechanics
CHE 535	Applications of Mathematics to Chemical Engineering
CHE 536	Computational Techniques in Engineering
PHYS 501	Methods of Theoretical Physics I
PHYS 502	Methods of Theoretical Physics II

Selected engineering electives

CS 480	Artificial Intelligence
CS 525	Advanced Database Organization
CS 580	Medical Informatics
CS 583	Expert Systems
CHE 450	Principles of Polymer Science and Engineering
CHE 532	Process Modeling
CHE 533	Statistical Analysis of Process Data
CHE 544	Kinetic Theory of Multiphase Flow
CHE 555	Polymer Processing
CHE 573	Bioseparations
CHE 575	Polymer Rheology
CHE 586	Particulate Technology
CHE 761	Statistical Design of Experiments for Process Improvement
CHE 577	Biochemical Engineering
CHE 579	Enzyme Reactor Engineering
CHE 582	Interfacial and Colloidal Phenomena with Applications
CHE 583	Pharmaceutical Engineering
CHE 585	Drug Delivery
ECE 433	Real-Time Data Acquisition and Processing
ECE 511	Analysis of Random Signals
ECE 565	Multidimensional Signal Processing
ECE 566	Statistical Pattern Recognition
ECE 567	Statistical Signal Processing
MMAE 407	Biomechanics
MMAE 467	Polymeric Materials
MMAE 507	Introduction to Continuum Mechanics
MMAE 510	Fluid Mechanics
MMAE 512	Dynamics of Viscous Fluids
MMAE 517	Computational Fluid Dynamics
MMAE 579	Characterization of Polymers

Department of Biomedical Engineering

Course Descriptions

Note: For description of courses other than BME, see the appropriate departmental listing.

BME 500
Introduction to Biomedical Engineering
Introduction to the concepts and research in biomedical engineering. Provides an overview of current biomedical engineering research areas, emphasis on application of an engineering approach to medicine and physiology.

BME 501
Biomedical Instrumentation
Bioelectric phenomena, transducers, amplifiers. Processing of ECG, EMG and EEG signals. (3-0-3)

BME 502
Computational Neuroscience I
This course briefly review the historical development of computational neuroscience and discusses the functional properties of individual neurons. The electrotonic structure of neurons, functional properties of synapses, and voltage-gated ion channels are discussed. (3-0-3)

BME 503
Math/Statistics: Neuroscience I
Prerequisites: Consent of Instructor. This quarter introduces mathematical ideas and techniques in a neuroscience context. Topics will include some coverage of matricies and complex variables; eigenvalue problems, spectral methods and Grens functions for differential equations; and some discussion of both deterministic and probabilistic modeling in the neurosciences. (2-0-2)

BME 504
Neurobiology
Neurobiology Prerequisites: Consent of Instructor. This course is concerned with the structure and function of systems of neurons, and how these are related to behavior. Common patterns of organization are described from the anatomical, physiological, and behavioral perspectives of analysis. The comparative approach is emphasized throughout. Laboratories include exposure to instrumentation and electronics, and involve work with live animals. A central goal of the laboratory is to expose students to in vivo extracellular electrophysiology in vertebret preparations. Laboratoratries will be attended only on one day a week but may run well beyond the canonical perios. (2-0-2)

BME 505
Math/Statistics: Neuroscience II
Prerequisites: BME 503, consent of instructor. This quarter treats statistical methods important in understanding nervous system function. It includes basic concepts of mathematical probability; information theory, discrete Markoy processes, and time series. (2-0-2)

BME 506
Comp Neuroscience II: Vision
This course considers computational approaches to vision. It discusses the basic anatomy and physiology of the retina and central visual pathways, and then examines computational approaches to vision based on linear and non-linear systsms theory, and algorithms derived from computer vision. (3-0-3)

BME 507
Cognitive Neuroscience
Consent of Instructor. This course is concerned with the relationship of the nervous system to higher order behaviors such as perception and encoding, action, attention and learning and memory. Modern methods of imaging neural activity are introduced, and information theoretic methods for studying neural coding in individual neurons and populations of neurons are discussed. (2-0-2)

BME 508
Math/Statistics: Neuroscience III
Prerequisites: BME 503, BME 505, Consent of Instructor. This quarter covers more advanced topics including perturbation and bifurcation methods for the study of dynamical systems; symmetry methods and some group theory. A variety of application to neuroscience will be described. (2-0-2)

BME 521
Medical Imaging
Study of modern technology for medical imaging. Theory and operation of CAT, SPECT, PET, MRI, Xray and echo imaging modalities. (3-0-3)

BME 522
Mathematical Methods in BME
Prerequisites: Graduate standing in BME or consent of instructor. This course is an introductory graduate level course that integrates mathematical and computational tools that address directly the needs of biomedical engineers. The topics covered include the mathematical or diffusion, pharmacokinetic modesl, biological fluid mechanics, and biosignal representations and analysis. The use of MATLAB will be emphasized for numerically solving problems of practical relevance. (3-0-3)

BME 525
Concepts of Tissue Engineering
This course seeks to provide students with an introduction to the field of Tissue Engineering. The first portion of the course will introduce the field, including a discussion of cell sorcing, biomaterials, DA, and ethical consideration. The second portion of the course will present case studies in specific tissue and organ systems in which these concepts are put together in an attempt to develop a clinically applicable tissue engineered product. (3-0-3)

BME 530
Inverse Problems in Biomedical Imaging
This course will introduce graduate students to the mathematical theory of inverse problems. Concepts from functional analysis will be applied for understanding and characterizing mathematical properties of inverse problems. This will permit for the analysis of the stability and resolution of image reconstruction algorithms for

various existing and novel biomedical imaging systems. The singular value decomposition (SVD) is introduced and applied for understanding fundamental properties of imaging systems and reconstruction algorithms. (3-0-3)

BME 532
Medical Imaging Science

This course is an introduction to basic concepts in medical imaging, such as: receiver operating characteristics, the rose model, point spread function and transfer function, covariance and auto-covariance, noise, filters, sampling, aliasing, interpolation, and image registration. (3-0-3)

BME 533
Biostatistics

This course is designed to cover the tools and techniques of modern statistics with specific applications to biomedical and clinical research. Both parametric and nonparametric analysis will be presented. Descriptive statistics will be discussed although emphasis is on inferential statistics and experimental design. (3-0-3)

BME 535
Magnetic Resonance Imaging

This course is an introduction to magnetic resonance imaging (MRI). It includes basic MR physics, the principles of selective excitation, signal detection, and MR image reconstruction, different pulse sequences, MRI hardware, issues on image quality and artifacts, and advanced MRI techniques. (3-0-3)

BME 538
Neuroimgaging

This course describes the use of different imgaging modalities to study brain function and connectivity. The first part of the course deals with brain function. It includes an introduction to energy metabolism in the brain, cerebral blood flow, and brain activation. It continues with an introduction to magnetic resonance imaging (MRI), perfusion-based fMRI, BOLD fMRI, fMRI paradigm design and statistical analysis, introduction to positron emission tomography (PET) and studying brain function with PET, introduction to magnetoencephalography (MEG) and

studying brain function with MEG. The second part of the course deals with brain connectivity. It includes an introduction to diffusion tensor MRI, explanation of the relationship between the diffusion properties of tissue its structural characteristics, and white matter fiber tractography techniques. (3-0-3)

BME 540
Wave Physics and Applied Optics for Imaging Scientists

This course will introduce students to fundamental concepts in wave physics and the analysis of optical wavefields. These principles will be utilized for understanding existing and novel imaging methods that employ coherent radiation. Solutions to inverse scattering and inverse source problems will be derived and algorithmic realizations of the solutions will be developed. Phase-contrast imaging techniques and X-ray imaging systems that employ coherent radiation will be studied.

BME 542
Advanced Concepts in Image Science

Prerequisites: BME 530, BME 532 or consent of instructor. This graduate level course introduces students to fundamental concepts in image science that are related to the optimization and evaluation of biomedical imaging systems. Topics covered include: deterministic descriptions of imaging systems, stochastic descriptions of imaging systems, statistical cdecision theory, and objective assessment of image quality. (3-0-3)

BME 543
Bioinstrumentation and Electronics

Principles of circuit analysis are applied to typical transducer and signal recording situations found in biomedical engineering. Basic electrical and electronic circuit theory is reviewed with an emphasis on biomedical measurement applications. A special topic is individually studied by the student and presented to the class electrical physics class or basic circuits. (3-0-3)

BME 551
Physiological Signal Analysis & Control Theory I

This is the first of a 2 part course co-taught at IIT and the University of Chicago. essential elements of signal processing and control theory as it is applied to physiological systems will be covered. Part I will cover data acquisition and sampling, Laplace and Fourier transforms, filtering, time and frequency domains, sytem descriptions and lumped vs. distributed parameters. Students will use Matlab to test concepts presented in class. (2-0-2)

BME 552
Physiological Signal Analysis & Control Theory II

This is the second part of a 2 part course co-taught at IIT and the University of Chicago. Part II will cover time and frequency domain analysis, impulse vs. step response functions, open vs. closed loop responses, stability, systems identification and control, non-linear control. Students will use Matlab to test concepts presented in class. (2-0-2)

BME 553
Quantitative Physiology

Prerequisites: BME 100. The primary objective of this course is to introduce students to basic physiological concepts using a quantitative approach. The main systems that control the human body functions will be reviewed to enable the students to understand the individual role of each major functional system as well as the need for the integration or coordination of the activities of the various systems. Attempts will be made to highlight the patho-physiological consequences of defects or failures in the organ systems, and the relevant corrective approaches. This course will include lectures from individuals who have relevant expertise in the different organ systems because of the complexity of the human body. (3-0-3)

Department of Biomedical Engineering

BME 570
Engineering Biocompatible Materials
The primary objective of this course is to introduce students to synthetic materials that are routinely used as componets of various medical devices implanted in the human body. In this course, students will critically examine prosthetic materials used in specific devices (for example: muscle, eye, skin, vascular). The biological environment relevant to the discussed implant will be reviewed. Problems with current materials will be analyzed and strategies and techniques required to engineer sophisticated biomaterials for future applications will be developed. Legal procedures required to obtain FDA approval for such materials will be taught. Industry personnel specializing in medical implants will deliver guest lectures. (3-0-3)

BME 575
Neuromechanics of Human Movement
This course will explore how we control movement of our extremities, with concepts drawn from mechanics and neurophysiology. The progression from neurological signals to muscle activation and resulting movement of the hand or foot will be modeled, starting at the periphery and moving back toward the central nervous system. Biomechanics of the limbs will be modeled using dynamic simulation software (Working Model) which will be driven by a neural controller, implemented in MATLAB. Issues related to sensory feedback and redundancy will be addresses.

BME 581
Fluid Dynamics for Biomedical Engineers
This course is primarily focused on the development of theoretical and experimental principles necessary for the delineation of fluid flow in various "in vitro" chambers and the cardiovascular system. Its content will primarily deal with the basic concepts of flow in various geometries, the heterogeneous nature of blood and the application of such principles in flow chambers designed to expose blood elements to defined flow conditions. The relationship to flow in the normal and diseased vascular system will also be considered. (3-0-3)

BME 582
Advanced Mass Transport for Biomedical Engineers
The development of theoretical and mathematical principles necessary for the delineation of mass transport processes in biological and medical systems. Herogeneous reactions which occur at or in the vicinity of cells. Basic transport mechanisms in the vasculature, across cells or within tissues.(3-0-3)

BME 597
Neural Prostheses
The goal of this course is to provide students the fundamentals of sensory and motor neural prosthetic devices. Principles of recording from, and electrical stimulation of, neural tissue will be presented. Students will study past and current literature for specific neural prosthesis systems.

BME 691
Research and Thesis for Ph.D. degree
(Variable credit)

Classes co-offered at the University of Chicago:

BME 502
Computational Neuroscience I: Single neuron computation

BME 503
Mathematics and Statistics for Neuroscience I

BME 504
Neuroethology

BME 505
Mathematics and Statistics for Neuroscience II

BME 506
Computational Neuroscience II: Vision

BME 507
Cognitive Neuroscience

BME 508
Mathematics and Statistics for Neuroscience III

Department of Chemical and Environmental Engineering

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www.chee.iit.edu

Chair:
Fouad Teymour

Associate Chair, Graduate Affairs:
David C. Venerus

Associate Chair, Undergraduate Affairs:
Javad Abbasian

Director, Rice Campus Programs:
Paul R. Anderson

Liaison, Environmental Management Program:
Fouad Teymour

The mission of the Department of Chemical and Environmental Engineering is to meet the present and future needs of society and industry by providing state-of the-art education and research programs. In order to accomplish this mission, the department provides graduate students with:

· Fundamental knowledge and design capability in biological engineering, chemical engineering, gas engineering, environmental engineering, and food process engineering.

· Advanced research programs in core competency areas.

· Knowledge of industrial ecology/design for the environment

· Understanding of ethical, economic and social issues that influence intellectual technological choices.

· Leadership and communication skills.

· Lifelong learning capabilities.

Degrees Offered

Master of Biological Engineering
Master of Chemical Engineering
Master of Environmental Engineering
Master of Gas Engineering (Internet only)
Master of Science in Chemical Engineering
Master of Science in Environmental Engineering
Doctor of Philosophy in Chemical Engineering
Doctor of Philosophy in Environmental Engineering

With the National Center for Food Safety and Technology:
Master of Food Process Engineering
Master of Science in Food Process Engineering

With the Department of Electrical and Computer Engineering, and the Department of Mechanical, Materials and Aerospace Engineering:
Master of Manufacturing Engineering
Master of Science in Manufacturing Engineering

Dual-Degree Programs

Master of Science in Computer Science/Master of Chemical Engineering

Certificate Programs

Chemical Engineering Certificate Programs

Biological Engineering
Current Energy Issues (Internet only)
Food Process Engineering
Particle Processing

Pharmaceutical Engineering
Polymer Science and Engineering
Process Operations Management

Environmental Engineering Certificate Programs

Air Resources
Hazardous Waste Engineering

Indoor Air Quality
Water and Wastewater Treatment

Department of Chemical and Environmental Engineering

Interdisciplinary Programs

Energy/Environment/Economics (E^3) specialization
(see page 206)

With the Stuart School of Business:
Master of Science in Environmental Management (degree
is offered by the Stuart School of Business)

Research Centers

Energy + Power Center: Henry R. Linden, director

Center for Electrochemical Science and Engineering:
Jai Prakash, director

Center of Excellence in Polymer Science and Engineering:
Jay Schieber, director

Particle Technology and Crystallization Center: Dimitri
Hatziavramidis, director

Research Facilities

Research facilities of the department include:
- Air Resource Lab
- Biochemical Engineering Lab
- Biointerfaces Lab
- Biomaterials Lab
- Center for Electrochemical Science
    and Engineering Lab
- Center of Excellence in Polymer Science
    and Engineering Lab
- Computational Fluid Dynamics Lab
- Environmental Biotechnology Lab
- Environmental Engineering Analytical Lab
- Environmental Risk Lab
- Fuel Cell Lab
- Fuel Cell Battery Lab
- Fluidization Lab
- Gas Processing Lab
- Interfacial Phenomena Lab
- Light Scattering Lab
- Multiphase Flow and Fluidization Lab
- Particle Technology Lab
- Pharmaceutical and Crystallization Lab
- Polymer Characterization Lab
- Polymer Reaction Engineering Lab
- Porous Media and Core Analysis Lab
- Process control & Optimization Lab
- Process Modeling, Monitoring and Control Lab
- Rheology Lab
- Riser Lab
- Solar Hydrogen Lab
- Solar/Photo Voltaic Lab

The computational facilities of the department include
the Advanced Computer Laboratory, and the computer
facilities of each research group. There are 26 Pentium-
based computers in the PC lab that can access the
workstations, creating a 26-seat computational lab for
instructional activities at the graduate and undergradu-
ate levels. All computers are connected to the IIT
computer network by ethernet. Both the PCs and
workstations access the multimedia system to provide
data visualization and high-quality presentations. Each
research lab also has specialized computer facilities.
The computational capability for the department is
provided by three servers that include both Linux and
Windows. Students also have access to the university's
Computing and Network Services.

Research Areas

Faculty members conduct numerous projects in the
department's core areas of research competency:
- Air pollution and gas separation
- Biological, biochemical and biomedical engineering
- Chemical process modeling, statistical monitoring
    and control
- Computational fluid dynamics and fluidization
- Crystallization and particulate technology
- Electrochemical science and engineering
- Energy, sustainability and renewable resources
- Environmental engineering
- Food processing and safety
- Fuel cells and batteries
- Gas processing and pollution control
- Interfacial science
- Multiphase flow
- Polymer science and engineering
- Waste remediation, wastewater treatment
    and water resources

Department of Chemical and Environmental Engineering

Faculty

Javad Abbasian (abbasian@iit.edu), GTI Associate Professor of Chemical Engineering and Associate Chair, Undergraduate Affairs. B.S., Abadan Institute of Technology (Iran); M.S., Ph.D., Illinois Institute of Technology. Research interests: High temperature gas cleaning, pollution control and solid waste management; gas separation and purification; and process design and development.

Nader Aderangi (aderangi@iit.edu), Lecturer in Chemical Engineering and Director of Department Laboratories. B.S., University of Tehran; M.S., University of Colorado; Ph.D., Illinois Institute of Technology. Research interests: Unit operations, chemical processes, interfacial mass transfer, rheological properties.

Paul Anderson (andersonp@iit.edu), Associate Professor of Environmental Engineering and Director of Rice Campus. B.S., Purdue University; M.S., University of California, San Diego; Ph.D., University of Washington. Research interests: Physical-chemical processes in water and wastewater treatment, watershed management, industrial ecology education, biosolids mineralization, and trace element geochemistry.

Hamid Arastoopour (arastoopour@iit.edu), Max McGraw Professor of Energy, Environment and Economics and Dean, Armour College of Engineering. B.S., Abadan Institute of Technology (Iran); M.S., Ph.D., Illinois Institute of Technology. Research interests: Computational fluid dynamics (CFD) of multiphase flow, fluidization, flow in porous media, particle technology and material processing, and environmental engineering problems.

Barry Bernstein (bersteinb@iit.edu), Professor of Chemical Engineering and Applied Mathematics. B.S., City College of New York; M.A., Ph.D., Indiana University. Research interests: Computational fluid mechanics, materials properties, and polymer rheology.

Donald J. Chmielewski (chmielewski@iit.edu), Associate Professor of Chemical and Environmental Engineering. B.S., Illinois Institute of Technology; M.S., Ph.D., University of California–Los Angeles. Research interests: Advanced process control; fuel cell system design and control.

Ali Cinar (cinar@iit.edu), Professor of Chemical Engineering, Dean of the Graduate College and Associate Vice President for Research. B.S., Robert College (Turkey); M.S., Ph.D., Texas A&M. Research interests: Fundamental methodology and tools used in various applications including: polymer reaction engineering, food processing, medicine and biotechnology.

David Gidalevitz (gidalevitz@iit.edu), Assistant Professor of Chemical Engineering. B.S., Urals Technical University (Russia); Ph.D., Weizmann Institute of Science (Israel). Research interests: Membrane biophysics, biomaterials, drug delivery, biosensors and biomimetic thin films, and polymer films.

Dimitri Gidaspow (gidaspow@iit.edu), IIT Distinguished Professor of Chemical Engineering. B.S., City College of New York; M.S., Polytechnic Institute of Brooklyn; Ph.D., Illinois Institute of Technology. Research interests: Hydrodynamic theories of fluidization and multiphase flow, gas-solid transport, and hydrodynamic models for slurry bubble column reactors.

Henry Linden (linden@iit.edu), Max McGraw Professor of Energy, Power Engineering and Management and Director, IIT Energy + Power Center. B.S., Georgia Institute of Technology; M.Ch.E., Polytechnic Institute of Brooklyn; Ph.D., Illinois Institute of Technology. Research interests: Fossil fuel technologies, energy and resource economics, energy and environmental policy, electrification and distributed generation, global climate change, and industrial ecology.

Demetrios J. Moschandreas (moschandreas@iit.edu), Professor of Environmental Engineering. B.S. Stetson University; M.S., University of Kentucky; M.S. Ph.D., University of Cincinnati. Research interests: Air quality transport, exposure analysis, risk assessment, indoor air quality, Environmental Index theory and application, sustainable environmental development.

Allan S. Myerson (myerson@iit.edu), Armour Professor of Chemical Engineering, and Provost and Senior Vice President. B.S., Columbia University; M.S. and Ph.D., University of Virginia. Research interests: Crystallization from solution, and nucleation molecular modeling.

Kenneth E. Noll (noll@iit.edu), Professor of Environmental Engineering. B.S., Michigan Technical University; M.S., Ph.D., University of Washington. Research interests: Design of air pollution control devices, study of atmospheric aerosols, VOC emissions from wastewater treatment plants, and physical and chemical changes and fates of toxic air.

Krishna Pagilla (pagilla@iit.edu), Associate Professor of Environmental Engineering. B.E., Osmania University (India); M.S., University of Oklahoma, Norman; Ph.D., University of California, Berkeley. Research interests: Water and wastewater engineering, environmental microbiology, biological nutrient control, soil remediation, and sludge treatment.

Satish Parulekar (parulekar@iit.edu), Professor of Chemical Engineering. B.S., University of Bombay; M.S., University of Pittsburgh; Ph.D., Purdue University. Research interests: Biochemical engineering and chemical reaction engineering.

Victor H. Pérez-Luna (perezluna@iit.edu), Associate Professor of Chemical Engineering. B.S., M.S. Universidad de Guadalajara (Mexico); Ph.D., University of Washington. Research interests: Surface analysis and modification, biomaterials and biosensors, and tissue engineering

Jai Prakash (prakash@iit.edu), Professor of Chemical Engineering and Director, Center for Electrochemical Science and Engineering. B.S., M.S., Ph.D., University of Delhi; Ph.D., Case Western Reserve University. Research interests: Electrochemistry, materials development, and batteries and fuel cells.

Department of Chemical and Environmental Engineering

Faculty continued

Vijay K. Ramani (ramani@iit.edu) Assistant Professor of Chemical Engineering. B.E. Annamalai University (India); Ph.D., University of Connecticut. Research interests: Hybrid materials for sustainable chemical and electrochemical energy conversion, hydrogen and liquid fueled polymer electrolyte fuel cells (PEFCs), degradation mitigation strategies in PEFCs, and development of educational modules to demonstrate sustainable energy economy concepts.

Jay D. Schieber (schieber@iit.edu), Professor of Chemical Engineering and Director, Center of Excellence in Polymer Science and Engineering. B.S., University of Illinois-Urbana; Ph.D., University of Wisconsin, Madison. Research interests: Kinetic theory, polymer rheology predictions, and thermal conductivity measurements.

Fouad A. Teymour (teymour@iit.edu), Johnson Polymer Professor of Chemical Engineering and Chairman. B.S., M.S., Cairo University; Ph.D., University of Wisconsin-Madison. Research interests: Polymer reaction engineering, mathematical modeling, nonlinear dynamics, and complexity and complex systems.

David C. Venerus (venerus@iit.edu), Professor of Chemical Engineering and Associate Chair, Graduate Affairs. B.S., University of Rhode Island; M.S., Ph.D., Pennsylvania State University. Research interests: Transport phenomena in complex materials, Forced Rayleigh Scattering, polymer rheology, and polymer foam processing.

Darsh T. Wasan (wasan@iit.edu), Motorola Chair Professor of Chemical Engineering and Vice President of International Affairs. B.S., University of Illinois, Urbana-Champaign; Ph.D., University of California, Berkeley. Research interests: Thin liquid films, foams, emulsions and nano-particle suspensions, film rheology and applications, wetting, spreading and adhesion of nano-fluids on solid surfaces, environmental technologies, food colloids.

Research Faculty

Said Al-Hallaj (alhallaj@iit.edu), Research Associate Professor of Chemical Engineering and Coordinator, Renewable Energy Programs. B.S., M.S., University of Science and Technology (Jordan); Ph.D., Illinois Institute of Technology. Research interests: Hydrogen storage and production, renewable energy systems, water desalination, advanced batteries and fuel cell systems for hybrid/electric vehicles, electrochemical engineering and technology, distributed power generation systems, energy, environment and economics and renewable energy, heat and mass transfer, and thermodynamics of chemical processes, thermal modeling and scale-up design, and unit operation and system integration.

Dimitri T. Hatziavramidis (hatziavramidis@iit.edu), Research Professor and Director of the Particle Technology and Crystallization Center. B.S., National Technical University of Athens; M.S., University of Manchester; Ph.D., University of Illinois at Urbana-Champaign. Research interests: Drug delivery, fluid and thermal sciences' molecular simulations, pharmaceutical technology.

George K. Ivanov (ivanovg@iit.edu), Research Professor of Chemical Engineering. B.S., M.S., Ph.D., University of Chemical Technology and Metallurgy (Bulgaria). Research interests: Thermoplastic and thermoset resins; polymer composites, alloys and blends; plastics pulverization and recycling.

Zoltan Nagy, (nagy@iit.edu) Research Professor of Chemical Engineering. Dipl. Ch.E., Technical University of Veszprem (Hungary); Ph.D., University of Pennsylvania. Research interests: Electrochemistry.

Alex Nikolov (nikolov@iit.edu) Research Professor of Chemical Engineering. B.S., Ph.D., University of Sofia (Bulgaria). Research interests: Interfacial rheology, foams, emulsion, dispersion, and thin liquid films.

Bert Plomp (l.plomp@ecn.nl) Research Professor of Chemical Engineering and Project Manager Supercapacitors, Energy Research Centre of the Netherlands ECN. Ing. Electrical Engineering and Information Technology, Ir. Applied Physics Delft University of Technology (Netherlands); Dr. Physical Chemistry, Free University of Amsterdam (Netherlands) Research interests: Fuel cells and supercapacitors.

Giselle Sandi (sandi@iit.edu), Research Associate Professor of Chemical Engineering. B.S., M.S., University of Costa Rica (Costa Rica); Ph.D., Northern Illinois University. Research interests: Electrochemistry, nanocomposite materials, and polymer electrolytes.

J. Robert Selman (selman@iit.edu), IIT Distinguished Research Professor of Chemical Engineering. Ing., Technical University (Netherlands); M.S., University of Wisconsin-Madison; Ph.D., University of California, Berkeley. Research interests: Fuel cell and battery design and operation; high-temperature fuel cells; lithium battery design and thermal management.

Adjunct Faculty

Michael Caracotsios, Ph.D., University of Wisconsin, Madison.

Ted Knowlton, Ph.D Iowa State University

Harold Lindahl, Ph.D., Illinois Institute of Technology.

Department of Chemical and Environmental Engineering

Admission Requirements

Cumulative Undergraduate GPA: 3.0/4.0
GRE score minimum:
For tests taken prior to Oct.1, 2002,
M.S./MAS/Ph.D.:1200 (combined)
For tests taken on or after Oct.1, 2002, M.S./MAS: 900
(quantitative + verbal), 2.5 (analytical writing)
For tests taken on or after Oct.1, 2002, Ph.D.: 1000
(quantitative + verbal), 3.0 (analytical writing)
TOEFL minimum score: 550/213*

Note: The GRE requirement is waived for Professional
Master's degree applicants who hold a Bachelor of
Science in a related field from an ABET-accredited
university in the United States, with a minimum
cumulative GPA of 3.0/4.0

Certificate program applicants must possess a bachelor's
degree with a minimum cumulative GPA of 2.5 on a 4.0
scale. The GRE is not required.

Meeting the minimum GPA and test score requirements
does not guarantee admission. Test scores and GPA are
just two of several important factors considered.

Admission to graduate study in chemical engineering,
biological engineering, or gas engineering requires the
completion of a program leading to a bachelor's degree
in chemical engineering or another engineering discipline
from an accredited institution. Students with degrees in
related fields must remove deficiencies or must show

proof of proficiency in the required undergraduate mater-
ial before entering the graduate program. Students with
a B.S. degree in science are required to take up to four
engineering deficiency courses. Admission to the graduate
degree program in biological engineering requires one
college-level semester of biology. Students not meeting
this requirement may be admitted, but will have to take
CHE 412 to remove the deficiency.

Admission to graduate degree programs in environmental
engineering requires a bachelor degree in an appropriate
undergraduate field, awarded by an educational institu-
tion of recognized standing. In addition, proof of
high-quality academic ability in the applicant s under-
graduate program must be provided. Prerequisites for the
program vary; however, it is expected that all applicants
will have had one year each of calculus and chemistry.
Qualified applicants with degrees in the life sciences,
engineering and the physical sciences will normally be
admitted to the program without extensive prerequisites.

Admission to graduate degree programs in food process
engineering normally requires a bachelor's degree in
chemistry; biology; food science; chemical, agricultural,
food or environmental engineering; or a related field.
Depending on the student's background, additional
deficiency courses, some of which may not count toward
the degree, may be required.

* Paper-based test score/computer-based test score.

Master of Biological Engineering

30 credit hours
No Thesis Requirement

The objective of this degree program is to prepare stu-
dents for professional practice in any field of engineering
involving heavy emphasis on biological processes, and
to provide a foundation in the fundamental knowledge
of biological engineering. Candidates are required to take
a total of 30 credits, 9 credits for core courses, 7 credits
of required biology courses, 2 credits of a required profes-
sional course, and 12 credits of electives chosen from the
list below.

Core courses:
CHE 406   Transport Phenomena
CHE 503   Thermodynamics
CHE 577   Bioprocess Engineering

Biology requirement:
BIOL 504   Biochemistry Lectures
BIOL 515   Molecular Biology (after completing BIOL 504)

Professional requirement:
CHE 506   Entrepreneurship and Intellectual
            Property Management

Electives
BME 533   Biostatistics
BME 570   Engineering Biocompatible Materials
CHE 552   Bionanotechnology and Interfacial Phenomena
CHE 514   Process Analytical Technology
CHE 519   Biosensors
CHE 533   Statistical Analysis of Systems
CHE 545   Metabolic Engineering
CHE 573   Bioseparations
CHE 580   Biomaterials
CHE 583   Pharmaceutical Engineering
CHE 584   Tissue Engineering/BME 525: Concepts
            of Tissue Engineering
CHE 585   Drug Delivery
CHE 597   Research Project
ENVE 513   Biotechnological Processes
            in Environmental Engineering
Any 500 level Food Process Engineering course

Other approved electives from CHE, CHEM, BME, BIOL

Department of Chemical and Environmental Engineering

Master of Chemical Engineering

30 credit hours
No Thesis Requirement
Project option

The objective of this degree program is to prepare students for professional practice in the field of chemical engineering, and to provide a foundation in the fundamental knowledge of chemical engineering. Candidates are required to take a total of 30 credits, 12 credits for core courses, 2 credits of a required professional course, and 16 credits of electives.

Core courses:

CHE 406	Transport Phenomena	
CHE 503	Thermodynamics	
CHE 525	Chemical Reaction Engineering*	

AND one of the following:

CHE 535	Applications of Mathematics to Engineering or	
CHE 530	Advanced Process Control	

*Note: Interested students can substitute, upon advisor consent, CHE 577: Bioprocess Engineering for CHE 525: Chemical Reaction Engineering.

Professional requirement:

CHE 506	Intellectual Property Management and Entrepreneurship

Master of Environmental Engineering

Master of Food Process Engineering

32 credit hours
Project option

The objective of these degree programs is to prepare students for professional practice in their major discipline (environmental or food process engineering) and to provide a foundation in the fundamental knowledge of their major. The requirements are the same as those for the M.S. degree, with the following exceptions:

At least 18 credit hours must be taken in 500-level courses in the student's chosen program (environmental engineering, food process engineering), and the thesis work should be replaced by six to eight hours of coursework or a project.

The student may choose courses in any of the areas of specialization listed on page 117 for the M.S. programs. Undergraduate courses may sometimes be used to fulfill graduate program requirements in order to overcome deficiencies or to broaden the candidate's background. The limit is 12 credit hours in courses numbered 400—499.

Students in Master of Food Process Engineering are strongly encouraged to do an independent project for up to four credit hours.

Master of Gas Engineering (Internet only)

30 credit hours
No Thesis Requirement

The Online Professional Master's Degree Program in Gas Engineering is a joint program offered by Illinois Institute of Technology (IIT) and Gas Technology Institute (GTI). The objective of this degree program is to enable the student to build a strong foundation in the fundamentals of gas engineering, energy engineering, and related environmental and economic issues. Applicants to the program should hold an engineering degree (preferably in chemical or mechanical engineering), or a bachelor's degree in science (such as environmental science, physics or chemistry). Students with a science degree must take the following bridging courses or demonstrate proficiency in each of these areas:

• Material and Energy Balances (CHE 202)

• Fluid Mechanics and Heat Transfer Operations (CHE 301)

• Mass-Transfer Operations (CHE 302)

• Chemical Engineering Thermodynamics (CHE 351)

All departmental minimum admission requirements must be met.

Candidates are required to take a total of 30 credit hours, 3 core courses are required, and 7 courses may be chosen from the 11 electives listed below. All courses are administered online.

Core Courses

CHE 406	Transport Phenomena
CHE 505	Fluid Properties
CHE 543	Energy, Environment, and Economics

Electives

CHE 426	Statistical Tools for Engineers
CHE 481	Flow-Through Porous Media and Fundamentals of Reservoir Engineering
CHE 489	Fluidization
CHE 515	Natural Gas Processing
CHE 516	Gas Transmission and Distribution
CHE 517	Gas Utilization Technologies and Economics
CHE 520	LNG Fundamentals and Technologies
CHE 522	Fundamentals of Combustion
CHE 541	Renewable Energy Technologies
CHE 565	Electrochemical Engineering
ENVE 578	Physical and Chemical Processes for Industrial Gas Cleaning

Department of Chemical and Environmental Engineering

Master of Science in Chemical Engineering

32 credit hours
Thesis

The objective of this degree program is to enable the student to build a strong foundation in multiple areas of chemical engineering and to specialize in one area via research and thesis. Candidates are required to take a total of 32 credit hours, 12 credits of which must be for the chemical engineering core courses listed below, and six to eight credit hours must be in research and thesis work.

Core courses

CHE 525   Chemical Reaction Engineering
CHE 535   Applications of Mathematics to Engineering
CHE 551   Advanced Transport Phenomena
CHE 553   Advanced Thermodynamics

The student must have a minimum grade point average of 3.0/4.0 in the core areas. Aside from the core courses, coursework may be selected (with advisor approval) to satisfy the needs of the individual student or may be concentrated in any area of specialization available in the department, including:

Biological Engineering
Electrochemical Science and Engineering
Energy/Environment/Economics (E3)
Environmental Engineering
Food Process Engineering
Particle Technology and Multiphase Flow
Pharmaceutical Engineering
Polymer Science and Engineering
Process Design, Statistical Modeling and Control

Undergraduate courses may sometimes be used to fulfill graduate program requirements in order to overcome deficiencies or to broaden the candidate s background. The limit is 12 credit hours in courses numbered 400—499. A thesis may be completed outside the depart-ment only by special arrangement with the department chair. The successful M.S. degree candidate will complete a thesis based on research as well as an oral defense of the thesis, under the direction of the thesis examining committee.

Master of Science in Environmental Engineering

32 credit hours
Thesis

The objective of this program is to enable the student to build a strong foundation in multiple areas of environ-mental engineering and to specialize in one area via research and thesis. Candidates are required to take a total of 32 credit hours, 15 credits of which must be for the environmental engineering core courses listed below, and six to eight credit hours must be in research and thesis work.

Core courses

ENVE 426*   Statistical Tools for Engineers
ENVE 501   Environmental Chemistry
ENVE 506   Chemodynamics
ENVE 542   Physicochemical Processes in Environmental Engineering
ENVE 580   Hazardous Waste Engineering

* Students with background in statistics (before joining the graduate program) equivalent to ENVE 426 will be required to take ENVE 527 as a core course (in place of ENVE 426). Students should consult the course descrip-tions on page 127 for details.

The student must have a minimum grade point average of 3.0/4.0 in the core areas. Aside from the core courses, coursework may be selected (with adviser approval) to satisfy the needs of the individual student or may be concentrated in one of the areas of specialization available in the department, including:

Air Pollution Engineering
Chemical Engineering
Energy/Environment/Economics (E^3)
Environmental Chemistry
Environmental Resource Management
Hazardous Waste Engineering
Water and Wastewater Engineering

Undergraduate courses may sometimes be used to fulfill graduate program requirements. The limit is six credit hours in courses numbered 400—499. A thesis may be completed outside the department only by special arrangement with the department chair. The successful M.S. degree candidate will complete a thesis based on research as well as an oral defense of the thesis, under the direction of the thesis examining committee.

Department of Chemical and Environmental Engineering

Master of Science in Food Process Engineering

32 credit hours
Thesis

The objective of this program is to educate engineers and scientists in different aspects of food engineering and food processing with specialization in an area of food process engineering. Candidates are required to take a total of 32 credit hours, 12 credits of which must be for the core courses listed below, and six to eight credit hours must be in research and thesis work.

Core Courses
Choose 4 of the following:
FPE 505   Food Microbiology
FPE 521   Food Process Engineering
FPE 522   Advanced Food Process Engineering
FPE 524   Fundamentals of Food Science and Technology
            (For students with non-food science background)
FPE 541   Principles of Food Packaging

Proficiency Requirement
These courses may be required if the student has not taken an equivalent course at the undergraduate level:
CHE 406   Transport Phenomena
CHE 423   Chemical Reaction Engineering
CHE 435   Process Control

The student must have a minimum grade point average of 3.0/4.0 in the core areas. In addition to the core courses, coursework may be selected (with adviser approval) to satisfy the needs of the individual student or may be concentrated in one of the following areas of specialization:

Process and product development
Food processing operations
Packaging
Food Safety

Food Biotechnology
Process and quality monitoring and control
Required courses for these specializations are described on page 130.

Electives
Students must take at least two courses from the following group of food process engineering courses:
FPE 504   Food Biotechnology
FPE 506   Food Microbiology Laboratory
FPE 507   Food Analysis
FPE 511   Food Law and Regulation
FPE 531   HACCP Planning and Implementation

Students must take at least two courses from the following group of chemical and environmental engineering courses:
CHE 439   Numerical Analysis
CHE 494   Chemical Process Design
CHE 560   Statistical Quality and Process Control
CHE 573   Bioseparations
CHE 577   Bioprocess Engineering
CHE 579   Enzyme Reactor Engineering
CHE 761   Statistical Design of Experiments
            for Process Improvement
CHE 771   Applications of Enzymes and Microbes
            in Food Processing
ENVE 513   Biotechnological Processes
            in Wastewater Treatment
ENVE 542   Environmental Unit Processes

A thesis may be completed outside the department only by special arrangement with the department chair. The final examination is normally oral, but may be written at the discretion of the thesis examining committee.

Master of Science in Computer Science/Master of Chemical Engineering

44 credit hours
No thesis requirement

The objective of the program is to educate, and prepare for professional practice, process engineers with broad based knowledge of chemical engineering and computer science fundamentals, and computer scientists with strong engineering fundamentals. Candidates are required to take 18 credit hours in graduate chemical engineering courses (courses numbered 500 or higher) and 26 credit hours in computer science courses (of which 20 credit hours must be in courses numbered 500 or higher). The 18 credit hours in chemical engineering courses consist of 12 credit hours in core courses listed in the description of the Master of Science in Chemical

Engineering requirements and six credit hours from the following courses:
CHE 507   Computer-Aided Design
CHE 508   Process Design and Optimization
CHE 528   Analysis and Simulation of Chemical
            Processing
CHE 532   Process Modeling
CHE 533   Statistical Analysis of Systems
CHE 536   Computational Techniques in Engineering
CHE 560   Statistical Quality and Process Control

Students should refer to the Department of Computer Science section (page 148) for details on computer science course requirements for the dual degree.

Department of Chemical and Environmental Engineering

Doctor of Philosophy

84 credit hours
Qualifying exam
Comprehensive exam
Thesis proposal
Dissertation and oral defense

The doctorate degree in chemical/environmental engineering is awarded in recognition of mastery in chemical/environmental engineering and upon demonstration of an ability to make substantial creative contributions to knowledge in chemical/environmental engineering. The recipients of these degrees will be capable of a continuing effort toward advancement of knowledge and achievement in research while pursuing an academic or industrial research career. The program should satisfy the following requirements: chemical engineering or environmental engineering study, 30—40 percent; research, 40—50 percent; other fields of study, 10—30 percent. The coursework must include up to 18 credits of core chemical or environmental engineering courses.

For the Ph.D. in Chemical Engineering, students must take the following core courses:

CHE 551	Advanced Transport Phenomena
CHE 553	Advanced Thermodynamics
CHE 525	Chemical Reaction Engineering
CHE 535	Applications of Mathematics to Engineering
CHE 530	Advanced Process Control or CHE 536 Computational Techniques in Engineering

For the Ph.D. in Environmental Engineering, in addition to the core courses listed in Master of Science in Environmental Engineering, students must take:
ENVE 527   Statistical Analysis of Systems

Students should consult the Transfer Credits section for rules on how many credit hours may be transferred from another institution.

Students must pass a written qualifying examination within three semesters after they have been admitted to the Ph.D. program. The exam is diagnostic in nature, and the results of the exam will determine the student's potential for success in the Ph.D. program and recommendations for a future program of study. The examination in the chemical engineering program will cover all core areas, including thermodynamics, reaction engineering and kinetics, transport phenomena, process modeling, design and control, and applied mathematics. The examination in the environmental engineering program will cover core areas, including environmental chemistry, chemodynamics, environmental systems and analysis, and physicochemical processes.

The comprehensive examination is oral and may include a written exam based on the student's performance on the qualifying exam. The exam questions will be formulated by the members of the Ph.D. examining committee. The examination will also include oral presentation and discussion by the student of a journal article in the student's major (chemical/environmental engineering) selected a priori by the examining committee. The exam must be conducted within a year following completion of the qualifying exam. The Ph.D. examining committee, which may be the same as the Ph.D. thesis committee, should be suggested by the adviser and approved and appointed by the chairperson at least three weeks prior to the examination.

The thesis proposal approval examination, which is diagnostic in nature, should be conducted after the comprehensive exam and at least one year before the final thesis defense. The exam will be oral and will be administered by the Ph.D. thesis committee.

Doctoral research can begin after admission to the Ph.D. program. However, the major portion of the research should not be started until the comprehensive examination is passed and the thesis proposal is approved by the committee. All research must be conducted under the supervision of a full-time department faculty member and in the laboratories of the university. Off-campus research is possible with the approval of the department chairperson. The preliminary thesis draft must meet the approval of all members of the examination committee. An oral examination in defense of the thesis is given as an open university seminar. The thesis defense must meet with the approval of the examination committee; if it does not, the committee has the authority to determine whether or not to grant a re-examination.

Department of Chemical and Environmental Engineering

Certificate Programs

The department offers 11 graduate certificate programs, with one available only via the Internet. These programs provide students with post-baccalaureate knowledge of an area of specialization within chemical or environmental engineering. Students in these programs register as certificate students.

Certificate programs typically require a set of three to four courses that must be completed in three years with a minimum GPA of 3.0/4.0. (Note: Some courses may have prerequisites.) Students who are admitted to master's degree programs may apply coursework previously taken in a certificate program toward the requirements for the master's degree.

Biological Engineering

This program provides an introduction to the field of biological engineering and its application in biological, biomedical and environmental processes. Students must complete four courses (12 credits) to receive the certificate.

Required course
CHE 577   Bioprocess Engineering

AND at least three courses from the elective courses listed under the Master of Biological Engineering.

Current Energy Issues (Internet only)

This program explores issues related to the establishment of sustainable energy systems including energy/environment/economics, renewable energy, batteries and fuel cells. Students must complete 3 of the following 4 courses (9 credits) to receive the certificate.

Required Courses
At least three from the following:
CHE 517   Energy Utilization Technologies and Economics
CHE 541   Renewable Energy Technologies
CHE 543   Energy, Environment and Economics
CHE 565   Electrochemical Engineering

Food Process Engineering

This program provides an introduction to the field of food engineering with applications of chemical engineering to food manufacturing and food safety. Students must complete four courses (12 credits) to receive the certificate.

Required courses
Two from the following:
CHE 406   Transport Phenomena (Prerequisite: CHE 302)
CHE 518   Mass-Transfer (Prerequisite: CHE 302)
CHE 577   Bioprocess Engineering
CHE 584   Tissue Engineering
FPE 521   Food Process Engineering

FPE 522   Advanced Food Process Engineering
AND two courses from the following group:
FPE 504   Food Biotechnology
FPE 505   Food Microbiology
FPE 506   Food Microbiology Laboratory
FPE 507   Food Analysis
FPE 511   Food Law and Regulation
FPE 524   Fundamentals of Food Science and Technology
           (For students with non-food science background)
FPE 531   HACCP Planning and Implementation
FPE 541   Principles of Food Packaging

Particle Processing

This program provides an introduction to the field of particle processing, specifically in fluidization and fluid/particle systems. Fundamentals of fluid/particle system design, computational multiphase approach to gas/particle systems and advanced measurement techniques are presented. Students must complete three courses (nine credits) to receive a certificate.

Required courses
At least one of the following courses:
CHE 542   Fluidization and Fluid/Particle Flow Systems
CHE 489   Design of Fluidized Beds and Fluid/Particle Systems
AND one/two of the following courses:
CHE 587   Particle Processing and Characterization
CHE 486   Applied Particle Technology
CHE 582   Interfacial Colloidal Phenomena
CHE 586   Particle Technology

Pharmaceutical Engineering

This program develops, expands and refines skills to advance the technology of prescription drug development and manufacturing. Fundamentals of pharmaceutical engineering, drug delivery systems and regulatory issues are presented. Students must complete four courses (12 credits) to receive a certificate.

Required courses
The following three courses:
CHE 583   Pharmaceutical Engineering
CHE 585   Drug Delivery Systems
CHE 511   Regulatory Issues in Pharmaceutical Processes
AND one of the following:
CHE 514   Process Analytical Technology
CHE 560   Statistical Quality and Process Control

Department of Chemical and Environmental Engineering

Polymer Science and Engineering

This program introduces fundamentals of polymerization and polymer synthesis, polymer kinetics, polymer processing and characterizations. Students must take four courses (12 credits) to receive the certificate.

Required course

CHE 470   Introduction to Polymer Science and Engineering (Prerequisite for all other courses in this certificate program.)

AND any three of the following courses:

CHEM 535   Advanced Polymer Chemistry
CHE 538   Polymerization Reaction Engineering
CHEM 542/
MMAE 579   Characterization of Polymers
CHE 555   Polymer Processing (Prerequisite: CHE 406)

Process Operations Management

This program introduces methodology and tools to improve the technical management of process operations including process modeling, simulation, monitoring, control and optimization. Students must take four courses (12 credits) to receive the certificate.

Required courses

At least one course from each of the following groups:

I

CHE 426   Statistical Tools for Engineers
CHE 533   Statistical Analysis of Systems
CHE 560   Statistical Quality and Process Control
CHE 761   Statistical Design of Experiments for Process Improvement

II

CHE 435   Process Control
CHE 437   Discrete Time Systems and Computer Control
CHE 530   Advanced Process Control (Prerequisite: CHE 435, CHE 437 or equivalent)

III

CHE 431   Artificial Intelligence Applications in Engineering
CHE 508   Process Design Optimization
CHE 528   Analysis and Simulation of Chemical Processing
CHE 532   Process Modeling

Environmental Engineering Certificate Programs

Air Resources

This program explores outdoor air quality, causes of outdoor air pollution, and investigative and diagnostic techniques used in outdoor air quality control. Students must take three courses (nine credits) to complete the certificate.

Required courses

ENVE 570   Air Pollution Meteorology
AND two courses from the following group:
ENVE 502   Atmospheric Chemistry
ENVE 572   Ambient Air Monitoring
ENVE 575   Control of Toxic Air Pollution
ENVE 577   Design of Air Pollution Control Devices
ENVE 578   Physical and Chemical Processes for Industrial Gas Cleaning

Hazardous Waste Engineering

This program is an introduction to the characterization of hazardous waste sites, common and innovative remediation techniques, and current issues in hazardous waste engineering. Students must take three courses (nine credits) to complete the certificate.

Required courses

ENVE 580   Hazardous Waste Engineering
AND two of the following courses:
ENVE 506   Chemodynamics
ENVE 542   Physicochemical Processes in Environmental Engineering
ENVE 577   Design of Air Pollution Control Devices
ENVE 585   Groundwater Contamination

Department of Chemical and Environmental Engineering

Indoor Air Quality

This program covers sick building syndrome, the causes of indoor air pollution, and investigative and diagnostic techniques used in controlling indoor air quality. Students must take three courses (nine credits) to complete the certificate.

Required courses

ENVE 546	Industrial Hygiene
ENVE 576	Indoor Air Pollution

AND one of the following courses:

ENVE 426	Statistical Tools for Engineers OR
ENVE 527	Statistical Analysis of Systems
ENVE 575	Control of Toxic Air Pollution
MAE 452	Air Conditioning and Refrigeration
BIOL 514	Toxicology

Waste and Wastewater Treatment

This program is an introduction to the biological and physical/chemical processes used in water and wastewater treatment, and the design of water and wastewater treatment processes. Students must take three courses (nine credits) to complete the certificate.

Required courses

ENVE 513	Biotechnological Processes in Environmental Engineering
ENVE 542	Physicochemical Processes in Environmental Engineering

AND one of the following courses:

ENVE 551	Industrial Waste Treatment
ENVE 555	Industrial Waste Treatment Design Criteria
ENVE 561	Design of Sanitary Engineering Processes

Department of Chemical and Environmental Engineering

Course Descriptions

Numbers in parentheses respectively indicate class, lab and credit hours. Note: Core courses are available once per year. Other courses may be offered less frequently.

Chemical Engineering

CHE 503
Thermodynamics
Laws of thermodynamics applied to chemical and biological engineering problems, properties of real fluids, phase and chemical equilibria, applications to chemical and biological process and auxiliary equipment. Core course. Prerequisites: CHE 351, CHE 451. (3-0-3)

CHE 505
Fluid Properties
Prediction and correlation of physical and transport properties using equations of state, thermodynamic relationships, phase and chemical equilibrium. (3-0-3)

CHE 506
Entrepreneurship and Intellectual Property Management
This course aims to introduce and develop a number of diversified professional skills necessary for success in an engineering research and development environment. Selected topics covered in the areas of technology entrepreneurship, opportunity assessment, creativity and innovation, project management, management of organizational change, entrepreneurial leadership, and intellectual property management. Prerequisite: Graduate standing or consent of the instructor. (2-0-2)

CHE 507
Computer-Aided Design
Computer process simulation to develop technically and economically optimum overall process designs. Simulation framework includes unit operation computations, physical property determinations, Newton-Raphson convergence procedures and simulation language. Prerequisite: CHE 494. (3-0-3)

CHE 508
Process Design Optimization
Organization of the design problem and application of single and multi-variable search techniques using both analytical and numerical methods. Prerequisite: CHE 494. (3-0-3)

CHE 509
Advanced Topics in Reactor Engineering
Selected topics based on current research interests of the instructor. Typical examples are reactor stability analysis, diffusional effects in heterogeneous catalysis, catalyst and enzyme deactivation analysis, immobilized enzyme reaction systems, liquid-liquid or gas-liquid dispersed phase reactors, biological reactors for wastewater treatment, photochemical reactors, polymerization reactors and crystallization dynamics. Prerequisite: CHE 525 or instructor approval. (3-0-3)

CHE 510
Fluid Dynamics
Cross listed with MMAE 510 Kinematics of fluid motion. Derivation of equations of motion and Navier-Stokes equations. Exact and approximate solution techniques. Boundary layer theory. Introduction to stability and turbulence. Prerequisite: CHE 406 (3-0-3)

CHE 511
Regulatory Issues in Pharmaceutical Processes
Legal and scientific issues in regulating the pharmaceutical and healthcare industrial sectors. Role of regulatory agencies; FDA and the Center for Drug Evaluation and Research. Definitions and standards: laws, regulations, policies, procedures. Manufacturing pharmaceutical drugs, devices, and components in compliance with regulations. (3-0-3) Prerequisite: Graduate standing or consent of the instructor. (3-0-3)

CHE 512
Heat Transfer
A survey course in conduction, convection and radiation. Problems in condensation and convection are solved with the use of fundamental laws of fluid dynamics. Finite difference and algebraic solutions for unsteady-state and heat-regenerator problems are covered. Prerequisite: CHE 406. (3-0-3)

CHE 514
Process Analytical Technology
Provides an introduction to Process Analytical Technology (PAT) as a framework to enhance process understanding and assist in the development of reliable yet efficient pharmaceutical operations. The course is divided into four sections. Definition of critical performance attributes within the context of FDA regulations. Overview of analytic measurement methods, including at/in- or on-line measurement of chemical, physical and microbiological quantities. Mathematical description of common data analysis and chemometric methods, including statistical process monitoring, multivariate analysis and parameter estimation. Design of real-time decision systems, including feedback control of operations and risk-based analysis of final product quality (real-time release). Prerequisite: BS in engineering or equivalent. (3-0-3)

CHE 515
Natural Gas Processing
Application of engineering principles to natural gas separation processes, including multi-stage separation, solvent extraction, adsorption, membrane separation, and supercritical extraction. Design and economic analysis of various gas treating processes such as natural gas dehydration, sweetening, and LNG processes, using commercially available process simulators. Prerequisite: CHE 505. (3-0-3)

CHE 516
Gas Transmission and Distribution
Fundamentals of the subsonic compressible flow, flow in gas transmission distribution systems, gas measurement, storage and compression. Gas/liquid two-phase flow fundamentals. Gas transmission and distribution in pipeline network using commercially available process simulators. Prerequisite: CHE 406. (3-0-3)

Department of Chemical and Environmental Engineering

CHE 517
Gas Utilization Technologies and Economics
Gas and electric energy markets structure, costs and load profiles; Concepts, benefits, and applications of gas for power generation, and integrated energy systems for combined cooling, heating and power (CHP); Power generation technologies of engines, turbines, microturbines, and fuel cells; Thermally-activated technologies, of absorption chillers, desiccant dehumidifiers, and steam turbines; Economics; Case studies; Software tools. Prerequisite: CHE 406. (3-0-3)

CHE 518
Mass Transfer
Principles of diffusion, both steady and unsteady state, as applied to heat transfer, gas absorption, distillation, drying and extraction. Prerequisite: CHE 406. (3-0-3)

CHE 519
Biosensors
Engineering Principles used for the detection of biomolecules and cells in the context of biomedical, environmental, biochemical process applications. Immobilization of biological receptors for interfacing biomolecules with a transducer. Specific and non-specific interactions with surfaces. Transduction mechanisms for signal detection. Signal analyte and multiple analyte detection. Nanotechnology and biosensors. (3-0-3)

CHE 520
LNG Fundamentals and Technologies
Properties and phase equilibria of Natural Gas liquid and gas mixtures at low temperatures. Thermodynamic analysis and design of natural gas liquefaction processes. Recent advances in LNG processing, storage and transportation. Prerequisites: CHE 505 (3-0-3)

CHE 522
Fundamentals of Combustion
Fundamentals of Combustion Thermodynamics of combustion. Combustion reaction kinetics. Combustion of Gaseous and vaporized fuels. Adiabatic flame temperature. Transport processes. Gas flames classification. Premixed flames. Diffusion flames. Laminar and turbulent regimes. Flame propagation. Gas fired furnace combustion. Detonation of Gaseous mixtures. Environmental issues and greenhouse effect. Environmental control technologies. Hydrogen as a fuel. (3-0-3)

CHE 523
Fundamentals of Heterogeneous Catalysis
Fundamental principles governing heterogeneous catalysis, including chemical reaction equilibria, kinetics of gas-surface interactions and surface chemistry. Application of these fundamental principles to catalysis by metals and to acid catalysis. Discussion of several examples of reactions of technological interest. Prerequisites: CHE422; CHE423; CHE351; CHEM343 (3-0-3)

CHE 524
Industrial Catalysis
A comprehensive state-of-the-art introduction to catalytic processes and catalysts used in the chemical and petroleum industries. Prerequisite: Basic background in organic, inorganic and physical chemistry. (3-0-3)

CHE 525
Chemical Reaction Engineering
Advanced treatment of chemical kinetics and reactor systems including non-isothermal, non-ideal flow systems. Modeling of complex reactions, catalysis and heterogeneous reactor analysis. Reactor stability concepts. Core course. Prerequisite: CHE 423 or equivalent. (3-0-3)

CHE 527
Petrochemical Systems
This course will cover descriptions and evaluations of processes designed to manufacture petrochemicals. The source, availability and characterization of feedstock will also be discussed. Process design procedures particular to petrochemicals will be emphasized. Prerequisite: CHE 494. (3-0-3)

CHE 528
Analysis and Simulation of Chemical Processing
Introduction to techniques for computer- aided analysis of chemical processing systems. Study of process simulation computer systems. Prerequisites: CHE 433, CHE 439, CHE 494. (3-0-3)

CHE 529
Advanced Process Design of Chemical Processes
In depth treatment of topics on the chemical engineering design and operation of chemical processes. Selected process applications are emphasized. Prerequisites: CHE 495, CHE 496(3-0-3)

CHE 530
Advanced Process Control
State space, transfer function and discrete-time representations of process systems. Control system design. Interaction assessment. Multivariable and model predictive-control techniques. Core course for Ph.D. Prerequisite: CHE 435. (3-0-3)

CHE 532
Process Modeling
Development of steady-state and dynamic models of various physical and chemical processes. Parameter identification and state-estimation techniques. Prerequisite: CHE 433. (3-0-3)

CHE 533
Statistical Analysis of Systems
Multivariate probability distributions. Inference about mean, variance. Multivariate linear regression and response surface analysis. Principal components analysis, factor analysis, canonical correlation analysis. Clustering, discrimination and classification. Selected advanced topics such as survey design, design of experimental techniques, statistical methods for discrete and binary variables, time series analysis, partial least squares techniques. Prerequisites: CHE 426, ENVE 426. Same as ENVE 527. (3-0-3)

Department of Chemical and Environmental Engineering

CHE 535
**Applications of Mathematics
to Chemical Engineering**
Mathematical techniques and their
application to the analytical and
numerical solution of chemical engi-
neering problems. The analytical
component includes review of linear
algebra, as well as solution of ordi-
nary, partial differential and integral
equations. The numerical component
includes iterative solution of alge-
braic equations, numerical analysis
and solution of ordinary differential
equations. Core course. (3-0-3)

CHE 536
**Computational Techniques
in Engineering**
Advanced mathematical techniques,
numerical analysis, and solution to
problems in transport phenomena,
thermodynamics and reaction engi-
neering. Review of iterative solution
of algebraic equations. Nonlinear ini-
tial and boundary value problems for
ordinary differential equations.
Formulation and numerical solution
of parabolic, elliptic and hyperbolic
partial differential equations.
Characteristics, formulation and
numerical solution of integral equa-
tions. Solution of transient two-phase
flow problems using CFD codes.
Prerequisite: A familiarity with
FORTRAN is desirable. Core course
for Ph.D. (3-0-3)

CHE 538
**Polymerization Reaction
Engineering**
The engineering of reactors for the
manufacture of synthetic polymeric
materials, commercial processes for
manufacture of polymers of many
types, polymer chemistry and engi-
neering reactor design. Prerequisite:
CHE 423. (3-0-3)

CHE 540
**Flow-Through Porous Media
and Fundamentals of Reservoir
Engineering**
Introduction to structural geology
and gas and oil formation. Reservoir
rock and fluid properties. Darcy's
Law and applications. Single and
multiphase flow in porous media.
Fundamentals of enhanced oil recov-
ery. Unconventional gas and
petroleum reserves. (3-0-3)

CHE 541
Renewable Energy Technologies
Topics related to renewable energy
technologies including review of
renewable energy sources (solar,
wind, biomass, etc.), energy storage
and conversion with emphasis on
batteries and fuel cells, hydrogen as
an energy carrier, and the hydrogen
economy. (3-0-3)

CHE 542
**Fluidization and Gas-Solids
Flow Systems**
Fluidization phenomena (bubbling,
slugging, elutriation and jets in flu-
idized beds). Multiphase flow
approach to fluidization and gas/solids
flow systems. Kinetic theory approach
to fluid/particle flow systems. Analysis
of flow of particles in pneumatic con-
veying lines (dilute flow) and stand
pipe (dense flow). Hydrodynamic
analysis of spouted and circulating
fluidized beds. Examples from current
literature on applications of multi-
phase flow. Prerequisites: CHE 501,
CHE 535. (3-0-3)

CHE 543
**Energy, Environment and
Economics**
The linkage of energy, environmental
and economic issues. The impact
of energy supply and end use on
human well-being and the ecosystem.
A comprehensive approach to the
resolution of resource, technical,
economic, strategic, environmental,
socio- and geopolitical problems of
the energy industries. Pathways to
a sustainable global energy system.
Same as ENVE 544. (3-0-3)

CHE 544
Kinetic Theory of Multiphase Flow
The classical theory of gases is applied
to particulate flow and to fluidization
by the introduction of a granular tem-
perature concept. Equations of state
for powders, viscosities of suspensions
and Navier-Stokes-like equations of
motion are derived. Applications to the
design of industrial equipment, such
as fluidized bed catalytic crackers, are
shown using solutions of these equa-
tions with workstations. (3-0-3)

CHE 545
Metabolic Engineering
Cellular metabolism, energetics and
thermodynamics of cellular metabo-
lism, regulation of metabolic
pathways, metabolic flux analysis,
metabolic control analysis, analysis
of metabolic networks, synthesis and
manipulations of metabolic pathways,
applications – case studies. (3-0-3)

CHE 551
Advanced Transport Phenomena
Formulation, solution and interpreta-
tion of problems in momentum,
energy and mass transport phenom-
ena that occur in chemical and
biological processes. Prerequisite:
CHE 406. (3-0-3)

CHE 552
**Bionanotechnology and Interfacial
Phenomena**
Bionanotechnology and Interfacial
Phenomena The course will intro-
duce the students to the
interdisciplinary concept of bionan-
otechnology, where engineering at
atomic and molecular scale is
achieved via biological principles of
self-assembly and self-organization.
Structural and functional principles
of bionanotechnology will be dis-
cussed with an emphasis on impact
of biological nanoengineering or
interfacial science. (3-0-3)

CHE 553
Advanced Thermodynamics
Advanced thermodynamics for
research-oriented graduate students.
The course covers the fundamental
postulates of thermodynamics and
introductory statistical mechanics,
with applications to pure fluids, fluid
mixtures, elastic solids, surfaces and
macromolecules. (3-0-3) Prerequisite:
CHE 351, CHE 451. (3-0-3)

CHE 555
Polymer Processing
Analysis of momentum, heat- and
mass-transfer polymer processing
operations. Polymer processes consid-
ered include extrusion, calendering,
fiber spinning, injection molding and
mixing. Prerequisite: CHE 406. (3-0-3)

Department of Chemical and Environmental Engineering

CHE 560
Statistical Quality and Process Control
Basic theory, methods and techniques of on-line, feedback, quality-control systems for variable and attribute characteristics. Methods for improving the parameters of the production, diagnosis and adjustment processes so that quality loss is minimized. Same as MMAE 560. (3-0-3)

CHE 561
Chemical Engineering Calculations
Comprehensive problems to give the student a higher degree of proficiency in analyzing and solving comprehensive problems and situations. Subject matter varies with the interest and background of the instructor. (2-3-3)

CHE 563
Separation Processes
Application of chemical engineering principles to separation processes, including distillation, extraction, chromatographic separation, electrokinetic separation, membrane separation, supercritical extraction, crystallization, foam fractionation and solubilization and coacervation. Prerequisites: CHE 301, CHE 302, CHE 351. (3-0-3)

CHE 565
Electrochemical Engineering
Basic concepts of electrochemistry used in electrochemical reactor analysis and design. Electrolytic mass transfer, current and potential distribution, corrosion engineering. Electrodeposition. Batteries and fuel cells. Industrial electrolysis and electrosynthesis. (3-0-3)

CHE 566
Fundamentals of Electrochemistry
Thermodynamics and potential, Marcus theory, charge transfer kinetics and mass transport of simple systems. Electrode reactions coupled with homogeneous chemical reactions. Double-layer structure and adsorbed intermediates in electrode processes. Potential step and potential sweep methods. (3-0-3)

CHE 573
Bioseparations
Recovery of particulates (cells and other solids), chromatographic separations and applications, membrane separations, electrophoresis, recycle and immobilization, economics of bioseparations. (3-0-3)

CHE 575
Polymer Rheology
Flow of viscoelastic fluids, integral and differential constitutive equations from continuum and molecular considerations, methods of experimental evaluations. Prerequisite: CHE 406. (3-0-3)

CHE 576
Industrial Chemistry: Catalytic and Thermal Reactions and Processes
Includes petroleum refining, gasoline and alternative fuels, petrochemicals, such as polymers and polymer intermediates for films, fibers, elastomers and thermosets; surfactants, adhesives, lubes and gasoline additives; paper, wood, pesticides, pharmaceutical and biotechnology; sulfuric acid and derivatives, fertilizers, ceramics, glasses and other aspects of materials science. (3-0-3)

CHE 577
Bioprocess Engineering
Application of engineering principles to the biological production processes. Enzyme kinetics, cell culture kinetics, transport phenomena in cells, membranes, and biological reactors, genetics, bioseparation and downstream processing, energetics of metabolic pathways, operation modes of cell cultures, mixed cultures and their applications (3-0-3)

CHE 579
Enzyme Reactor Engineering
The biochemical structure of proteins (enzymes), enzyme kinetics, methods of enzyme production and purification and methods of enzyme immobilization are discussed. Fundamentals of reactor design with emphasis on diffusional influences in heterogeneous systems are developed to permit analysis of novel immobilized enzyme processes. Prerequisite: CHE 423 (3-0-3)

CHE 580
Biomaterials
Metal, ceramic, and polymeric implant materials. Structure-property relationships for biomaterials. Interactions of biomaterials with tissue. Selection and design of materials for medical implants. (3-0-3)

CHE 581
Processing and Applications of Polymer Composite Materials
Types, multiphase structures, classification, processing. Different moldings, foamed and cellular composites, cellular structure, types of foams. Applications. (3-0-3)

CHE 582
Interfacial and Colloidal Phenomena with Applications
Applications of the basic principles of physical chemistry, surfactants and interfacial phenomena, surface and interfacial tension, adsorption of surfactants from solutions, spreading, contact angles, wetting, electrokinetic phenomena, rheology, dynamic interfacial properties, mass transport across interfaces. Applications include emulsions, foams, dispersions, tribology, detergency, flotation, enhanced oil recovery, suspension, emulsion polymerization and liquid membranes. Prerequisites: CHEM 343, CHE 406. (3-0-3)

CHE 583
Pharmaceutical Engineering
Application of transport phenomena, and reaction engineering to pharmaceutical processes. Heat and mass transfer in bioreactors and the fluidized beds. Drying, coating and granulation. Environmental and economical issues in the pharmaceutical processes. Examples from industrial processes and current literature. (3-0-3)

CHE 584
Tissue Engineering
Growth and differentiation of cells and tissue. In vitro control of tissue development. In vivo synthesis of tissues and organs. Transplantation of engineered cells and tissue. Techniques and clinical applications of tissue engineering. (3-0-3)

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CHE 585
Drug Delivery
Principle of diffusion in liquid membranes and polymers, and methods for measurement and analysis of diffusion coefficient. Principle of molecular transport in polymeric material, and drug solubility in polymers. Intravenous infusion, and polymer drug delivery systems. Process involved and kinetics of solute release. Design and optimization of drug delivery systems based on pharmacokinetic/pharmacodynamic requirements. (3-0-3)

CHE 586
Particulate Technology
Advances in applied particulate technology. Current specialized topics in systems such as powders, emulsions, suspensions, dusts and mists. (3-0-3)

CHE 587
Particle Processing and Characterization
Particle rheology, particle size and distribution measurements, pulverization and attrition processes, agglomeration and materials processing. (3-0-3)

CHE 591
Research and Thesis for M.S. Degree

CHE 593
Seminar in Chemical Engineering
Presentations on recent developments in the field by academic and industrial visitors. (1-0-1)

CHE 594
Special Projects
Advanced projects involving computer simulation, modeling or laboratory work. (Credit: 1—6 credit hours.)

CHE 597
Special Problems
Independent study and project. (Credit: Variable)

CHE 691
Research and Thesis for Ph.D. Degree

CHE 701
Computer-Aided Process Design and Optimization
Process design, steady-state and dynamic process simulation and process optimization using commercial software for computer-aided process design and optimization. Prerequisites: CHE 494 or consent of instructor. (2-0-2)

CHE 703
Computer Aided Process Modeling
Computer-aided modeling of lumped and distributed parameter systems of process models. Numerical algorithms for solving the resultant differential equations. Nonlinear parameters estimations from single and multi-response data, optimal experimental design and model discrimination. (2-0-2)

CHE 761
Statistical Design of Experiments for Process Improvement
Full and fractional factorial designs of experiments, optimal designs, interactions, analysis of variance, empirical modeling and regression analysis, response surface analysis, process improvement by Taguchi methods and alternative designs of experiments. Prerequisite: Consent of instructor. (2-0-2)

CHE 771
Applications of Enzymes and Microbes in Food Processing
Kinetics of enzyme-catalyzed reactions, applied enzyme catalysis in the food industry, stoichiometry of cell growth and product formation, carbon metabolism pathways, fermentation technology, applications of mixed cultures in the food industry, case studies. Prerequisite: CHE 411 or consent of instructor. (2-0-2)

Environmental Engineering

ENVE 485
Pollution Prevention
(Note: This course will be renamed Industrial Ecology.) (Co-listed with EM 507) Industrial Ecology is the study of material and energy flows from industrial and consumer activities, and the related regulatory, political, economic, tech-

nical, and social issues. Industrial ecologists strive to bring environmental concerns into harmony with economic development. The course includes several projects and readings on current topics such as life cycle analysis (LCA), design for the environment (DFE), and environmental management systems. (3-0-3)

ENVE 501
Environmental Chemistry
Chemical processes in environmental systems, with an emphasis on equilibrium conditions in aquatic systems. The types of processes examined include acid-base, dissolution-precipitation, air-water exchange and oxidation-reduction reactions. Methods presented for describing chemical speciation include analytical and graphical techniques, as well as computer models. Core course. (3-0-3)

ENVE 502
Atmospheric Chemistry
The fundamentals and applied aspects of the photochemical processes that drive the daytime chemistry of the lower atmosphere are discussed. Basic chemistry of photochemical smog, acid deposition, and fate of gaseous and airborne toxic chemicals in the atmosphere are presented. An in-depth review of the experimental techniques employed in fundamental and applied studies of reaction in real and simulated atmospheres is also provided. Prerequisites: ENVE 463, ENVE 501. (2-0-2)

ENVE 503
Water and Wastewater Analysis
Standard and advanced analytical techniques for measuring water quality and efficiencies of water and wastewater treatment processes. Course covers both theoretical and applied aspects of standard methods and advanced techniques for trace metal and organic analyses. Prerequisite:ENVE 501 or consent of instructor. (2-3-3)

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ENVE 504
Advanced Techniques in Environmental Analysis
Principles and applications of advanced techniques in analytical chemistry appropriate to environmental surveillance and control. Includes pesticide analysis, trace metal identification, and automated photometric techniques. Prerequisite: ENVE 501 or consent of instructor. (2-3-3)

ENVE 505
Principles of Water Chemistry
Examination of current research theories and state-of-the-art in subjects pertinent to the chemical aspects of environmental science. Includes chemistry of humic substances and of pesticides in natural waters; physical, chemical and biological fates of trace metals and organic pollutants, and chemistry of biological nutrients. Prerequisite: ENVE 501 or consent of instructor. (3-0-3)

ENVE 506
Chemodynamics
The dynamics of pollutant transfer in biogeochemical systems of the earth. The overall objective of this course is to introduce fundamental science and engineering principles needed to formulate creative, comprehensive solutions to transport problems; critically evaluate proposed solutions to transport problems; and acquire and integrate new information to build on these fundamentals. Core course. (3-0-3)

ENVE 509
Special Topics in Environmental Chemistry
Lectures and field studies on topics pertinent to the chemical aspects of environmental systems. May be repeated with change of course content, up to a maximum of six credits. Prerequisite: Consent of instructor. (Credit: 1—3 hours.)

ENVE 510
Environmental Biodynamics
Properties and characteristics of microorganisms as they relate to water quality and to treatment processes. Batch population growth characteristics. Microbial degradation of organic compounds. Microbial pathogens of waterborne diseases and microbial indicators. Biogeochemical relations. (3-1 4)

ENVE 512
Special Topics in Environmental Biology
Selected laboratory techniques pertinent to the biological aspects of environmental engineering. May be repeated with change of course content, up to a maximum of six credits. Prerequisite: Consent of instructor. (Credit: 1—3 hours.)

ENVE 513
Biotechnological Processes in Environmental Engineering
Fundamentals and applications of biological mixed culture processes for air, water, wastewater and hazardous waste treatment. Topics include biochemical reactions, stochiometry, enzyme and microbial kinetics, detoxification of toxic chemicals, and suspended growth and attached growth treatment processes. The processes discussed include activated sludge process and its modifications, biofilm processes including trickling filters and biofilters, nitrogen and phosphorous removal processes, sludge treatment processes including mesophilic and thermophilic systems, and natural systems including wetlands and lagoons. Prerequisite: ENVE 542 or consent of instructor. (3-0-3)

ENVE 520
Environmental Monitoring and Assessment
Modeling and monitoring methods for the prediction and assessment of environmental impacts due to changes in the physical, chemical and biological environment. Comparative studies of methodologies to assess immediate and extended effects, including trends in space and time due to changes in anthropogenic systems. Dynamics of environmental changes, inventory methods and priority impact criteria. Same as ENVE 405. (3-0-3)

ENVE 525
Advanced Water Resources
Water resources engineering, including hydrology, quality standards, groundwater flow and surface hydraulics. Optimization and allocation of water resources. Prerequisite: ENVE 401. (3-0-3)

ENVE 527
Statistical Analysis of Systems
Multivariate probability distributions. Inference about mean, variance. Multivariate linear regression and response surface analysis. Principal components analysis, factor analysis, canonical correlation analysis. Clustering, discrimination and classification. Selected advanced topics such as survey design, design of experimental techniques, statistical methods for discrete and binary variables, time series analysis, partial least squares techniques. Prerequisites: CHE 426, ENVE 426. Same as CHE 533. (3-0-3)

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ENVE 528
Modeling of Environmental Systems
To introduce students to mathematical modeling as a basic tool for problem solving in engineering and research. Environmental problems will be used as examples to illustrate the procedures of model development, solution techniques and computer programming. These models will then be used to demonstrate the application of the models, including simulation, parameter estimation and experimental design. The goal is to show that mathematical modeling is not only a useful tool, but also an integral part of process engineering. (3-0-3)

ENVE 532
Special Topics in Environmental Engineering
Lectures and discussion on topics pertinent to the engineering aspects of environmental systems. May be repeated with change of course up to a maximum of six credits. Prerequisite: Consent of instructor. (Credit: 1—3 hours.)

ENVE 542
Physicochemical Processes in Environmental Engineering
Fundamentals and applications of physicochemical processes used in air, water, wastewater and hazardous waste treatment systems. Topics include reaction kinetics and reactors, particle characterization, coagulation and flocculation, sedimentation, filtration, membrane separation, adsorption and absorption. Prerequisite: ENVE 404 or consent of instructor. Co-requisite: ENVE 501 or consent of instructor. Core course. (3-0-3)

ENVE 544
Energy, Environment and Economics
The linkage of energy, environmental and economic issues. The impact of energy supply and end-use on human well-being and the ecosystem. A comprehensive approach to the resolution of resource, technical, economic, strategic, environmental, socio- and geopolitical problems of the energy industries. Pathways to a sustainable global energy system. Same as CHE 543. (3-0-3)

ENVE 545
Environmental Regulations and Risk Assessment
One third of the course is a review of current environmental regulations, including the Clean Air Act, Clean Water Act, Toxic Substances Control Act, Resource Conservation and Recovery Act, CERCLA, and the Pollution Prevention Act. The rest of the course deals with the fundamentals of risk assessment, including hazard identification, dose-response assessment, exposure assessment and risk characterization for public health and ecosystems. (3-0-3)

ENVE 546
Industrial Hygiene
An introduction to toxicology, exposure routes and physiological classification of toxicants. Epidemiological considerations, measurement methods, strategies and calculations. Modeling of exposures and evaluation of controlling parameters. Ventilation methods of control. Physical stressors of sound, heat, vibration and lifting. Methods for measurement and calculation of exposure/compliance levels. (3-0-3)

ENVE 551
Industrial Waste Treatment
Industrial waste sources and characteristics, significance of industrial wastes as environmental pollutants; applications of standard and special treatment processes, including physical, chemical and biological systems. Prerequisite: ENVE 513, ENVE 542 or consent of instructor. (3-0-3)

ENVE 555
Industrial Waste Treatment Design Criteria
Theoretical and laboratory development of industrial wastewater treatment systems design criteria. Evaluation and selection of unit treatment processes. Application of design procedures for selected representative industrial wastewater. Prerequisites: ENVE 513, ENVE 542 or consent of instructor. (2-3-3)

ENVE 561
Design of Environmental Engineering Processes
Design of water and wastewater treatment systems. System econom-

ics and optimal design principles. Prerequisite: ENVE 513, ENVE 542 or consent of instructor. (3-0-3)

ENVE 563
Systems Engineering: Waste Facility Design and Operation
Fundamentals of systems engineering applied to wastewater facility design and operation. Modeling, simulation, optimization, techniques for biological and physicochemical treatment processes. Process analysis and control simulations, cost optimization. Prerequisite: ENVE 404 or consent of instructor. (3-0-3)

ENVE 570
Air Pollution Meteorology
Physical processes associated with the dispersion of windborne materials from industrial and other sources. Atmospheric motion, including turbulence and diffusion, mathematical models and environmental impact assessment. Global climate change, ozone depletion, acid rain are studied. Prerequisite: ENVE 513, ENVE 542 or consent of instructor. (3-0-3)

ENVE 572
Ambient Air Monitoring
Ambient air sampling and pollutant analysis. Methods for collection and identification of gaseous and particulate pollutants. Air monitoring survey design, instrument calibration, interpretation of atmospheric data. Prerequisites: ENVE 501, ENVE 570. (2-3-3)

ENVE 573
Air Pollution Engineering
Air pollution sources and source control, chemistry and meteorology of the atmosphere, atmosphere diffusion and stack performance, equipment and engineering processes for air emission control. Prerequisite: ENVE 463. (3-0-3)

ENVE 574
Stack Sampling and Analysis
Current practices of measuring pollutants emitted from stationary sources. Methods of collection and analysis of stack effluents, including field-sampling techniques and data evaluation. (2-3-3)

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ENVE 575
Control of Toxic Air Pollution
Definition of toxic air pollutants; sources of toxic air pollutants; emissions measurement, air dispersion and deposition models; risk assessment and risk management; ecological risk analysis, gaseous toxic air pollutant control technologies; fugitive emissions control. Pollution prevention. Prerequisite: Consent of instructor. (3-0-3)

ENVE 576
Indoor Air Pollution
Indoor air pollution sources, indoor pollutant levels, monitoring instruments and designs; indoor pollution control strategies: source control, control equipment and ventilation; energy conservation and indoor air pollution; exposure studies and population time budgets; effects of indoor air pollution; risk analysis; models for predicting source emission rates and their impact on indoor air environments. Prerequisite: ENVE 405, ENVE 520 or consent of instructor. (3-0-3)

ENVE 577
Design of Air Pollution Control Devices
Principles and modern practices employed in the design of engineering systems for the removal of pollutants. Design of control devices based on physical and chemical characteristics of polluted gas streams. Prerequisite: ENVE 463. (3-0-3)

ENVE 578
Physical and Chemical Processes for Industrial Gas Cleaning
Application of physical and chemical processes in the design of air treatment systems; fundamentals of standard and special treatment processes. Prerequisite: ENVE 463. (3-0-3)

ENVE 580
Hazardous Wastes Engineering
Sources and characteristics of hazardous wastes, legal aspects of hazardous waste management, significance of hazardous wastes as air, water and soil pollutants. Principles and applications of conventional and specialized hazardous waste control technologies. Prerequisites: ENVE 501 and ENVE 506, or consent of instructor. Core course. (3-0-3)

ENVE 585
Groundwater Contamination and Pollutant Transport
Applications of groundwater flow principles, transport phenomena, and chemical and biological processes to problems of groundwater contamination. Simulation model and case studies of current topics. (3-0-3)

ENVE 590
Environmental Engineering Seminar
Presentations on recent developments in the field by academic and industrial visitors. (1-0-1)

ENVE 591
Research and Thesis for M.S.Degree

ENVE 594
Special Projects
Advanced projects involving computer simulation, modeling or laboratory work. (Credit: 1—6 hours.)

ENVE 597
Special Problems
Independent study and project. (Variable credit.)

ENVE 691
Research and Thesis for Ph.D. Degree

Food Process Engineering

FPE 504
Food Biotechnology
Introduction of biotechnology in the food industry including genetic engineering of microorganisms. Fundamentals of microbial genomics and proteomics. Practice of a variety of software and bioinformatics tools including database search, sequence alignment, phylogenetic and cluster analyses, gene prediction, genomic map construction, structural and functional prediction of proteins. Applications of DNA fingerprinting techniques in food safety and public health. Prerequisite: Biology or Microbiology. (3-0-3)

FPE 505
Food Microbiology
Microorganisms of importance to food safety, spoilage and food fermentations. Principles of occurrence and control. Importance of sanitation and prevention of public health problems. Microbiological contaminants and methods for their detection. Mechanisms of microbial inactivation. (3-0-3) Prerequisites: Introductory Microbiology, Food Science and Biochemistry

FPE 506
Food Microbiological Laboratory
Basic microbiological techniques and safe laboratory practices. Introductory Food Microbiology. Isolation of pathogenic bacteria. Spoilage microorganisms. Fermentation. Environmental Monitoring. Rapid Identification tests. Sporeformers. (0-3-3) Prerequisites: Introductory Microbiology and Biochemistry

FPE 507
Food Analysis
Techniques for analyzing food toxins, food constituents of public health concern, intentional and unintentional food additives, modern separation and analytical techniques. Prerequisites: chemistry, analytical chemistry. (3-0-3)

FPE 511
Food Law and Regulation
Legal and scientific issues in regulating the nation's food supply and nutritional status. Rules of regulatory agencies; Federal Food, Drug and Cosmetic Act; definitions and standards for food and adulterated foods. Manufacturing processed foods in compliance with regulations. (3-0-3)

FPE 521
Food Process Engineering
Food engineering fundamentals, heat transfer in food processing, food rheology, freezing of foods, food dehydration, kinetics of chemical reactions in foods, refrigeration and thermal process calculations, alternative methods of food processing. (3-0-3)

Department of Chemical and Environmental Engineering

FPE 522
Advanced Food Process
Engineering
Process calculations for food process-ing methods such as canning, aseptic processing, ohmic heating, microwave processing and pulsed energy processing. Extrusion tech-niques in food processing. Discussion of new food processing techniques and safety implications. Prerequisite: FST 521 or permission of the instruc-tor. (3-0-3)

FPE 524
Fundamentals of Food Science
and Technology
This course will cover the central food science issues encountered with storage and processing of all major American food commodities including meats, grains, confections, vegeta-bles, eggs, dairy. It will also review the relevant chemistry, physics and engineering required to understand common food-related unit operations such as drying, freezing, sterilization and radiation treatment of foods. An introduction to microbial and chemi-cal issues of food quality and safety will also be covered. (3-0-3)

FPE 531
HACCP Planning
and Implementation
Examination of the hazard analysis and critical control point (HACCP) principles; microbiological and process overviews; generic HACCP models, good manufacturing prac-tices; monitoring of critical control points, process control and imple-mentation. (3-0-3)

FPE 541
Principles of Food Packaging
Type and application of packaging materials. Migration Theories. Food Package interaction. Package testing to ensure safety. Special design con-siderations. Recycling of package materials. (3-0-3)

FPE 591
Research and Thesis
Students conduct their research on a particular topic and write a thesis. Students are also required to write manuscripts from his/her thesis work for publication. (Credit: Variable 1-10 hours)

FPE 593
Seminar on Food Safety and
Technology
Students attend seminars offered during the semester. Each student is also required to give a 30 minute presentation on a topic of his/her interest or a research project on which she/he has worked. (Credit: 1 Hour)

FPE 594
Special Projects
Advanced projects involving analysis of food safety processing, packaging and biotechnology systems. (Credit: 1-6 hours)

FPE 597
Special Problems
Independent study focusing on cur-rent problems, issues of professional relevance. Topics selected from food process engineering, food safety, packaging, biotechnology. Repeatable to a maximum of six credit hours. (Credit: 1-6 hours)

Undergraduate Courses
Available to Graduate Students

With the approval of their advisers, students in the chemical and food process engineering graduate pro-grams may apply up to 12 credits hours to their program from the fol-lowing400-level undergraduate courses. Environmental engineering students may apply up to six credit hours with the approval of their adviser. This does not apply to stu-dents pursuing the dual master's degree in chemical engineering and computer science.

Chicago-Kent College of Law

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Dean:
Harold J. Krent

Chicago-Kent College of Law is accredited by the American Bar Association and is a member of the Association of American Law Schools and the Order of the Coif. In January 1992, the college moved into a new state-of-the-art, 10-story facility in the West Loop area of downtown Chicago. The building is a short walk from the Federal Building that houses the U.S. District Court, the Court of Appeals, and numerous federal agencies; the Daley Center, where the Illinois state courts sit; and LaSalle Street, the hub of law practice in Chicago. Being located in the heart of one of the major legal centers in the United States enables the college to supplement its distinguished full-time faculty with outstanding practitioners and jurists who teach courses in their areas of expertise.

Degrees Offered

Juris Doctor (J.D.)

Master of Laws (LL.M.)

Joint-Degree Programs

J.D./LL.M. in Taxation
J.D./LL.M. in Financial Services Law
J.D./LL.M. in Family Law

With Department of Social Sciences:
J.D./M.P.A.

With Stuart School of Business:
J.D./M.B.A.
J.D./M.S. in Environmental Management
J.D./M.S. in Financial Markets

With University of Illinois, Chicago:
J.D./Master of Public Health (M.P.H.)

Certificate Programs

To earn certificates, students must be admitted and enrolled as law students in the J.D. program.

Environmental and Energy Law
Intellectual Property Law

International and Comparative Law
Labor and Employment Law
Litigation and Alternative Dispute Resolution
Public Interest Law

Research Centers

Global Law and Policy Initiative

The Global Law and Policy Initiative (GLAPI) aims to develop a better understanding of the evolving global environment and to strengthen democratic institutions wherever they may be found. It brings together the Chicago-Kent faculty, the Chicago community and Chicago-Kent students who have an active interest in broadening their involvement in international law.

In addition, GLAPI provides a forum to promote the exchange of views and experiences among academics, policy makers and business leaders about critical issues of global policy. GLAPI-sponsored dialogues cover a wide range of topics, including the rule of law, international policing, anti-corruption strategies, economic development, technology and human rights.

Chicago-Kent College of Law

Institute for Science, Law & Technology

The Institute for Science, Law and Technology is a joint venture of the academic units of IIT designed to meet the growing need for science and law-trained professionals capable of addressing the complex issues that arise in a global, technologically driven marketplace of ideas, product standards, and conflicts. The most difficult challenges at the intersection of law and science today arise from new technologies. New possibilities in biotechnology, such as cloning and genetic engineering, raise difficult questions about ethics and challenge traditional legal concepts. Environmental concerns about the generation of greenhouse gases, rain forest devastation and sustainable development challenge public policy. The Internet and other new information networks escape legal control at national boundaries. The Institute serves as a cross-disciplinary forum for lawyers, scientists, ethicists, psychologists, businesspeople, designers and engineers to confront the challenges presented by new technologies.

Institute for Law and the Workplace

The Institute for Law and the Workplace is a national center for research, training, dialogue and reflection on the law that governs the workplace. The Institute pools the resources of leading scholars and the practicing professional community to train students and professionals, monitor policies and trends, and reflect upon major issues in a neutral setting.

Institute for Law and the Humanities

The Institute for Law and the Humanities was created to facilitate, support and encourage symposiums, lectures, scholarship and faculty discussion on the relationship between law and other humanistic disciplines. It provides opportunities for faculty and students to integrate humanities-based studies with the study of law and explore the increasingly rich and diverse scholarship in areas such as legal philosophy, legal history, law and literature, and law and religion.

Center for Access to Justice and Technology

Chicago-Kent College of Law established the Center for Access to Justice and Technology (CAJT) to make justice more accessible to the public by promoting the use of the Internet in the teaching, practice and public access to the law. The one focus of CAJT is to help pro se litigants obtain greater access to justice. Many self-represented litigants, even in simple cases, struggle to navigate through an unfamiliar and procedurally complex court system. The Center conducts research, builds software tools, teaches classes, and supports faculty, staff and student projects on access to justice and technology.

Institute on Biotechnology and the Human Future

The Institute on Biotechnology and the Human Future offers assessments of the scientific benefits and risks of new developments in biotechnology, while at the same time analyzing their cultural and ethical significance. Based at Chicago-Kent, the Institute couples continuing academic and policy research with the ability to provide advice and analysis to businesses, professional organizations, consumer groups and policymakers. It is able to draw on the resources of many scholars and opinion leaders through its wide network of fellows and links to many other organizations.

The Institute serves as a place where leading individuals from a wide range of cultural and political persuasions can work together and exchange understandings about recent developments in genetic and reproductive technology; to move toward a greater understanding of shared goals; and to develop joint efforts to examine and assess developments in biotechnology in terms of risks, benefits, impacts on cultural values, challenges for cultural institutions, and potential contribution to human flourishing.

The Institute is home to the Center on Nanotechnology and Society, which aims to catalyze informed, interdisciplinary research and education on the implications of nanoscale science and technology for ethical, legal, policy, business and wider social issues, and with a special focus on the human condition.

Chicago-Kent College of Law

Research and Training Facilities

The Downtown Campus Library

The Downtown Campus Library contains nearly 550,000 volumes and supports the Chicago-Kent College of Law, the Stuart School of Business, and the Financial Markets programs. A special collection known as the Library of International Relations contains a diverse collection of international reference materials in law, business, economics and history, as well as important collections of documents from a wide variety of international organizations. The library, which is both wired and wireless, seats more than 400 people and contains computer classrooms, copier rooms and nine reservable rooms for group study. Seating throughout the library provides access to all of the network computer facilities, including online research systems both remote (e.g., LexisNexis, Westlaw, and numerous other subscription databases in law and business) and internal, such as Web-based interactive tutorials, computer assisted legal instruction, productivity tools and e-mail.

Computer Facilities

Chicago-Kent boasts a computer network that is among the most technologically advanced of any law school in the nation. Networked workstations are devoted to student use throughout the building in three computer labs as well as in student lounges, the library, and even the cafeteria and atrium. Web-based resources allow 24-hour access to e-mail as well as online registration and grading systems. Faculty members routinely prepare interactive tutorials that can be access by students ahead of class.

Students with laptops can connect to the law school's network from almost anywhere in the building. Every seat in the library and almost every classroom seat has a hard-wired computer node with adjacent power connections. Wireless technology allows complete access to the network and is available throughout much of the building, including the atrium area that spans the concourse, first and second floors; all floors of the library; many classrooms; and the student lounge.

The Judge Abraham Lincoln Marovitz Courtroom

The Judge Abraham Lincoln Marovitz Courtroom, named for the late distinguished Chicago-Kent graduate and Senior Judge of the U.S. District Court for the Northern District of Illinois, integrates design features from the best courtrooms and trial advocacy training facilities in the nation. Planned for both law school instruction and actual legal proceedings, the Marovitz Courtroom incorporates the latest computer and audio/visual technology in a traditional setting.

Research and Clinical Training Areas

Legal Research and Writing

Chicago-Kent has one of the most rigorous and comprehensive legal research and writing programs in the country. The required five-course curriculum introduces students to basic and advanced research techniques; memorandum and brief writing; transactional writing and client representation; and specialized research and writing in such areas as securities, labor and employment, environmental, international, public interest, or intellectual property law.

Chicago-Kent College of Law

Clinical Education

The Law Offices of Chicago-Kent, a teaching law office located in the law school, is one of the largest in-house clinical programs in the United States. The center is staffed by 12 full-time attorneys and serves more than 1,000 clients each year. Students who intern in the law offices work on cases from 10 clinical practice areas — civil practice, criminal law, environmental law, family law, health law, immigration law, intellectual property law, mediation, tax law and the advice desk — under the supervision of a clinical professor.

Other clinical experiences are available through the Judicial and Advanced Externship programs. Students selected for the Judicial Externship Program serve as judicial externs with participating judges in the federal district, appellate and bankruptcy courts. Judicial externs work directly with the judge and the judge's senior law clerk and perform the same duties as the law clerk, including researching, writing memoranda of law, drafting opinions, and generally observing and participating in the day-to-day operation of the court. Those selected for the Advanced Externship Program work with teaching attorneys in a wide range of government and private practice settings.

Faculty

Kari Aamot, Assistant Professor of Legal Research and Writing. B.A., St. Olaf College; J.D., University of Minnesota Law School.

Susan Johanne Adams, Professor of Legal Research and Writing, Associate Director of the Legal Research and Writing Program, and Director of Writing Services. B.A., M.A., University of Wisconsin; J.D., Valparaiso University School of Law.

Lori B. Andrews, Distinguished Professor of Law, Director of the Institute for Science, Law & Technology, and Associate Vice President. B.A., Yale College; J.D., Yale Law School.

Bernadette Atuahene, Assistant Professor of Law. B.A., University of California, Los Angeles; M.P.A., Harvard University; J.D., Yale Law School.

Katharine K. Baker, Professor of Law and Associate Dean. B.S., Harvard-Radcliffe College; J.D., University of Chicago Law School.

Matthew I. Bernstein, Assistant Professor of Clinical Practice. B.A., Arizona State University; J.D., Chicago-Kent College of Law.

Fred P. Bosselman, Professor of Law Emeritus. B.A., University of Colorado; J.D., Harvard Law School .

Ralph L. Brill, Professor of Law. B.A., J.D., University of Illinois, Urbana-Champaign.

Evelyn Brody, Professor of Law. B.A., Yale University; J.D., Georgetown University Law Center.

Bartram S. Brown, Professor of Law and Co-Director of the Program in International and Comparative Law. B.A., Harvard University; J.D., Columbia University; Ph.D., Graduate Institute of International Studies (Switzerland).

Gerald Brown, Clinical Professor of Law and Director of the Graduate Program in Taxation. B.S.C., DePaul University; J.D., University of Chicago.

Howard S. Chapman, Professor of Law. B.S., J.D., University of Illinois, Urbana-Champaign.

Sungjoon Cho, Assistant Professor of Law. LL.B., M.P.A., Seoul National University; LL.M. University of Michigan Law School; S.J.D., Harvard Law School.

Lewis Collens, President of Illinois Institute of Technology and Professor of Law. B.S., M.A., University of Illinois, Urbana-Champaign; J.D., University of Chicago.

Richard J. Conviser, Professor of Law. B.A., J.D., University of California, Berkeley; Dr. Jur., University of Cologne (Germany).

Daniel T. Coyne, Associate Professor of Clinical Practice. B.A., University of Illinois, Chicago; J.D., The John Marshall Law School.

Elizabeth De Armond, Assistant Professor of Legal Research and Writing. B.S., Georgia Institute of Technology; J.D., University of Notre Dame Law School.

Jonathan P. Decatorsmith, Assistant Professor of Clinical Practice. B.A., University of Illinois; J.D., University of Colorado.

Graeme Dinwoodie, Professor of Law, Associate Dean, and Director of the Program in Intellectual Property Law. LL.B., University of Glasgow; LL.M., Harvard Law School; J.S.D., Columbia Law School.

Howard C. Eglit, Professor of Law. B.A., University of Michigan; J.D., University of Chicago.

Suzanne Ehrenberg, Professor of Legal Research and Writing. B.A., Williams College; J.D., University of Chicago Law School.

Chicago-Kent College of Law

Faculty continued

Ira C. Feldman, Associate Professor of Clinical Practice. B.A., American University; J.D., Washington College of Law.

David J. Gerber, Distinguished Professor of Law and Co-Director of the Program in International and Comparative Law. B.A., Trinity College; M.A., Yale University; J.D., University of Chicago.

Douglas Wm. Godfrey, Assistant Professor of Legal Research and Writing. B.A., M.A., University of Illinois, Urbana-Champaign; J.D., University of Michigan Law School.

Richard J. Gonzalez, Clinical Professor of Law. B.A., Northwestern University; J.D., Ohio State University College of Law.

Sanford N. Greenberg, Visiting Associate Professor of Law. A.B., Princeton University; J.D., George Washington University; M.A., Ph.D., University of California, Berkeley.

Vivien C. Gross, Clinical Professor of Law. B.A., Northwestern University; M.A., University of Illinois, Urbana-Champaign; J.D., Indiana University Law School.

Philip N. Hablutzel, Professor of Law. B.A., Louisiana State University; M.A., J.D., University of Chicago.

Daniel W. Hamilton, Assistant Professor of Law and Co-Director of the Institute for Law and the Humanities. B.A., Oberlin College; J.D., George Washington University; Ph.D., Harvard University.

Sarah K. Harding, Associate Professor of Law. B.A., McGill University (Canada); LL.B., Dalhousie University (Canada); B.C.L., Oxford University (England); LL.M., Yale Law School.

Edward C. Harris, Visiting Assistant Professor of Law. B.A., Loyola University Chicago; J.D., Chicago-Kent College of Law.

Steven L. Harris, Professor of Law. B.A., J.D., University of Chicago.

Steven J. Heyman, Professor of Law. A.B., Harvard College; J.D., Harvard Law School.

Timothy R. Holbrook, Associate Professor of Law. B.S., North Carolina State University; J.D., Yale Law School.

Pamela Kentra, Associate Professor of Clinical Practice. B.A., University of Illinois; J.D., Chicago-Kent College of Law.

Richard S. Kling, Clinical Professor of Law. B.A., University of Illinois, Chicago; J.D., Northwestern University School of Law.

Edward Kraus, Associate Professor of Clinical Practice. B.A., University of Michigan; J.D., Georgetown University Law Center.

Harold J. Krent, Dean and Professor of Law. A.B., Princeton University; J.D., New York University School of Law.

Gary S. Laser, Associate Professor of Law and Director of Clinical Education. B.B.A., J.D., University of Miami.

Laurie E. Leader, Professor of Clinical Practice. A.B., Washington University; J.D., Cleveland-Marshall College of Law.

Christopher R. Leslie, Professor of Law. B.A., University of California, Los Angeles; M.P.P., Harvard University; J.D., University of California, Berkeley.

Martin H. Malin, Professor of Law and Director of the Institute for Law and the Workplace. B.A., Michigan State University; J.D., George Washington University.

Nancy S. Marder, Professor of Law. B.A., Yale University; M.Ph., University of Cambridge; J.D., Yale Law School.

Sheldon H. Nahmod, Distinguished Professor of Law and Co-Director of the Institute of Law and the Humanities. A.B., University of Chicago; LL.B., LL.M., Harvard University.

Henry H. Perritt, Jr., Professor of Law and Director of the Graduate Program in Financial Services Law. B.S., M.S., Massachusetts Institute of Technology; J.D., Georgetown University Law Center.

Mickie A. Piatt, Associate Professor of Law and Executive Director of the Program in Intellectual Property Law. B.A., M.L.S., J.D., University of Texas, Austin.

Mark D. Rosen, Professor of Law. B.A., Yale College; J.D., Harvard Law School.

David S. Rudstein, Professor of Law. B.S., LL.M., University of Illinois, Urbana-Champaign; J.D., Northwestern University.

Julie S. Schrager, Visiting Assistant Professor of Law. A.B., Harvard-Radcliffe College; J.D., University of Chicago Law School.

Michael A. Scodro, Assistant Professor of Law. A.B., Dartmouth College; J.D., Yale Law School.

Carolyn Shapiro, Assistant Professor of Law. B.A., University of Chicago; M.A., University of Chicago Harris Graduate School of Public Policy; J.D., University of Chicago Law School.

Jeffrey G. Sherman, Professor of Law. A.B., J.D., Harvard University.

Stephen D. Sowle, Assistant Dean for Academic Administration and Student Affairs and Senior Lecturer. B.A., Williams College; J.D., Yale Law School.

Michael I. Spak, Professor of Law. B.S., J.D., DePaul University; LL.M., Northwestern University.

Ronald W. Staudt, Professor of Law and Associate Vice President for Law, Business and Technology. B.S., B.A., St. Joseph College; J.D., University of Chicago.

Joan E. Steinman, Distinguished Professor of Law. A.B., University of Rochester; J.D., Harvard Law School.

Margaret G. Stewart, Professor of Law. B.A., Kalamazoo College; J.D., Northwestern University.

Faculty continued

Keith Ann Stiverson, Director of the IIT Downtown Campus Library and Senior Lecturer. M.A., Catholic University of America; J.D., Georgetown University Law Center.

Kent Streseman, Associate Professor of Appellate Advocacy and Director of the Ilana Diamond Rovner Program in Appellate Advocacy. B.A., University of California, Davis; J.D., Cornell Law School.

Mary Rose Strubbe, Professor of Legal Research and Writing, Director of the Legal Research and Writing Program, and Assistant Director of the Institute for Law and the Workplace. B.A., Mundelein College; J.D., Chicago-Kent College of Law.

A. Dan Tarlock, Distinguished Professor of Law and Director of the Program in Environmental and Energy Law. B.S., J.D., Stanford University.

David C. Thomas, Clinical Professor of Law. A.B., Kenyon College; J.D., University of Michigan Law School.

Jeff Thomas, Assistant Professor of Clinical Practice. B.B.A., University of Michigan; J.D., Harvard Law School.

Richard Warner, Professor of Law and Faculty Director of the Center for Law and Computers. B.A., Stanford University; Ph.D., University of California, Berkeley; J.D., University of Southern California Law Center.

Richard W. Wright, Professor of Law. B.S., California Institute of Technology; J.D., Loyola University of Los Angeles; LL.M., Harvard University.

Admission Requirements

Applicants for admission to Chicago-Kent must have received a bachelor's degree from an accredited college or university prior to beginning classes at the law school. Students are admitted to the law school based on the information contained in their applications, their LSAT scores, undergraduate records, personal statements and their letters of recommendation. All candidates must take the LSAT and register with the Law School Data Assembly Service. For additional information on admission requirements, potential students should contact the law school admissions office at 312.906.5020 or visit the Chicago-Kent admissions Web site at www.kentlaw.edu/adm.

Juris Doctor

The college offers both full-time and part-time divisions. Entrance, scholastic and graduate requirements are the same for both divisions, and full-time faculty teach in both divisions. Entering classes begin only in the fall. Three years are normally required for full-time day division students to complete the 87 credit hours needed for the Juris Doctor (J.D.) degree. Evening division and part-time day division students normally take four years, including one summer session, to graduate. A selection of courses is offered each summer, mostly in the evening. First-year courses are required, while most courses in the second and third years are elective although the faculty recommends that all students take certain upperclass courses. In addition to traditional courses, the curriculum offers a wide variety of innovative courses and seminars to enrich the student's academic experience.

Chicago-Kent College of Law

Master of Laws (LL.M.)

Chicago-Kent offers Master of Laws (LL.M.) degree programs in taxation, international and comparative law, international intellectual property law, family law, and financial services law. Each program requires 24 credit hours. The courses are taught by outstanding practitioners and offer students the opportunity to do advanced research and writing under the direct supervision of a faculty member. A student may pursue these programs on a full- or part-time basis. The LL.M. in International and Comparative Law is offered to foreign attorneys. The college also offers a combined J.D./LL.M. in Taxation and J.D./LL.M. in Financial Services Law, in which a student may earn both degrees after seven semesters in residence instead of eight.

J.D./LL.M. in Taxation

The law school offers a combined J.D./LL.M. program in taxation that enables a student to earn both a J.D. and a Master of Laws (LL.M.) in taxation in a total of seven semesters of full-time study instead of eight. A student may take six LL.M. courses (12 credit hours of coursework) while a J.D. candidate. These 12 credit hours will be applied toward both the J.D. and the LL.M. The student will earn the J.D. in the usual time but will then go on, as a graduate student with advanced standing, to earn the LL.M. in only one additional semester instead of two. A degree of Master of Laws in Taxation is a recognized certification of exceptional knowledge and skill in tax law and tax planning.

J.D./LL.M. in Family Law

Chicago-Kent offers a combined J.D./LL.M. program in family law that allows students to gain the broad expertise required of contemporary family law practitioners. The practice-oriented curriculum-the only one of its kind in the United States-encompasses family law and attendant, increasingly complex issues of tax, finance, real estate, business entities, contracts and child psychology.

J.D./M.S. in Financial Markets

The law school, through the Stuart School of Business, offers a joint-degree J.D./M.S. in Financial Markets. The program is designed for students who wish to specialize in securities and commodities law for a law firm, brokerage firm, commodity exchange or trading company. Students gain a unique perspective on the economics of financial products and markets that are used to advise clients, to propose regulation, or to litigate.

J.D./LL.M. in Financial Services Law

Deregulation of financial services, tax reforms, and revolutionary market forces have created an environment in which attorneys and other professionals must broaden their knowledge and sharpen their analytical skills and understanding in these areas. The graduate program in financial services law, offer both full- and part-time students a unique opportunity to broaden their understanding of the principles underlying increasingly complex systems and services, deepen their knowledge of particular topics of interest, and enhance their skills as professionals. Courses are offered on weekday evenings and on Saturdays.

J.D./M.P.A.

The law school offers a joint-degree J.D./M.P.A. in conjunction with IIT's Graduate Program in Public Administration. This program explores practices and policies in the public sector.

J.D./M.B.A.

A joint degree J.D./M.B.A. program in conjunction with IIT's Stuart School of Business allows students to receive both J.D. and M.B.A. degrees in a reduced time period, depending on undergraduate preparation. The primary objective of the program is to provide law students with a strong academic background in management. This program is particularly valuable for those law students who intend to be involved in activities and commercial transactions within the business community. The M.B.A. program's focus on professional specialization, combined with business-oriented law courses in the law school curriculum, enhances a lawyer's ability to work effectively as part of the corporate and business world.

J.D./M.S. in Environmental Management

The law school offers a joint J.D./M.S. in Environmental Management degree program in conjunction with IIT's Stuart School of Business. The Environmental Management Program is a unique multi-disciplinary program integrating engineering, law and business man-agement to answer the increasing demand for manage-ment-level personnel who have an understanding of environmental issues. An attorney with environmental training is able to work either as a lawyer or in corporate or governmental management.

J.D./Master of Public Health (M.P.H.)

The law school offers a joint-degree J.D./M.P.H. in conjunction with the University of Illinois at Chicago. Students in the program must independently matriculate into the UIC School of Public Health. The comprehensive curriculum addresses the cutting-edge issues at the inter-section of public health, law and medicine. Students in the joint-degree program acquire legal tools to help solve pressing public health problems; to learn how to impact public policy makers; to explore and understand the empirical assumptions about public health that drive legal decision-making; and to discover how emerging medical technologies and new health-care delivery mech-anisms are likely to be regulated.

Certificate Programs

Students enrolled in the J.D. program at Chicago-Kent may earn certificates in specialized areas. Certificates indicate that, as part of the required J.D. curriculum, the student has completed an identified subset of elective courses in the area of specialization.

Environmental and Energy Law

The Program in Environmental and Energy Law trains students to be environmental and energy professionals as well as law practitioners. Taking an interdisciplinary approach to the field's scientific, economic and ethical aspects, the program immerses students in the statutes and administrative regulations, case decisions, and theo-retical underpinnings of environmentalism. The program attracts students from a wide range of professions. A highly regarded faculty teaches a carefully considered cur-riculum addressing a wide variety of cutting-edge issues.

Students in the program complete 14 credit hours of approved coursework. If students are full-time, these courses are taken during the second and third years; if students are part-time, courses are taken during the second, third and fourth years.

Intellectual Property Law

Intellectual property lawyers work where the law inter-sects with technology, science and the arts to protect their clients' creative products. The field of intellectual prop-erty law focuses on issues relating to patents, copyrights, trade secrets, unfair competition and antitrust. As part of the program's rigorous practical skills training, students learn how to draft intellectual property documents through specialized legal research and writing courses and develop litigation skills by participating in moot court competitions. The program encourages scholarship and discourse among academics, practitioners and stu-dents with events like the Chicago Intellectual Property Colloquium. Students complete 20 credit hours of approved course work, including courses in patent law, copyright law and trademark and unfair competition law.

Chicago-Kent College of Law

International and Comparative Law

In a climate of continuous change, Chicago-Kent's Program in International and Comparative Law addresses the law's global implications and extensive reach. Students can learn how to conduct an international business transaction, develop the skills to navigate between different legal regimes, and learn about the legal structures of international institutions and organizations. The program offers opportunities to link course work to externships, foreign law study and projects in nations across the globe. Students in the program must successfully complete 14 credit hours of course study in international and comparative law, including a two-credit-hour seminar.

Students can take advantage of the Library of International Relations, which contains a diverse collection of international legal, historical and business-related reference materials and is a depository library for the United Nations and the European Union.

Labor and Employment Law

The Program in Labor and Employment Law is the centerpiece of Chicago-Kent's Institute for Law and the Workplace. Through a logical, carefully paced sequence of coursework and practical skills training, the program provides comprehensive, rigorous preparation for the field of labor and employment law. To earn a certificate, program participants must complete four core courses, a seminar course, a practicum and additional electives. The core courses are Labor Law; Employment Relationships; Employment Discrimination; and a specialized advanced legal research and writing course in labor and employment law.

Litigation and Alternative Dispute Resolution

Chicago-Kent's Program in Litigation and Alternative Dispute Resolution offers an innovative curriculum that stresses the connection between legal doctrine, skills and values, and the art of lawyering. The program provides comprehensive training in trial skills, negotiation and mediation, and a rigorous curriculum of clinical education. Students in the program complete a series of courses that includes alternative dispute resolution, jurisprudence, evidence, pretrial litigation and trial advocacy. In-house clinical education takes place in the Law Offices of Chicago-Kent, the school's acclaimed teaching law firm, where students work with clinical professors on cases in criminal, civil rights, employment, family, health and tax law.

Public Interest Law

The Certificate in Public Interest Law builds on Chicago-Kent's strong public interest tradition and adds a concentrated curriculum to the rich array of activities, courses and resources that encourage Chicago-Kent students to consider public interest law and prepare students to be effective public interest lawyers. The certificate requires 12 credit hours, including Public Interest Law and Policy and a specialized advanced legal research and writing course concentrating on public interest law. Because the substantive scope of public interest lawyering is so broad, each student meets with the director of the program to plan additional courses and at least one public interest clinic or externship to satisfy individual career and interest objectives. Each student will also meet several times with the Career Services Office to complete a personalized Public Interest Career Path Plan.

The Public Interest Law Certificate is distinct from, but coordinated with, the current volunteer program of pro bono activities at the law school. The Dean's Certificate of Service, which can be obtained by volunteering for pro bono service during law school under the Public Interest Resource Center (PIRC), is a requirement for the Certificate in Public Interest Law, but the PIRC certificate will remain a distinct credential that any student can obtain.

Trial Advocacy

Chicago-Kent offers a two-semester sequence in trial advocacy taught by judges and practitioners with extensive trial experience. In the first semester, students practice jury selection, opening statements, direct examination, cross-examination and closing arguments, and they conduct at least two full trials. In the second semester, students learn strategic trial techniques and conduct at least four full trials.

An advanced course in litigation technology ensures students are prepared to use computer technology in the courtroom, a critical aspect of contemporary trial practice.

Course Descriptions

See the Chicago-Kent College of Law Web site for detailed information about faculty (www.kentlaw.edu/faculty) and courses (www.kentlaw.edu/academics/courses.html).

Department of Civil and Architectural Engineering

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Chair:
Jamshid Mohammadi

The Department of Civil and Architectural Engineering offers graduate instruction in structural engineering, transportation engineering, geotechnical engineering, geoenvironmental engineering, public works, construction engineering and management, and architectural engineering. The department maintains relationships with business, industry and government. An active research program provides highly relevant perspectives on current engineering challenges and issues in the field.

Degrees Offered

Master of Architectural Engineering
Master of Construction Engineering and Management
Master of Geoenvironmental Engineering
Master of Geotechnical Engineering
Master of Public Works
Master of Structural Engineering
Master of Transportation Engineering

Master of Science in Civil Engineering
with specialization in:
    Architectural Engineering
    Construction Engineering and Management
    Geotechnical Engineering
    Geoenvironmental Engineering
    Structural Engineering
    Transportation Engineering
Doctor of Philosophy

Joint-Degree Program

Bachelor of Architecture/Master of Civil Engineering

Certificate Programs

Construction Management
Earthquake and Wind Engineering Design
Geoenvironmental Engineering

Infrastructure Engineering and Management
Transportation Systems Planning

Research Facilities

Research facilities include laboratories devoted to concrete structures, structural models, metal structures, materials, architectural engineering, geotechnical engineering, transportation engineering, and construction engineering and management. In addition, researchers have access to the extensive on-campus facilities of the IIT Research Institute and the Argonne National Laboratory nearby. The department has a computer-aided engineering and design lab equipped with state-of-the-art hardware and software.

Research Areas

The main research areas in the department are structural, architectural, geotechnical and geoenvironmental engineering, construction engineering and management, transportation engineering and public works. The faculty conducts research in structural mechanics, analysis methods and design in concrete and steel; bridge engineering; acoustics; airflow and thermal modeling, energy conservation, indoor air quality and thermal comfort; soil mechanics, rock mechanics, engineering geology, earthquake engineering, soil structure and soil-water interactions; construction techniques, site productivity, contracts and specifications, planning, scheduling and control of construction activities, quantity takeoff and estimating, economic decision analysis, construction equipment, systems analysis, contract administration and computer applications in scheduling, estimating, resource planning and cost control; traffic engineering, urban transportation planning, traffic flow theory, public transport, railroad engineering and transportation systems management.

Research in the public works specialty area includes public policy evaluation, management of engineering operations, maintenance, repair and rehabilitation of bridges, and rehabilitation and renovation of existing infrastructures. The department also conducts research in the areas of architectural engineering and building envelopes, acoustics, fire protection and safety engineering, fire prevention and protection during construction, fire load environment and performance-based design.

Department of Civil and Architectural Engineering

Faculty

David Arditi, Professor. B.S., M.S., Middle East Technical University (Turkey); Ph.D., Loughborough University of Technology (United Kingdom). Construction engineering and management.

Jeffrey S. Budiman, Associate Professor. B.S., Bandung Institute of Technology (Indonesia); M.S., Illinois Institute of Technology; Ph.D., University of Colorado, Boulder. Geotechnical and geoenvironmental engineering.

Eduardo De Santiago, Assistant Professor. B.S., Illinois Institute of Technology; M.S., Ph.D., Stanford University. Structural engineering and computational methods.

Sidney A. Guralnick, Perlstein Distinguished Professor of Engineering, Emeritus, and Director of the Advanced Building Materials and Systems Center. B.S., Drexel Institute of Technology; M.S., Ph.D., Cornell University. Structural engineering and materials of construction.

C. Jotin Khisty, Professor Emeritus. B.S., Nagpur University (India), M.S., M.C.P., University of Cincinnati; Ph.D., The Ohio State University. Transportation systems, traffic engineering and infrastructure systems.

Zongzhi Li, Assistant Professor of Civil and Architectural Engineering. B.E. Chang'an University, (China); M.S., Ph.D., Purdue University.

A. C. Megri, Assistant Professor. Ph.D., INSA, Lyon (France). Passive cooling, alternative methods for plastic waste recycling, thermal modeling of heat exchangers, airflow modeling, design of cooling systems.

Jamshid Mohammadi, Professor and Chairman. B.S., M.S., University of Teheran (Iran); M.S., Ph.D., University of Illinois, Urbana-Champaign. Structural reliability and bridge engineering.

Ralph T. Muehleisen, Assistant Professor, B.S. University of Wisconsin, Madison, Ph.D., The Pennsylvania State University. Architectural acoustics, building simulations development including lighting and acoustics.

James Novak, Senior Lecturer and Director, Engineering Graphics Division. M.S., Illinois Institute of Technology.

John R. O'Leary, Associate Professor and Associate Chairman. B.S., M.S., Illinois Institute of Technology; Ph.D., University of Texas, Austin. Solid mechanics and computational methods.

Jay H. Shen, Associate Professor. B.S., Hefei University; M.S., Chinese Academy of Sciences; Ph.D., University of California, Berkeley. Structural engineering and seismic design.

Jonathan J. Shi, Associate Professor. B.Sc., M.Sc., Wuhan University; Ph.D., University of Alberta (Canada). Innovation and new development of modeling and simulation methods for construction.

Mark E. Snyder, Research Professor. B.S., M.S., Creighton University, M.S., Illinois Institute of Technology, Ph.D., Texas Tech University. Building energy and lighting systems, measurement techniques, fire engineering.

Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0
GRE minimum score:
For tests taken prior to Oct.1, 2002, M.S./MAS/Ph.D.:
    1200 (combined)
For tests taken on or after Oct.1, 2002, M.S./MAS:
    900 (quantitative + verbal) 2.5 (analytical writing)
For tests taken on or after Oct.1, 2002, Ph.D.:
    1000 (quantitative + verbal) 3.0 (analytical writing)
TOEFL minimum: 550/213*

Meeting the minimum GPA and test score requirements does not guarantee admission. Test scores and GPA are just two of many factors considered.

Admission to graduate degree programs normally requires a Bachelor of Science degree in civil engineering from an institution accredited by Accreditation Board of Engineering and Technology (ABET). The master's programs in construction engineering and management and

in architectural engineering also accept a bachelor's degree in architecture. Students who have completed an accredited program in a related field or in a foreign school may be admitted on a provisional status until any deficiencies in preparation are removed.

Every full-time graduate student is assigned a faculty adviser by the department chair at the time of initial registration. All part-time or non-degree students who have not been assigned an adviser and who intend to pursue a program toward a degree should contact the department chairman for counseling before registering for courses. Departmental seminars and colloquia are conducted on a regular basis each semester. All full-time graduate students are expected to register for CAE 593 each semester and attend these seminar meetings regularly.

* Paper-based test score/computer-based test score.

Department of Civil and Architectural Engineering

Master of Architectural Engineering

Master of Construction Engineering and Management

Master of Geoenvironmental Engineering

Master of Geotechnical Engineering

Master of Structural Engineering

Master of Transportation Engineering

32 credit hours (minimum)

These master's programs are course-only, professionally oriented degree programs that permit a concentration in preparation for engineering practice. Admission requirements to the programs in construction, architectural, geoenvironmental, geotechnical, structural and transportation engineering are the same as those for the M.S. program, with one possible exception. The GRE requirement is waived for applicants who hold a Bachelor of Science in a related field from an ABET-accredited university in the United States with a minimum GPA of 3.0/4.0.

Candidates in these programs must complete a minimum of 32 credit hours, three of which may be a special project course, CAE 597. Up to 12 credit hours of 400-level undergraduate coursework (except CAE 431 and CAE 432) may be included in the professional master's program with prior adviser approval. No thesis or comprehensive examination is required for successful completion of this degree.

Architectural Engineering

This program is oriented toward students who need to develop more knowledge about buildings. Students are expected to have educational backgrounds in disciplines such as architecture, structural engineering, mechanical engineering, and/or electrical engineering. The program covers the three basic aspects of architectural engineering: mechanical and electrical systems, structures and construction management.

This program involves four core courses, four or five elective courses from one field of concentration, and two courses from any relevant field of concentration, general background courses, or graduate courses offered by the College of Architecture.

Core courses

CAE 471	Construction Planning and Scheduling
CAE 531	Physical Performance of Buildings
CAE 542	Acoustics and Lighting
CAE 574	Economic Decision Analysis in Civil Engineering

Department of Civil and Architectural Engineering

Construction Engineering and Management

The professional master's program in construction engineering and management provides students with the knowledge and background that is essential to making decisions at site, company, industrial and sector levels. Students learn how to plan and schedule projects, estimate and control costs, make economic decisions, administer contracts, organize construction sites, manage construction equipment, analyze productivity, optimize construction activities, and address legal problems.

Core courses

CAE 570	Legal Issues in Civil Engineering
CAE 574	Economic Decision Analysis in Civil Engineering
CAE 575	Systems Analysis in Civil Engineering
CAE 577	Construction Equipment Management

Geoenvironmental Engineering and Geotechnical Engineering

The geotechnical and geoenvironmental engineering programs provide background knowledge and training to prepare students to analyze, design and construct structures, and to provide solutions to problems in geotechnical engineering and environmental geotechnics. The subjects include engineering behavior of soil and rock, geomechanics, foundations, earth support structures, dams, tunnels, slope stability, geotechnical earthquake engineering and soil dynamics, site improvement, geosynthetics, groundwater, pollutant transport, chemical behavior of soil, waste disposal facilities. Laboratory experiments and computer analyses/modeling are incorporated.

Geotechnical engineering core courses

CAE 562	Engineering Behavior of Soils
CAE 564	Design of Foundations, Embankments and Earth Structures
CAE 565	Rock Mechanics and Tunneling
CAE 566	Earthquake Engineering and Soil Dynamics

Geoenvironmental engineering core courses

CAE 562	Engineering Behavior of Soils
CAE 567	Physicochemical Behavior of Soils
CAE 589	Groundwater Hydrology and Sampling
CAE 590	Geotechnical Landfill Design and Maintenance

Structural Engineering

IIT's professional program in structural engineering provides students with the knowledge needed to design the built environment. Students learn how buildings and bridges may be designed to resist the forces imposed upon them by external loads, gravity, wind and earthquakes. Up-to-date computer-aided design techniques and the latest national building codes dealing with steel, reinforced concrete, pre-stressed concrete and masonry structures are treated.

Core courses

MMAE 504	Engineering Analysis 1A
CAE 503	Advanced Structural Theory and Design
CAE 518	Advanced Reinforced Concrete
CAE 525	Advanced Steel and Composite Structures

Transportation Engineering

With a Master of Transportation Engineering degree, a student will be a qualified transportation planner and traffic engineer. Additionally, the student will be trained to understand and evaluate the socioeconomic impacts of transportation and infrastructure engineering projects.

Core courses

CAE 543	Demand Models for Urban Transportation
CAE 546	Public Transportation Systems
CAE 548	Transportation Systems Management
CAE 575	Systems Analysis in Civil Engineering

Department of Civil and Architectural Engineering

Master of Public Works (Infrastructure Engineering and Management)

32 credit hours

The Master of Public Works (M.P.W.) degree is the most widely recognized educational credential for professionals engaged in public works and infrastructure engineering and management. IIT's M.P.W. program consists of four mandatory and six to seven elective courses, totaling a

minimum of 32 credit hours, drawn from the programs in civil and environmental engineering and public administration. This program is offered in cooperation with IIT's Master of Public Administration program. Admission to the M.P.W. program as a regular graduate student requires a bachelor's degree in engineering or science with a GPA of 3.0/4.0 or better.

Master of Science in Civil Engineering

32 credit hours
Thesis and oral defense

Five technical areas (construction, architectural, geoenvironmental, geotechnical, structural and transportation engineering) are included in the M.S. program. Degree candidates in the Master of Science program must complete a minimum of 32 credit hours, six to eight of which

are for research and thesis. Up to 12 credit hours of 400-level undergraduate coursework [except CAE 431 (Steel and Timber Design) and CAE 432 (Concrete and Foundation Design)] may be included in the M.S. program with prior adviser approval. An oral defense of the thesis constitutes the comprehensive examination, and no additional written comprehensive examination is required.

Doctor of Philosophy

96 credit hours, including master's degree
(A maximum of 48 credit hours may be transferred from another institution. Students should consult the rules for transfer credit on page 33.)
Qualifying exam
Comprehensive exam
Dissertation
Oral defense

The full-time doctoral program generally consists of two complete years of academic preparation, followed by one year of full-time research in residence at IIT. To be admitted to candidacy, students must successfully complete a qualifying examination; the department may waive this requirement for students who hold an M.S. degree from IIT in the same field. This examination should be completed within a year of entry into the program. After a student is admitted to candidacy, the department appoints a permanent committee consisting of at least two faculty members of the department and representatives of faculty in the minor fields. The advisory committee may permit the student to initiate

research at any time after admission to candidacy when, in the committee's opinion, he or she has achieved adequate preparation. Academic preparation normally includes the equivalent of one year of coursework, with civil engineering as the major field, as well as preparation in such minor fields as applied mathematics or solid mechanics.

The student should discuss the choice of a research adviser with the advisory committee before making his or her selection. The research adviser, if not already a member of the committee, will be added at this time. The research project must be in harmony with the interests of the faculty and with the facilities of the department. Off-campus research for the dissertation is possible if and only if approved by the entire faculty advisory committee. In those cases, the student must register for CAE 691 during each semester in which the thesis is being prepared. The comprehensive examination must be completed at least one year prior to the date of graduation.

Bachelor of Architecture/Master of Civil Engineering

Qualified students regularly enrolled at IIT may earn both the Bachelor of Architecture and the professional master's degree. They must complete preparatory courses for the professional master's program prior to entry into the combined program. Students who anticipate entry into the combined program and who intend to specialize in structural engineering must successfully complete the following courses as part of their undergraduate program in architecture: MATH 151, MATH 152, MATH 251, CAE 303, CAE 304, CAE 307, CAE 310, CAE 315, CAE 431

and CAE 432 (in place of MATH 119), MATH 122, CAE 287, CAE 351, and CAE 352. Students who anticipate entry into the combined program and who intend to specialize in construction engineering and management must successfully complete the following courses as part of the technical electives in their undergraduate program in architecture: CAE 323, CAE 431, CAE 432 and CAE 457. (For undergraduate course descriptions, students should refer to the undergraduate bulletin or the online course-description database at www.enrollment.iit.edu.)

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Certificate Programs

Construction Management

Required courses (Select four)

CAE 470	Construction Methods and Cost Estimating
CAE 471	Construction Planning and Scheduling
CAE 472	Construction Site Operation
CAE 473	Construction Project Administration
CAE 570	Legal Issues in Civil Engineering
CAE 571	Advanced Construction Scheduling and Control
CAE 572	Construction Cost Accounting and Control
CAE 573	Computer Applications in Construction
CAE 574	Economic Decision Analysis in Civil Engineering
CAE 575	Systems Analysis in Civil Engineering
CAE 577	Construction Equipment Management
CAE 578	Construction Claims Management

Earthquake and Wind Engineering Design

Required courses (Select four)

CAE 410	Introduction to Wind and Earthquake Engineering
CAE 420	Introduction to Dynamics of Structures
CAE 431	Steel and Timber Design
CAE 432	Concrete and Foundation Design
CAE 504	Seismic Retrofit and Earthquake Hazard Reduction
CAE 518	Advanced Reinforced Concrete
CAE 525	Advanced Steel and Composite Structures
CAE 582	Structural Wind and Earthquake Engineering

Geoenvironmental Engineering

Required courses

CAE 567	Physicochemical Behavior of Soils
CAE 589	Ground Water Hydrology and Sampling
CAE 590	Geotechnical Landfill Design and Maintenance

AND one of the following:

ENVE 480	Solid Waste Engineering
ENVE 580	Hazardous Waste Engineering
ENVE 585	Groundwater Contamination and Pollutant Transport

Infrastructure Engineering and Management

Required courses

PA 501	Introduction to Public Administration
PA 551	Public Works Management

AND two of the following:

CAE 408	Bridge and Structural Design
CAE 508	Bridge Inspection, Rehabilitation, Repair and Management
CAE 419	Transportation Engineering and Design
CAE 541	Pavement Evaluation and Management
CAE 486	Soil and Site Improvement
CAE 590	Geotechnical Landfill Design and Maintenance
CAE 471	Construction Planning and Scheduling
CAE 574	Economic Decision Analysis in Civil Engineering
ENVE 405	Environmental Impact Assessment
ENVE 551	Design of Sanitary Engineering Process

Transportation Systems Planning

Required courses (Select four)

CAE 419	Highway and Engineering Design
CAE 430	Probability Concepts in Civil Engineering Design
CAE 543	Demand Models for Urban Transportation
CAE 544	Urban Transportation Planning
CAE 549	Transportation Economics, Development and Policy
CAE 575	Systems Analysis in Civil Engineering

Department of Civil and Architectural Engineering

Course Descriptions

Numbers in parentheses indicate class, lab and credit hours, respectively.

CAE 503
Advanced Structural Theory and Design
Introduction to the mechanics of solids. Energy methods and the calculus of variations. Ritz/Galerkin approximation methods. Introductory discussions on elastic stability and plate analyses. Prerequisite: CAE 310. Corequisite: MMAE 504. (4-0-4)

CAE 504
Seismic Retrofit and Earthquake Hazard Reduction
Selection of site-dependent earthquake for retrofit. Strength and ductility of aging structures. Cyclic behavior and modeling of structures under seismic loading. Performance-based retrofit criteria. Evaluating earthquake vulnerability of existing buildings and bridges. Upgrading lateral load-carrying systems. Conceptual basis for seismic isolation and energy-absorbing techniques and their applications in earthquake hazard reduction in existing bridges and buildings. Selection of retrofit methods. Case studies of seismic retrofit of typical buildings, bridges and industrial facilities using strength upgrading, energy dissipation devices and base isolation. Prerequisite: CAE 420, CAE 582 or instructor's consent. (4-0-4)

CAE 505
Infrastructure Rehabilitation Engineering
Repair and rehabilitation of existing deteriorated infrastructure building structures and facilities. Course will include identification of problems, investigative techniques, non-destructive testing methods, discussion of repair materials, and strengthening and preparation of rehabilitation documents. (2-0-2)

CAE 506
Building Envelope Rehabilitation Engineering
Repair and rehabilitation of existing building exterior envelopes. The course will include problem identification, investigative techniques, repair methods, preparation of remedial design documents, and general management of rehabilitation projects. Types of constructions include buildings, exterior walls, facades, cladding, roofing, plazas and others. (2-0-2)

CAE 507
Control of Sound and Vibration in Buildings
Basic sound physics and sound propagation in enclosed spaces. Sound and vibration sources in and out of buildings. Theories of sound transmission through building elements. Effects of noise and vibration on man and buildings, criteria and standards. Design of noise control systems. Calculation of airborne and impact sound insulation. Noise and vibration control implementations in various indoor spaces, such as residential units, offices, schools and mechanical rooms. Prerequisite: CAE 542 or instructor's Consent. (3-0-3).

CAE 508
Bridge Inspection, Rehabilitation, Repair and Management
Elements of bridge management, rating and inspection process. Life-cycle, project-level and network-level analyses, condition assessment, case studies, and repair, retrofit and replacement alternatives, and their relation to infrastructure management. (3-0-3)

CAE 509
Analysis and Design of Acoustic Spaces
This course will discuss the design of acoustic spaces such as conference rooms, classrooms, lecture halls, music halls, theater, churches, recording studio, and home theater. Course covers the selection and determination of appropriate steady state, spatial, and temporal acoustic measures such as background noise levels, reverberation time, speech transmission index, and interaural cross correlation, as well as the selection of building materials and layout of rooms to meet those requirements.

Prerequisite: CAE 542 or instructor Consent. (3-0-3).

CAE 510
Dynamics of Fire
Introduction to fire, physics and chemistry, and mass and heat transfer principles, fire fluid mechanic fundamentals, fundamentals and requirements of the burning of materials (gases, liquids, and solids), fire phenomena in enclosures such as pre-flashover and post-flashover. Prerequisites: MMAE 310 or MMAE 313 or CAE 302, MMAE 322 or CAE 309 or instructor's consent. (Students who have taken the undergraduate course equivalent, CAE 424, may not take this course for credit.) (3-0-3)

CAE 511
Fire Protection of Buildings
Fundamentals of building design for fire and life safety. Emphasis on a systematic design approach. Basic considerations of building codes, fire loading, fire resistance, exit design, protective systems, and other fire protection systems. For architects and engineers not majoring in fire protection and safety engineering. (Students who have taken the undergraduate course equivalent, CAE 425, may not take this course for credit). (3-0-3)

CAE 512
Computer Modeling of Fire
Introduction to fire heat transfer processes and fire testing materials; application of a set of quantitative engineering tools (fire models) to construct a description of conditions that occur or might occur during the course of a fire; life and structural impacts from hostile fires in buildings. Prerequisites: CAE 424 or instructor's consent. (Students who have taken the undergraduate course equivalent, CAE 426, may not take this course for credit.) (3-0-3)

CAE 518
Advanced Reinforced Concrete
Mechanical properties of hardened concrete, including creep phenomena. Ultimate strength of columns, beams and beam-columns. Introduction to

Department of Civil and Architectural Engineering

limit analysis of frames and yield-line analysis of plates. Prerequisite: CAE 432. (3-0-3)

CAE 520
Buckling of Structures

Review of simple column buckling for various conditions. Basic considerations of stable and unstable equilibrium. Determination of buckling loads of columns with variable cross-section. Analysis of elastic stability of framed structures. Approximate solutions of more complicated problems by various numerical and energy methods. Analysis of lateral and torsional stability of beams and beam-columns. Stability in the inelastic range of columns. Buckling of plates and cylindrical shells. Prerequisites: CAE 310, CAE 431. Corequisite: MMAE 504. (4-0-4)

CAE 521
Building Illumination Design

An intensive study of the calculation techniques and qualitative aspects of good luminous design. Topics covered include photometric quantities and color theory, visual perception, standards, daylight and artificial illumination systems, radiative transfer, fixture and lamp characteristics, control devices and energy conservation techniques. Design problems, field measurements, computer and other models will be used to explore the major topics. Prerequisite: instructor's consent. (Students who have taken the under-graduate course equivalent, CAE 467, may not take this course for credit.) (3-0-3)

CAE 522
Structural Model Analysis

Theory of measurements, statistics, similitude and model laws and the usefulness of structural models. Displacement and strain measurement techniques. Theory and practice of indirect model analysis. Theory and practice of direct model techniques, including photoelasticity and moire methods. Prerequisite: CAE 503. (4-0-4)

CAE 523
Statistical Analysis of Engineering Data

Review of probability, random variables, distribution models, estimation of statistical parameters and testing validity of distribution models. Analysis of variance (ANOVA), hypothesis testing, correlation analysis, multiple range tests, pairwise comparisons, data compilation using unconventional sources, such as using simulations, expert opinion and cycle-counting methods. Prerequisite: MATH 252 or equivalent. (3-0-3)

CAE 525
Advanced Steel and Composite Structures

Torsion and web openings. Behavior and design of rigid and semirigid beam-to-column connections and base plates. Inelastic behavior of steel and composite members and systems under severe cyclic loading. Design of steel-concrete composite and hybrid systems. P-delta effect and design consideration for system stability. Design of special and ordinary moment-resisting frames. Design of concentrically and eccentrically braced frames. Design of bracing for stability. Plate girders. Fatigue and fracture. Prerequisites: CAE 431 or equivalent. (4-0-4)

CAE 526
Energy Conservation Design in Buildings

Identification of the optimal energy performance achievable with various types of buildings and service systems. Reduction of infiltration. Control systems and strategies to achieve optimal energy performance. Effective utilization of daylight, heat pumps, passive and active solar heaters, heat storage and heat pipes in new and old buildings. Prerequisite: instructor's consent. (Students who have taken the under-graduate course equivalent, CAE 465, may not take this course for credit.) (3-0-3)

CAE 527
Control of Building Environmental Systems

Introduction to automatic control systems. Control issues related to energy conservation, indoor air quality and thermal comfort in buildings. Classification of HVAC control systems. Control system hardware: selection and sizing of sensors, actuators and controllers. Practical HVAC control systems; elementary local loop and complete control systems. Designing and tuning of controllers. Building automation systems. Case studies. Computer Applications. Prerequisite: instructor's consent or CAE 528 or CAE 466 or concurrent registration. (Students who have taken an equivalent undergraduate course may not take this course for credit.) (3-0-3)

CAE 528
Communication and Electrical Systems in Buildings

Study of the analysis and design of electrical systems in buildings utilizing the National Electrical Code. The topics include basic circuits, ac and dc, single phase and three-phase power, transients, capacitance and inductance, branch circuits, panel boards, motors, system sizing, and electrical distribution in buildings. Study of the design and specification of communication systems in buildings, including fire alarm, security, sound, and telephone. Prerequisite: instructor's consent. (Students who have taken the undergraduate course equivalent, CAE 466, may not take this course for credit.) (3-0-3)

CAE 529
Information Technology in Buildings

Understanding the potential, the advantages, and the difficulties associated with using information technology to gain a strategic advantage in the building industry. Knowing the various components of any information system. Selection of suitable hardware and software for a certain design of construction task. Development and implementation of buildings-oriented databases. Use of the Internet to develop Web pages for project information. (3-0-3)

Department of Civil and Architectural Engineering

CAE 530
Finite Element Method of Analysis
Continuation of CAE 442. Covers advanced and special topics in finite element analysis such as finite element-boundary element method, plates, and shell analysis using finite elements and stochastic finite elements. Prerequisite: CAE 442. (3-0-3)

CAE 531
Physical Performance of Buildings
Study of the environmental exterior and interior influences (rain, snow, humidity, temperature, wind, sun, etc.) on the physical performance of buildings and the implications of these influences on building design. Study of indoor thermal environment and thermal comfort of building occupant is offered as well. (Students who have completed the undergraduate equivalent may not take this course for credit.) (3-0-3)

CAE 532
Analysis of Plates and Shells
Exact and approximate stress analysis of elastic, isotropic plates of various shapes acted upon by forces in their plane, as well as transverse forces. Stability of plates with various edge conditions, orthotropic plates, elastically supported plates and simple cylinders. Approximate methods such as finite differences, finite elements and the methods of Ritz and Galerkin. Corequisite: MMAE 504. (4-0-4)

CAE 533
Theory and Analysis of Thin Shells
Differential geometry of surfaces. Elastic theory of general shells with nonorthogonal curvilinear coordinates. Specialization to cylindrical shells, shells of revolution and translational shells. Exact and approximate solutions applied to the bending membrane theories of thin shells. Approximate methods including finite differences, finite elements and methods associated with Ritz, Galerkin, Puchler and Gaeckler. Corequisite: MMAE 504. (3-0-3)

CAE 534
Computational Techniques in Finite Element Analysis
Survey of numerical methods as applied to FEM software. Database management, equation solvers, eigenvalue routines and schemes for direct integration (both implicit and explicit), all as employed in the development of a finite element program. Topics covered also include band and front minimizers, static and dynamic substructuring via superelements and sensitivity studies. Same as MMAE 538. Prerequisite: CAE 442 or MMAE 451. (3-0-3)

CAE 535
Nonlinear Finite Element Analysis
FEM as applied to nonlinear problems. Contact problems, the mechanics of large deformation, full and updated Lagrange formulations, review of plasticity, solution algorithms, Eulerian approaches, application to FEM to limit analysis. Same as MMAE 539. Prerequisite: CAE 442 or MMAE 507. Corequisite: MMAE 504. (3-0-3)

CAE 537
Homeland Security Concerns in Building Design
Review of blast effects produced by solid phase weapons and their effects on structures and people. Estimation of the risk of a terrorist attack and the corresponding threat. Review of simplified methods for the analysis and design of structures to meet homeland security concers and procedures to minimize casualties. Analysis of post event fires and how to prevent them. Review of security measure to minimize the effects of blast on buildings and people. (3-0-3)

CAE 539
Introduction to Geographic Information Systems
Geographic information system (GIS) technology allows databases that display and query information in new ways. This course will teach general GIS and GPS skills and concepts, useful to students and practitioners in a variety of disciplines. Students will complete a final GIS project relevant to their field of study. This hands-on class will use ESRI's ArcView and Spatial Analyst products, as well as Trimble GeoExplorer GPS units. (3-0-3)

CAE 540
Asphalt Concrete Mix Design
Types of asphalt and physical properties of asphalt. Types of mixes: dense graded, open graded, base courses and maintenance mixes. Types of pavement structures and hot mix asphalt placement. Aggregate physical properties, tests and blending. Maintenance and rehabilitation materials. Mixture design procedures, including Marshall and Hveem procedures and weight-volume relationships. Evaluation of mixture properties, engineering property's importance to performance, resilient modulus, fatigue and creep testing and thermal cracking properties. Laboratory included. (2-3-3)

CAE 541
Pavement Evaluation and Management
Pavement management systems (PMS) concepts, network definition, condition survey, pavement condition index (PCI), non-destructive deflection testing (NDT), measurement of roughness and skid resistance, micropaver PMS, PMS implementation, project and network-level management, maintenance alternatives, development of annual and long-range work plans. Prerequisite: instructor's consent. (3-0-3)

CAE 542
Acoustics and Lighting
General introduction to the aural and visual environment. Subjective and objective scales of measurement. Laws of psychophysics. Introduction to vibration. The hearing mechanism. Transfer of sound. Passive control of noise in buildings, transmission loss. Absorption and reverberation time. Active control of the aural environment. Visual perception. Photometry, brightness, luminance and illumination. Natural lighting of buildings. Artificial lighting. Prerequisite: PHYS 221. (Students who have taken the undergraduate course equivalent, CAE 334, may not take this course for credit.) (3-0-3)

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CAE 543
Demand Models
for Urban Transportation
Fundamental theory of supply and demand, transportation economics, network equilibrium, land use and transportation equilibrium. Demand models: trip generation, geographical distribution, mode split, route assignment, the direct-demand model and disaggregate-behavioral-demand models. Special properties of models. Relationships among models. Prerequisite: CAE 416 or instructor's consent. (3-0-3)

CAE 544
Urban Transportation Planning
Exploration of the goals of urban transportation. Program planning in relating transportation technology to social, economic and environmental systems. Systems analysis in forecasting travel demand and evaluating alternatives in transportation planning. (4-0-4)

CAE 545
Traffic Operations and Flow Theory
Studies of space and time distribution of speed and other traffic characteristics in the transportation network. Macro- and microtraffic flow theories. Simulation in traffic systems. Application of flow theories to traffic control and operations. (3-0-3)

CAE 546
Public Transportation Systems
Operational and economic characteristics of urban systems. Transit planning process: demand for transit, transit routing, transit scheduling, network design. Improvements of existing systems and exploration of new technologies. (3-0-3)

CAE 547
Advanced Traffic Engineering
Data collection, statistical analysis and interpretation of traffic information. Advanced traffic engineering topics, such as signaling, street-and-highway capacity analysis; accident and safety research. Prerequisite: CAE 419 or instructor's consent. (3-0-3)

CAE 548
Transportation Systems
Management
Transportation as a system. Problems of traffic congestion, land use/transportation intersection; intersection control; freeway and arterial incident management; safety considerations; evaluation of strategies; case studies. Prerequisite: CAE 419 or instructor's consent. (3-0-3)

CAE 549
Transportation Economics,
Development and Policy
Application of managerial, micro- and macroeconomic concepts to transportation systems. Investment and impact analysis. Transport policy as it relates to social, economic and environmental issues. Legislative actions affecting transport issues. Prerequisite: CAE 419 or instructor's consent. (3-0-3)

CAE 551
Prestressed Concrete
Theory and design of prestressed concrete members and structure. Applications to both simple and continuous girders and frames subjected to stationary or moving loads. Prestressed cylindrical shells. Prerequisite: CAE 432. (3-0-3)

CAE 552
Heating and Refrigeration
Heating load analysis, including building shapes, construction type, infiltration, occupancy effects, and daily load variations. Computer applications for thermal load analysis. Water Heating Systems, Steam Heating Systems, Electrical Heating, Central Heating, Heating of Low and High-rise Buildings, Selection of Heaters, Boilers, Pumps, Piping Design. Computer Applications. Reciprocating Refrigeration. Refrigerant, Refrigeration Cycle, Evaporator, Compressor, Condenser, Thermostatic expansion valves, refrigeration system control equipment, motor and motor control equipment, refrigeration accessories, calculation of refrigeration piping and absorption systems. Computer Applications. Prerequisite: Thermodynamics, Heat Transfer, Fluid Mechanics or instructor's consent. (4-0-4)

CAE 553
Measurement and Instrumentation
in Architectural Engineering
Experimental Statistics and Data Analysis. Dynamic measurement. Measurement of Thermal Characteristics (Conductivity, diffusivity, etc). Fluid-Property Measurement (Pressure, Temperature, etc). Fluid Flow measurement (Flow, Viscosity, etc). Blower door and Tracer Gas Techniques. Duct leakage Measurement. Prerequisite: Thermodynamics, Fluid Mechanics and Heat Transfer or instructor's consent. (3-0-3)

CAE 554
Capstone Architectural Engineering
Design Project
The student has to perform major design project or an independent research project under the guidance of a CAE faculty member in one or more from the following areas: HVAC systems, Energy Conservation Technology, Lighting and Illumination, Acoustics, Safety and Fire Protection, Plumbing, Structure, Construction Management or integrated building Design. Requires the approval of the advisor (Credit: Variable; three hours maximum).

CAE555
Transportation Systems Evaluation
Concepts and principles of transportation economic analysis, transportation costs and benefits, user and nonuser consequences, needs studies, finance and taxation, methods of evaluation of plans and projects, cost effectiveness, environmental impact assessment. Prerequisites: CAE 419 or instructor's consent. (3-0-3)

CAE 556
Architectural Engineering Systems
Introduction to systematic solutions of building engineering problems. Techniques to be treated include linear programming, network analysis, nonlinear programming. Introduction to decision analysis and simulation. Application of optimization methods for solution of design problems in building science, building environment, building structures and construction management. Computer Applications. (3-0-3)

Department of Civil and Architectural Engineering

CAE 557
Computer-Aided Building Design
This course introduces students to the process of integrated building design. It emphasizes both computer assistance (CA) and building design (BD). Building design is viewed in a holistic manner integrating related fields such as spatial layouts, structures, enclosures, energy consumption, and construction cost estimation. Building engineering design process: methodology, identification of objectives, building codes, formulation of design problems. Development and evaluation of design alternatives. Conceptual building design: spatial requirements, design of space layout. Preliminary building design: synthesis and design of structures, enclosure systems, and services (HVAC, lighting, electrical distribution) using computer-aided design tools. Performance evaluation using modeling, sensitivity analysis and cost estimation. A major design project is an integral part of this course. Prerequisite: instructor's consent. (3-0-3)

CAE 560
Plastic Methods
Fundamental concepts of plasticity in the design of steel structures. Principle of plastic hinges. Upper- and lower-bound theorems. Alternating plasticity and incremental collapse. Analysis and design of single story and multistory framed structures. Prerequisites: CAE 503, CAE 431. (4-0-4)

CAE 561
Structural Reliability and Probabilistic Bases of Design
Fundamentals of probability theory and stochastic processes; statistical analysis of engineering data; probabilistic modeling of structural loads and material properties. Reliability analysis and design of structure, reliability-based design criteria. Evaluation of existing design codes. Safety analysis of structures under fatigue loads. Fault and event tree analysis. Prerequisite: CAE 307 or instructor's consent. (3-0-3)

CAE 562
Engineering Behavior of Soils
Soil mineralogy and soil fabric, soil-water electrolyte system, dispersive clay, stress and strain analyses, elastic equilibrium in soil masses, plastic equilibrium in soil of masses, in situ and laboratory stress paths, shear strength of sands and clays, thermal properties of soils, critical state soil mechanics principles, nonlinear pseudoelastic and elastoplastic constitutive models. Corequisite: CAE 563. Prerequisite: CAE 323. (4-0-4)

CAE 563
Advanced Soil Mechanics Laboratory
Advanced aspects of soil property measurement with application to design and analysis, system characteristics on soil sediment, pinhole test for identifying dispersive clays, consolidation, triaxial compression and triaxial extension with porewater measurement, cyclic triaxial test, permeability with back pressure, determination of critical void ratio. Corequisite: CAE 562. Prerequisite: CAE 323. (1-3-1)

CAE 564
Design of Foundations, Embankments and Earth Structures
Consolidation phenomena, derivation of bearing capacity equations, beams and slabs on soils, piles and pile groups, compaction, earth pressure theories and pressure in embankment, slope stability analyses, retaining structures, embankment design, soil structure interaction during excavation, design of anchors for landslide stabilization and retaining structures and instrumentation. Prerequisites: CAE 323, CAE 457. (4-0-4)

CAE 565
Rock Mechanics and Tunneling
Rock classification for engineering purposes, mechanical behavior of rocks, in situ stresses in rock, stresses around underground openings, rock slope engineering, design of underground structures, design of deep support excavation and tunnels, primary and secondary linings of tunnels, mined shafts, instrumentation. Prerequisite: CAE 457. (4-0-4)

CAE 566
Earthquake Engineering and Soil Dynamics
Earthquakes and their intensity, influence of ground motion, review of 1-DOF and M-DOF systems, wave propagation theories, vibration due to blast and shock waves, design earthquake motion, dynamic properties of soils, soil liquefaction, bearing capacity during earthquakes and design of machine foundations, isolation of foundations, pile foundation, and dynamic analysis, earth pressure during earthquakes on retaining structures and embankment. Prerequisites: CAE 323, CAE 420. (4-0-4)

CAE 567
Physicochemical Behavior of Soils
The nature of soils. Weathering and soil formation processes. Soil mineralogy. Surface and colloidal chemistry. Structures of water near clay mineral surfaces. Electrolyte solutions. Theories of cation and anion exchange. Adsorption of inorganic chemicals in soils. Organic matter in soils. Adsorption of organic chemicals in soils. Methods to determine petroleum products in soils. Effect of contaminants on permeability of clays. Leachate-clay liner compatibility. Prerequisites: CAE 323, ENVE 501. (3-0-3)

CAE 568
Transportation Asset Management
Process and techniques for managing preservation and expansion of highway transportation facilities such as pavements, bridges, as well as system usage. Five component management systems are examined: pavements, bridges, roadway maintenance, safety and congestions. The methodology for overall transportation asset management is discussed. The primary emphasis is on data collection, life cycle cost analysis, priority setting and optimization, program development strategies, risk an uncertainty modeling and institutional issues. Prerequisite: CAE 419 or instructor's consent. (3-0-3)

CAE 569
**Advanced Heating, Ventilating,
and Air-Conditioning**
Engineering design and performance
analysis procedures for complex com-
mercial building systems, including
energy conservation techniques, and
a design project. This course will
include specific subjects such as
spray chambers, cooling towers,
Extended Surface Heat Exchangers
and also hybrid ventilation. A design
of a real commercial Heating,
Ventilating, and Air-Conditioning
Systems is a major part of this
course. Prerequisite: CAE 464 or
equivalent, CAE 309 or equivalent,
CAE 302 or equivalent (3-0-3)

CAE 570/CAE 770
Legal Issues in Civil Engineering
Basics of the legal system, including
contracts, torts, land zoning and
property ownership. Working
knowledge of the law to avoid and
mitigate potential legal problems
that frequently occur in construction.
Contractor liability. Mechanics
liens, litigation and arbitration.
International construction law,
hazardous waste issues and labor
law. Prerequisite: CAE 473. (3-0-3)

CAE 571
**Advanced Construction
Scheduling and Control**
Review of project management prin-
ciples and network methodologies.
Interfacing computerized cost esti-
mating with network scheduling.
Claims management with networks.
Evaluation and selection criteria for
commercially available project-man-
agement software. Linear scheduling
systems for projects with repetitive
characteristics. Acyclic network mod-
els. Introduction to expert systems in
construction scheduling and control.
Prerequisite: CAE 471. (3-0-3)

CAE 572
**Construction Cost
Accounting and Control**
Review of basic accounting prin-
ciples and techniques—purchasing,
accounts payable, invoicing, accounts
receivable, general ledger, payrolls
and indirect costs. Job costing and
budgeting. Recording and reporting
procedures in construction projects—
invoices, subcontractor applications

for payment, labor time cards, unit
completion reports, change orders.
Cost-coding systems for construction
activities. Variance reporting proce-
dures. Project closeout. Class
exercise using computer program.
Prerequisites: CAE 470, CAE 570.
(3-0-3)

CAE 573
**Computer Applications
in Construction**
Knowledge engineering, human
and automated knowledge acquisi-
tion and knowledge representation.
Inferencing mechanisms. Decision-
making under uncertainty.
Introduction to very high-level pro-
gramming languages (LISP and
Prolog). Review of commercially
available expert system shells and
development tools for artificial
neural network and case-based rea-
soning applications. Class exercise to
construct a system prototype for a
civil engineering problem.
Prerequisite: CAE 430. (3-0-3)

CAE 574
**Economic Decision Analysis
in Civil Engineering**
Basic economic concepts, including
interest calculations, computation
of alternatives, replacements,
depreciation and depletion, and tax
considerations. Evaluation of public
projects, the effect of inflation,
decision making under risk and/or
uncertainty, economic decision
models. Case studies from the civil
engineering industry. Prerequisite:
CAE 430 or MATH 475. (3-0-3)

CAE 575
**Systems Analysis
in Civil Engineering**
Management and system concepts,
linear and dynamic programming,
system modeling by activity
networks. Maximal-flow and short-
est-path analysis, flow graphs,
decision-tree analysis, stochastic-
network modeling, queuing analysis,
and analysis of inventory systems.
Case studies from the civil engineer-
ing industry. Prerequisites: CAE 430,
CAE 471. (3-0-3)

CAE 576
**Advanced Construction
Accounting and Finance**
Review of sole proprietorships, part-
nerships, corporations, limited
liability companies, federal regular
income tax and alternative minimum
tax, state income tax, inventories,
cash-flow statements, analysis of
financial statements. Percentage of
completion with look-back and com-
pleted contract methods of long-term
contract accounting, cost-allocation
and equipment-cost-recovery deduc-
tions, under federal regular income
tax, alternative minimum tax
and state income tax rules.
International construction issues,
including foreign taxes, currencies,
tax treaties, income exclusion.
Construction claims and effects on
accounting. Government construc-
tion. Introduction to financing,
privatization, nonlump-sum con-
tracts, joint ventures and audits,
in accounting and the construction
process. Prerequisite: CAE 572.
(3-0-3)

CAE 577
**Construction Equipment
Management**
Factors affecting the selection of con-
struction equipment. Descriptions,
operating methods, production rates,
unit costs related to excavating
equipment. Power shovels, draglines,
clam shells, and trenching machines.
Engineering fundamentals. Moving
construction equipment, including
trucks, wagons, scrapers, dozers,
soil-stabilization and compaction
equipment. Belt conveyors, com-
paction and drilling equipment, pile
driving equipment, pumps and
crushers. Prerequisite: CAE 472.
(3-0-3)

CAE 578
Construction Claims Management
Types of contract claims, delays,
acceleration, and scope issues.
Underlying legal theories of construc-
tion contracts and claims, defenses to
claims, prophylactic claims mea-
sures. The claims process within the
contract, extra-contractual basis for
claims. Resolution of cliams by ADR
techniques, the formal litigation
process. AIA, AGC, and federal
claims provisions. Other types of

Department of Civil and Architectural Engineering

claims associated with construction projects such as a surety bond claims and various insurance claims (CGL, Builder's Risk, workers comp, etc). Prerequisite: CAE 473. (3-0-3)

CAE 580
Intelligent Transportation Systems
A seminar course on intelligent transportation systems (ITS). the concept of ITS involves the use of rapidly emerging information and communication technologies in mitigating congestion and attendant problems. This course provides an introduction to varous aspects of ITS and focuses on ITS planning, technology, and evaluation. In addition, such topics as deployment, financing and management are also discussed. Prerequisites: CAE 419, CAE 545 or instructor's consent. (3-0-3)

CAE 581
Algorithms in Transportation
Modeling and analysis of transportation network problems through design, analysis and implementation of agorithms. Emphasis is on the use of quantitative techniques of operations reserach to model system performance. The course covers fundamental datea structures, complexity analysis, memory management, recursive programs, application of graph theory and network analysis to transportation problems, analytical formulations and solution algorithms for traffic assignment problems and dynamic traffic assignment. Prerequisites: CAE 312, CAE 575 or instructor's consent. (3-0-3)

CAE 582
Structural Wind and Earthquake Engineering
Introduction to nature of wind, aerodynamic wind-loading and design. Strong ground motion phenomenon. Investigation of the response of structures to dynamic and pseudodynamic wind, earthquake, shock waves and other deterministic and probabilistic loadings. Design criteria for buildings and nuclear power stations, special topics in lifeline earthquake engineering. Prerequisite: CAE 420, MMAE 406, or instructor's consent. (4-0-4)

CAE 586
Seismic Design of Building and Bridge Structures
Several specific topics on seismic design of steel and reinforced concrete building and bridge structures are covered. In addition, fundamentals and experiences in seismic design are presented through design examples. Specific emphasis is placed on using various design codes relevant to design of buildings and bridges. Prerequisites: CAE 431 and CAE 432 or Instructor's consent. (3-0-3)

CAE 583
Special Topics on Earthquake and Wind Engineering
This course covers special topics on earthquake and wind design for buildings and bridges. The course covers eight topics. These topics are independent of each other and cover a variety of engineering applications in earthquake and wind enineering. Prerequisite: instructor's consent (2-0-2)

CAE 587
Numerical Methods in Geotechnical Engineering
Constitutive laws of granular and cohesive material, introduction to coupling of water and soil phase in solution, application to problems of consolidation procedures with finite element method. Prerequisites: CAE 562, CAE 442. (3-0-3)

CAE 588
Theory of Plasticity
Plastic strain, yield criteria, ideal plasticity, hardening and softening, flow theories, Levy-Mises and Prandtl-Reuss relations, Hencky's theory, Drucker's criterion. Modern theories of noncoaxiality. Applications to structures and soils. Same as MMAE 529. Prerequisite: MMAE 530. (4-0-4)

CAE 589
Groundwater Hydrology and Sampling
Groundwater geology and flow, aquifer and aquitar response of ideal aquifer to pumping. Chemical properties and principles, including source of contamination and estimation of saturated

hydraulic conductivity. Principles of exploration and sampling, methods of subsurface explorations, groundwater observation techniques. Prerequisites: CAE 323 and CAE 301 or ENVE 401. (3-0-3)

CAE 590
Geotechnical Landfill Design and Maintenance
Regulatory and legal issues, site selection and assessment, geotechnical-subsurface investigation, clay mineralogy and clay-water-electrolyte system, linear and leachate-control-systems design, stability of landfill slopes, cover design, construction and operation, final use and remediation design. Prerequisite: CAE 323. (3-0-3)

CAE 591
Research and Thesis for M.S. Degree

CAE 593
Civil Engineering Seminar
Reports on current research. Graduate students are expected to register and attend. (1-0-0)

CAE 597
Special Problems
Subject matter will vary with the interests and background of students and instructor. Design or research problems may be assigned from the areas of construction, geotechnical, geoenvironmental, structural or transportation engineering. Prerequisite: Graduate coursework in the problem subject matter. (Credit: Variable)

CAE 599
Graduate Workshop
(0-0-0)

CAE 691
Research and Thesis for Ph.D. Degree
(Credit: Variable)

Department of Computer Science

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info@cs.iit.edu

Chair:
Edward M. Reingold

The study of computer science is the inquiry into the nature of computation and its use in solving problems in an information-based society. Computer science is an evolving discipline, but it has a well-defined core of knowledge and a set of characteristic methodologies. The methods and skills required of the computer scientist include formalization and abstraction, algorithm design, programming, organization of unstructured knowledge, modeling, language development, and software system architecture and design. The graduate program in computer science at IIT stresses high achievement in both fundamental knowledge and practical problem solving. It offers the student a solid background in the core areas and exposure to cutting-edge computer technologies.

Degrees Offered

Master of Computer Science (MAS)
Master of Computer Science with specialization in
    Computer Networking and Telecommunications
    Information Systems
    Software Engineering

Master of Science in Computer Science
Master of Science for Teachers
Doctor of Philosophy in Computer Science

Joint- and Dual-Degree Programs

**With the Department of Electrical
and Computer Engineering:**
Master of Telecommunications and Software Engineering

**With the Department of Chemical
and Environmental Engineering:**
Master of Science in Computer Science/
    Master of Chemical Engineering

Certificate Programs

Computer Networking and Telecommunications
Information Systems

Software Engineering

Research Facilities

The department has research computing facilities that include Sun SPARC and Silicon Graphics UNIX work-stations, and Windows-based PCs. The department also has facilities for research in parallel computing. The equipment includes a large scale "ComputeFarm" consisting of 72 Sun Blade UltraSparc-ii workstations and a 4 CPU Sun Enterprise 450 server connected via high-performance network switches. An advanced technology Access Grid node has been installed by the department, which allows researchers, teachers and students at different locations worldwide to interact via a network multimedia environment.

Research Areas

Algorithms, data structures, artificial intelligence, computer architecture, computer graphics, computer networking and telecommunications, computer vision, database systems, distributed and parallel computing, image processing, information retrieval, natural language processing, and software engineering.

Department of Computer Science

Faculty

Gady Agam, Assistant Professor. B.Sc., M.Sc., Ph.D., Ben-Gurion University. Computer vision, computer graphics, image processing, pattern recognition, image-based rendering, non-linear signal processing, mathematical morphology.

Shlomo Argamon, Associate Professor. B.S. Carnegie-Mellon University, M.Phil, Ph.D. Yale University. Machine Learning, computational linguistics, stylistics, information retrieval.

Charles Bauer, Professor Emeritus. B.S., M.Ed., Loyola University. Computer Education, computers used in education, distance learning, computer-based educational technology, computer learning, teacher training.

Ilene Burnstein, Research Associate Professor. B.S., Brooklyn College; M.S., University of Maryland; Ph.D., Illinois Institute of Technology. Software engineering, knowledge-based testing and debugging tools, test process assessment and improvement models, capability maturity models.

Gruia Calinescu, Assistant Professor. Diploma, University of Bucharest (Romania); Ph.D., Georgia Institute of Technology. Algorithms, approximation algorithms, optical and wireless, ad-hoc networks.

C. Robert Carlson, Professor, Director of Center for Professional Development. B.A., Augustana College; M.S., Ph.D., University of Iowa. Information architecture, object-oriented modeling and design, software maturity models.

Edward Chlebus, Industry Associate Professor., Ph.D., Cracow University, Network modeling, performance evaluation and tele-traffic analysis.

Tzilla Elrad, Research Associate Professor. B.S., Hebrew University (Israel); M.S., Syracuse University; Ph.D., Technion Israel Institute of Technology (Israel). Concurrent programming, formal verification, embedded real-time systems and ADA standards.

Martha Evens, Research Professor. A.B., Bryn Mawr College; A.M., Radcliffe College; Ph.D., Northwestern University. Natural language processing, expert systems and intelligent tutoring/information systems.

Ophir Frieder, IITRI Chair Professor. Ph.D., University of Michigan. Parallel and distributed information retrieval systems, communication systems, high performance database systems, biological and medical data processing architectures.

Nazli Goharian, Clinical Assistant Professor, Ph.D., Florida Tech, Information retrieval, medical informatics and data warehousing.

Peter Greene, Research Professor. A.B., Amherst College; Ph.D., University of Chicago. Neural networks, feeling-based reasoning, artificial intelligence and robotics.

David Grossman, Associate Professor. B.S., Clemson University; M.S., American University; Ph.D., George Mason University. Information retrieval, data mining, integration of structured data and text.

Cynthia Hood, Associate Professor. B.S., Rensselaer Polytechnic Institute; M.E., Stevens Institute of Technology; Ph.D., Rensselaer Polytechnic Institute. Network management, statistical signal processing, learning processing.

Sanjiv Kapoor, Professor. B.Tech., Indian Institute of Technology, Delhi (India); Ph.D., University of Illinois, Urbana-Champaign. Computational geometry, graph algorithms, combinatorial optimization, graphics, data structures.

Bogdan Korel, Associate Professor. M.S., Technical University of Kiev (Ukraine); Ph.D., Oakland University. Software engineering, automated software testing and analysis.

Zhiling Lan, Assistant Professor, B.S. Beijing Normal University, M.S. Chinese Academy of Sciences, Ph.D., Northwestern University. Parallel and distributed computing, performance analysis and modeling.

Xiang-Yang Li, Assistant Professor. B.S., B.M., Tsinghua University, Beijing (China); M.S., Ph.D., University of Illinois, Urbana-Champaign. Computational geometry, mesh generation, wireless ad hoc networks, cryptography, computer graphics.

Edward M. Reingold, Professor. B.S., Illinois Institute of Technology; M.S., Ph.D., Cornell University. Analysis of algorithms, data structures, combinatorial algorithms, mathematics, history, and computer implementation of calendars.

Shangping Ren, Assistant Professor. Ph.D., University of Illinois, Urbana-Champaign. Domain specific computing (including distributed computing, real-time computing, and mobile computing), and domain specific programming abstractions (such as language abstractions for real-time systems, for context-aware adaptive mobile systems, and for coordination among distributed asynchronous entities).

Xian-He Sun, Professor. Ph.D., Michigan State University. Distributed and parallel system, network software environment, scientific computing performance evaluation.

Peng-Jun Wan, Associate Professor. B.S., Tsinghua University (China); M.S., Institute of Applied Mathematics, Chinese Academy of Sciences (China); Ph.D., University of Minnesota. Interconnection design, routing and resource management in optical networks, low-earth orbit satellite networks, wireless local area networks.

Wai Gen Yee, Assistant Professor, B.S. University of Chicago, M.S., Ph.D. Georgia Institute of Technology. Database systems, mobile and distributed computing.

Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0
Cumulative Master of Science GPA minimum (for Ph.D. applicants): 3.5/4.0
GRE minimum combined (quantitative/verbal/analytical) score for tests taken prior to Oct.1, 2002:
M.S.: 1400
MAS : 1200
Ph.D.: 1600, with a minimum in the 70th percentile of the quantitative section
GRE minimum score for tests taken on or after Oct.1, 2002:
M.S.: 1000 (quantitative + verbal) 3.0 analytical writing
MAS: 900 (quantitative + verbal) 2.5 analytical writing
Ph.D.: 1100 (quantitative + verbal) 3.5 analytical writing, with a minimum in the 70th percentile of the quantitative section
TOEFL score (international students from non-English speaking countries): 550/213*

Meeting the minimum GPA and test score requirements does not guarantee admission. Test scores and GPA are just two of several important factors considered. Applicants to master's degree programs in computer science should hold a bachelor's degree in computer science with a minimum overall GPA of 3.0/4.0 or its equivalent. For international students from non-English speaking countries, a minimum TOEFL score of 550/213 is required. All applicants must submit scores from the GRE general test. (The GRE requirement is waived for applicants to the Master of Computer Science program who hold bachelor's degrees from accredited U.S. institutions with a minimum cumulative GPA of 3.0/4.0.) Applicants with bachelor's degrees in other disciplines

can be admitted to Master of Science or Master of Computer Science programs. However, students whose training does not include the equivalent of CS 201 (Accelerated Introduction to Computer Science), CS 330 (Discrete Structures), CS 331 (Data Structures and Algorithms), CS 350 (Computer Organization and Assembly Language Programming) and CS 351 (Systems Programming) will be required to complete all of the courses in which a deficiency exists. Some students may be able to complete their deficiencies with the following six-credit hour sequence with a grade of "B" or better:

CS 401 Introduction to Advanced Studies I
CS 402 Introduction to Advanced Studies II

In addition, students who have not had at least one course in calculus will be required to take a calculus course.

Applicants to the Ph.D. program should hold an M.S. degree in computer science with a minimum GPA of 3.0/4.0 for their bachelor's degree and 3.5/4.0 for their M.S. degree, or a minimum GPA of 3.5/4.0 for their bachelor's degree if they apply without a M.S. degree. For non-English speaking applicants without a U.S. degree, a minimum TOEFL score of 550/213 is required.

* Paper-based test score/computer-based test score.

Master of Computer Science

30 credits.

This Professional Master's degree program consists of 30 credit hours of coursework in computer science. This program is designed for those without a prior degree in computer science, or those who are primarily interested in a (non-thesis) program preparing them for careers as working computer science professionals in business and industry. A full-time student enrolled in the program should be able to complete the requirements in 1 to 1.5 years. Specializations in business, software engineering, networking and telecommunications and information systems are available. Admission requirements include:

Four-year bachelor's degree from an accredited university with a minimum cumulative GPA of at least 3.0/4.0. Combined verbal and quantitative GRE examination score of at least 900 and an analytic writing score of at least 2.5, for the post-October 2002 test. The GRE requirement is waived for students with a bachelor's

degree from an accredited college or university in the United States with a cumulative GPA of at least 3.0/4.0.

Prerequisites include knowledge of a high level programming language at the level of CS 201 (Java or C/C++ programming is required). Students with insufficient background in computer science will be required to take CS 401 and CS 402 (Introduction to Advanced Studies I and II) and to earn at least a "B" in these courses. These prerequisite courses do not count toward the 30 credit-hour requirement.

A maximum of 12 credit hours of 400-level courses and a maximum of 6 credit hours of accelerated courses are allowed as part of the 30 credit hours requirement. Twenty hours of coursework must be in CS or CSP (CS Professional) courses at the 500 level.

Students are required to take one course in each of the three core areas (Programming, Systems and Theory).

Department of Computer Science

Master of Computer Science continued

Programming core courses

CS 522	Data Mining
CS 525	Advanced Database Organization
CS 529	Information Retrieval
CS 540	Syntactic Analysis of Programming Languages
CS 546	Parallel Processing
CS 551	Operating System Design and Implementation

Systems core courses

CS 542	Computer Networks I: Fundamentals
CS 544	Computer Networks II: Network Services
CS 547	Wireless Networking
CS 550	Advanced Operating Systems

CS 555	Analytic Models and Simulation of Computer Systems
CS 570	Advanced Computer Architecture
CS 586	Software Systems Architecture

Theory core courses

CS 530	Theory of Computation
CS 532	Formal Languages
CS 533	Computational Geometry
CS 535	Design and Analysis of Algorithms
CS 536	Science of Programming
CS 538	Combinatorial Organization

Master of Computer Science with specialization in Business

33.6 credit hours

This program is designed to help computer science professionals extend and deepen their technical and practical knowledge of the field while introducing themselves to core topics in modern business practices. To complete the program students must satisfy Master of Computer Science requirements and also take four specialization courses from the Stuart School of Business:

MBA 510:	Financial and Managerial Accounting
MBA 520:	Organizational Behavior
MBA 530:	Managerial Economics

One other advisor-approved 500-level course offered by the Stuart School of Business for their MBA program (MBA, ACCT, EBUS, ECON, etc).
Notes: Each business course counts as 3.6 quarter credit hours = 2.4 semester credit hours. A student can take no more than two MBA courses per quarter. With advisor approval, students who have already taken MBA 510, 520, or 530 or their equivalents can substitute other courses. Applicants to the program are not required to take the GMAT.

Master of Computer Science with specialization in Computer Networking and telecommunications

30 credit hours

This program is designed to provide an in-depth knowledge of the theories and practices in computer networking and telecommunications. Students must satisfy Master of Computer Science requirements and are also required to select four specialization courses. Note that CS 542, CS 544, and CS 547 also count as Systems core courses.

Specialization courses

CS 542	Computer Networks I: Fundamentals
CS 544	Computer Networks II: Network Services
CS 547	Wireless Networking
CS 548	Broadband Networks
CS 555	Analytic Models and Simulation of Computers Systems
CS 549	Cryptography and Network Security

Master of Computer Science with specialization in Information Systems

30 credit hours

This program is designed to provide in-depth knowledge of the principles of design and development of information systems. Students must satisfy Master of Computer Science requirements and are also required to select four specialization courses. Note that CS 522, CS 525, and CS 529 also count as Programming core courses

Specialization courses

CS 521	Object-Oriented Analysis and Design
CS 522	Data Mining
CS 525	Advanced Database Organization
CS 529	Information Retrieval
CS 545	Distributed Computing Landscape

Department of Computer Science

Master of Computer Science with specialization in Software Engineering

30 credit hours

This program is designed to provide an in-depth knowledge of theory and practices in software engineering, including hands-on experience in software design, development and maintenance. Students must satisfy Master of Computer Science requirements and are also required to select four specialization courses here. Note that CS 536 and CS 586 also count as Theory and Systems core courses respectively.

Core courses

CS 536	Science of Programming
CS 537	Software Metrics
CS 586	Software System Architectures
CS 587	Software Project Management
CS 588	Advanced Software Engineering Development
CS 589	Software Testing and Analysis

Master of Science in Computer Science

32 credit hours

The purpose of this program is to prepare students for the Ph.D. program and/or a research/development career in the industry in the field of computer science. Students have the option to pursue thesis research or project under the guidance of a faculty adviser.

Program Requirements

All programs require a core curriculum of 12 credit hours and 20 credit hours of elective courses, which may include a thesis or project. The student, with a faculty adviser, develops a program of study that specifies the supportive and elective program and describes the thesis or project, if included in the program. The program of study must consist of at least 32 credit hours, at least 20 of which must be 500-level computer science courses. Up to six credits of accelerated courses may be applied to the degree. (Students should see the definition of "accelerated courses" on page 41.)

A student may choose from three options to complete the degree:

Option 1: Master's thesis: Coursework and up to five hours of CS 591 for a total of 32 hours. The result is a master's thesis.

Option 2: Master's project: coursework and up to five hours of CS 597 for a total of 32 hours. The result is a project that results in one of the following:

1. A high-quality paper submitted for publication as an article or as a technical report.

2. A high-quality piece of software. The software should be of distribution quality, but can be proprietary.

Option 3: 32 credit hours of coursework. A student must complete 32 hours of regular coursework including electives and core courses with a GPA of 3.0/4.0 or better.

Students are required to take courses in three core areas: Programming, Systems and Theory. The student is required to take one course in the programming area, one course in the systems area, and two courses in the theory area. The list below contains the core course offerings in the M.S. program:

Programming core courses

CS 522	Data Mining
CS 525	Advanced Database Organization
CS 529	Information Retrieval
CS 540	Syntactic Analysis of Programming Languages
CS 546	Parallel Processing
CS 551	Operating System Design and Implementation

Systems core courses

CS 542	Computer Networks I: Fundamentals
CS 544	Computer Networks II: Network Services
CS 547	Wireless Networks
CS 550	Advanced Operating Systems
CS 555	Analytic Models and Simulation of Computer Systems
CS 570	Advanced Computer Architecture
CS 586	Software Systems Architectures

Theory core courses

CS 530	Theory of Computation
CS 532	Formal Languages
CS 533	Computational Geometry
CS 535	Design and Analysis of Algorithms
CS 536	Science of Programming
CS 538	Combinatorial Optimization

Department of Computer Science

Master of Science for Teachers (M.S.T.)

32 credit hours
Comprehensive exam (project)

The M.S.T. is designed for experienced teachers or training officers to strengthen their academic background in a rapidly changing discipline. The program, though flexible enough to meet a variety of needs, also requires substantive coursework in the core of computer science. The student, with a faculty adviser, develops a program of study, describes the project, and specifies an elective program, which must be approved by the faculty of the department.

The program of study consists of 32 credit hours, at least 20 hours of which must be 500-level courses. It also includes an M.S.T. project that deals with some aspect of computer science or with computer science applied to some other academic discipline. To be awarded the M.S.T.

degree, the student must satisfactorily complete the program of study and pass a project defense examination, which consists of an oral defense of the project. Of the 32 credit hours, 12 credit hours must be from the courses listed below:

CS 485	Computers in Society
CS 560	Computer Science in the Classroom
CS 561	The Computer and Curriculum Content
CS 565	Computer-Assisted Instruction
CS 566	Practicum in the Application of Computers to Education

Master of Telecommunications and Software Engineering (M.T.S.E.)

30 credit hours

The Master of Telecommunications and Software Engineering (M.T.S.E.) is a course-only degree program that prepares students for professional practice in

telecommunications and information technologies. The program, jointly offered by the electrical and computer engineering (ECE) and computer science (CS) departments, can be completed in one year of full-time study.

Admission Requirements

A person holding a B.S.E.E., B.S.C.P.E. or B.S.C.S. degree has the necessary broad background to undertake the M.T.S.E. program. A student without adequate background in specific areas is required to demonstrate proficiency in prerequisite courses; an abbreviated list is given below.

Specific proficiency courses will be detailed for each student at the time of admission to the M.T.S.E. program. Proficiency in a course may be demonstrated by completing the course with a grade of "A" or "B," or by achieving a grade of "A" or "B" in a proficiency examination administered by the ECE or the CS department. Students should contact the departmental adviser for more details on prerequisites and proficiency requirements.

Students interested in the M.T.S.E. degree whose B.S. degree is not in electrical engineering, computer engineering, or computer science should contact the departmental advisor before applying.

Computer Science Prerequisites
CS 201	Accelerated Introduction to Computer Science
CS 401	Introduction to Advanced Studies

Electrical and Computer Engineering Prerequisites
ECE 211	Circuit Analysis I
ECE 213	Circuit Analysis II
ECE 308	Signals and Systems
MATH 252	Introduction of Differential Equations

Department of Computer Science

Program Requirements

The M.T.S.E. is a professional master's degree requiring a minimum of 30 credit hours of adviser-approved course-work. The M.T.S.E program of studies must include a minimum of 12 credit hours of ECE coursework and a minimum of 12 credit hours of CS coursework. Four required courses and one elective course from each of the three categories given below must appear on the M.T.S.E. program of studies.

Required courses

CS 586	Software Systems Architecture	
CS 587	Software Project Management	
ECE 513	Communication Engineering Fundamentals	
ECE 541	Performance Evaluation of Computers and Communications Networks	

Elective categories

I. Software Engineering

CS 521	Object-Oriented Information Systems
CS 537	Software Metrics
CS 589	Software Testing and Analysis

II. Telecommunication Systems

CS 544	Computer Networks II: Network Services
CS 548	Broadband Networks
CS 555	Analytic Models and Simulation of Computer Systems
ECE 545	Computer and Communication Networks

III. Telecommunications

ECE 504	Communications Systems Design
ECE 515	Modern Digital Communications
ECE 519	Coding for Reliable Communications

The remaining nine credits of coursework may be taken from courses listed above, or other courses approved by the M.T.S.E. adviser. Students with no background in communications or software engineering should consider including in their programs of study:

CS 487	Software Engineering
CS 450	Operating Systems
ECE 403	Communication Systems I
ECE 407	Computer Communications Systems

Other courses that students in this program typically choose from include:

ECE 437	Digital Signal Processing I
ECE 511	Analysis of Random Signals
ECE 514	Digital Communication Principles
CS 542	Computer Networks I: Fundamentals
CS 588	Advanced Software Engineering Development

With advisor approval, the M.T.S.E. program can include up to two credit hours of Master's Seminar (ECE 595, ECE 596). It can also include up to four credits of accelerated courses.

Master of Science in Computer Science/Master of Chemical Engineering

44 credit hours

This combined program in computer science and chemical engineering addresses the growing need for process engineers with expertise in computational modeling and simulation of chemical processes. Similarly, the program provides strong engineering background that is required today in many areas of computer science. The program is jointly offered by the Department of Computer Science and the Department of Chemical and Environmental Engineering. Students in this program earn both Master of Science in Computer Science and Master of Chemical Engineering degrees.

Students must fulfill the core course requirements of both departments. Students are required to take 18 credit hours in graduate chemical engineering courses (courses numbered 500 or higher) and 26 credit hours in computer science courses (of which 20 credit hours must be 500-level courses). The 18 credit hours in chemical engineering courses consist of 12 credits in core courses listed in the description of the Master of Chemical Engineering requirements and six credit hours from the following courses:

CHE 507 Computer-Aided Design
CHE 508 Process Design Optimization
CHE 528 Analysis and Simulation of Chemical Processing
CHE 532 Process Modeling
CHE 533 Statistical Analysis of Process Data
CHE 536 Computational Techniques in Engineering
CHE 560 Statistical Quality and Process Control

Department of Computer Science

Doctor of Philosophy

85 credit hours if without MS degree; 54 credit hours if with MS degree.
Qualifying exam
Comprehensive exam
Dissertation and oral defense

The Ph.D. is awarded in recognition of a significant original contribution to one of the fields of computer science and a high level of mastery in several fields of computer science and a significant original contribution to one of those fields. Students work with faculty members to develop programs to match individual interests. The goal is to develop computer scientists who can take complex, undefined problems and restructure and resolve them through imaginative application of their knowledge. Graduates typically go on to teaching and/or research positions in industry and universities. The degree normally requires three to four years beyond the master's degree for full-time students. Part-time students can also enter the program but will need more time to complete the degree. Generally, students can enter the program with either a BS degree or an MS degree in related fields. The requirements of the Ph.D. program are described separately as follows.

Requirements for students entering with B.S. Degree

85 credit hours
Qualifying exam
Comprehensive exam
Dissertation and oral defense

The Ph.D. (post B.S.) program (called the direct Ph.D. program) encourages bright and highly motivated students to participate in research program immediately after the B.S. degree.

Admission Requirements

The applicants should have at least a four-year B.S degree in computer science. Admission to the program is competitive and depends on a student's GRE score and it is expected that applicants will have a high grade-point average. For non-English speaking applicants without a U.S. degree, a minimum TOEFL score of 550 is required. If the TOEFL score is less than 600, the applicant is required to take the English Proficiency Exam administered by the IIT Humanities Department. Applicants must submit three letters of recommendation.

Program Requirements

The program requires students to complete at least 85 and at most 128 advisor-approved semester credit hours of study. This must include

0-12 credits of 400-level courses

36-54 credits of 500- and 600- level courses. Among them, at most 6 credits come from outside the Computer Science Department of IIT. Credits from CS 595 are allowed.

6-12 credits of CS 597 (Reading and Special Problems)

24-48 credits of CS 691 (Research/Thesis for Ph.D. degree). Note CS 691 can only be taken after passing the Ph.D. qualifying exam.

1 credit of Ph.D. seminar

Notice that no credits will be given to accelerated courses (700-level courses). No credits are given to courses in which the student earns a grade of C or below. The student may have to take some other courses as required by the advisor. The credit hours of 500-level coursework must include five core courses with at least one each from Groups I, II, and III described below and at least one course from each of two different groups from among Groups IV, V, and VI. Advanced courses may be substituted after approval of the department. The groups of core courses are:

Group I: Theory of Computation
CS 530	Theory of Computation
CS 533	Computational Geometry
CS 535	Design and Analysis of Algorithms
CS 538	Combinatorial Optimization

Group II: Systems
CS 546	Parallel Processing
CS 550	Advanced Operating Systems
CS 570	Advanced Computer Architecture

Group III: Programming Languages
CS 536	Science of Programming
CS 541	Topics in Compiler Construction
CS 545	Distributed Computing Landscape

Group IV: Networks

CS 542   Computer Networks I: Fundamentals
CS 544   Computer Networks II: Network Services

Group V: Databases

CS 525   Advanced Database Organization

Group VI: Software Engineering

CS 586   Software Systems Architectures

M.S. Exit from Program

Students wishing to leave the direct Ph.D. program with the degree of Master of Science in Computer Science must satisfy all the requirements of the Master's degree and either write an M.S. thesis or pass the Ph.D. qualifying examination.

Ph.D. Qualifying Examination

The Ph.D. Qualifying Exam has two parts: a written examination and an oral examination. The written examination is used to judge a student's breadth of knowledge; the oral examination is used to judge a student's research potential. The first attempt in oral examination and the written examination must be taken no later than a student's 5th semester. The second attempt must be taken no later than a student's 6th semester. These requirements hold for both full-time and part-time students

The written examination is divided into three, independent "area" examinations. To pass the written examination, a student must pass all the area examinations. Extra coursework cannot be used in lieu of passing an area examination. Area examinations can be taken in the same or different semesters. A student who fails an area examination can retake the area examination, but

only once. See the computer science webpage for more detail of qualifying examinations.

Comprehensive (Research Proposal) Examination

The purpose of the Comprehensive Examination is to ensure that the candidate has the background to carry out successful research in the chosen area and that the research problem is properly formulated and has sufficient scholarly merit. The student (in concert with the student's research advisor) must develop a written research proposal containing a literature review, a proposed research topic, and a program of research based upon this topic, and then present the proposal orally as well.

The student must request appointment of an examination committee using Form #301. The examination committee may consist of from four to seven members. It must include at least three full-time faculty members from the Computer Science Department and one full-time faculty member from another department in the university. Other committee members from inside or outside the university may be chosen. The student should consult with his/her research advisor concerning the makeup of the committee.

Thesis Defense

Each student must present an oral defense of his/her Ph.D. Thesis. The Thesis Review Committee is appointed in much the same way as the Ph.D. Comprehensive Examination Committee. It will examine the written thesis and examine the student during the oral defense. All Ph.D. Thesis Defenses are open to the public.

Requirements for students entering with an M.S. Degree

54 credit hours
Qualifying exam
Comprehensive exam
Dissertation and oral defense

Admission Requirements

The applicants should have an M.S degree in computer science or related fields. Admission to the program is competitive and depends on a student's GRE score and it is expected that applicants will have a high grade-point average. For non-English speaking applicants without a U.S. degree, a minimum TOEFL score of 550 is required.

If the TOEFL score is less than 600, the applicant is required to take the English Proficiency Examination administered by the IIT Humanities Department. Applicants must submit three letters of recommendation.

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Program Requirements

If the student has an M.S. degree in computer science, the program requires the student to complete at least 54 adviser-approved semester credit hours of study. This must include

0-12 credits of 400-level courses

18-30 credits of 500- and 600-level courses. Amongst them, at most 6 credits come from outside the computer science department. Credits from CS 595 are allowed.

3-12 credits of CS 597 (Reading and Special Problems)

24-48 credits of CS 691 (Research/Thesis for Ph.D. degree). Note CS 691 can only be taken after passing the Ph.D. qualifying exam.

1 credit of Ph.D. seminar

Notice that no credits will be given to accelerated courses (700-level courses). No credits are given to courses in which the student earns a grade of C or below. The student may have to take some other courses as required by the adviser. The credit hours of 500-level coursework must include three core courses with at least one each from Groups I, II, and III described before. Advanced courses may be substituted after approval of the department.

If the student has an M.S. degree in a field other than computer science, the program requires the student to complete at least 60 advisor-approved semester credit hours of study. This must include

0-12 credits of 400-level courses

24-30 credits of 500- and 600-level courses. Among them, at most 6 credits may come from outside the computer science department. Credits from CS595 are allowed.

3-12 credits of CS 597 (Reading and Special Problems)

24-48 credits of CS 691 (Research/Thesis for the Ph.D. degree). Note CS 691 can only be taken after passing the Ph.D. qualifying exam.

1 credit for CS 695 (the Ph.D. seminar)

Notice that no credits will be given to accelerated courses (700-level courses). No credits are given to courses in which the student earns a grade of C or below. The student may have to take some other courses as required by the adviser. The credit hours of 500-level coursework

must include five core courses with at least one each from Groups I, II, and III described before and at least two courses from two different groups from among Groups IV, V, and VI. Advanced courses may be substituted after approval of the department.

Ph.D. Qualifying Examination
The Ph.D. Qualifying Examination has two parts: a written examination and an oral examination. The written exam is used to judge a student's breadth of knowledge; the oral exam is used to judge a student's research potential. The first attempt at the oral examination and the written examination must be made no later than a student's 3rd semester. The second attempt must be made no later than a student's 4th semester. These requirements hold for both full-time and part-time students.

The written examination is divided into three, independent "area" examinations. To pass the written examination, a student must pass all the area examinations. Extra coursework cannot be used in lieu of passing an area examination. Area examinations can be taken in the same or different semesters. A student who fails an area examination can retake the area examination, but only once. See the computer science web page for more details about the qualifying examinations.

Comprehensive (Research Proposal) Examination
The purpose of the Comprehensive Examination is to ensure that the candidate has the background to carry out successful research in the chosen area and that the research problem is properly formulated and has sufficient scholarly merit. The student (in concert with the student's research adviser) must develop a written research proposal containing a literature review, a proposed research topic, and a program of research based upon this topic, and then present it orally as well.

The student must request appointment of an examination committee on Form #301. The examination committee may consist of from four to seven members. It must include at least three full-time faculty members from the Computer Science Department and one full-time faculty member from another department in the university. Other committee members from inside or outside the university may be chosen. The student should consult with his/her research adviser concerning the makeup of the committee

Thesis Defense
Each student must present an oral defense of his/her Ph.D. Thesis. The Thesis Review Committee is appointed in much the same way as the Ph.D. Comprehensive Examination Committee. It will examine the written thesis and examine the student during the oral defense. All Ph.D. Thesis Defenses are open to the public.

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Certificate Programs

Certificate programs offer working professionals an opportunity to increase their knowledge and skills in the specific areas of computer science. A certificate representing proven academic performance is presented after the required coursework is completed with a GPA of 3.0/4.0. Courses taken may be later applied toward an M.S.

degree program. Applicants should have a bachelor's degree from an accredited college or university. The degree need not be in computer science.

Computer Networking and Telecommunications

Students should select nine credits from the following:

CS 455	Data Communications
CS 542	Computer Networks I: Fundamentals
CS 544	Computer Networks II: Network Services
CS 548	Broadband Networks

Information Systems

The student in this program must complete nine hours of coursework from the following:

CS 425	Database Organization
CS 521	Object-Oriented Analysis and Design
CS 525	Advanced Database Organization

Software Engineering

The student in this program must complete nine hours of coursework from the following list:

CS 445	Object-Oriented Design and Programming
CS 487	Software Engineering
CS 537	Software Metrics
CS 586	Software Systems Architecture
CS 587	Software Project Management
CS 588	Advanced Software Engineering Development
CS 589	Software Testing and Analysis
CS 750	Computer-Aided Software Engineering
CS 763	Automated Software Testing

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Accelerated Courses

The department offers accelerated courses for credit in several areas of computer science. These courses go beyond traditional core topics and are designed for working professionals who are interested in keeping abreast of rapidly changing technologies. Accelerated courses provide an opportunity for degree-seeking students at IIT to complete M.S. degree requirements in a shorter time period. If taken by non-degree students, these courses can be applied towards requirements for an M.S. degree at IIT.

Course Descriptions

Numbers in parentheses indicate class, lab and credit hours, respectively.

CS 511
Topics in Computer Graphics
Covers advanced topics in computer graphics. The exact course contents may change based on recent advances in the area and the instructor teaching it. Possible topics include: Geometric modeling, Subdivision surfaces, Procedural modeling, Warping and morphing, Model reconstruction, Image based rendering, Lighting and appearance, Texturing, Natural phenomena, Non-photorealistic rendering Particle systems, Character animation, Physically based modeling and animation. Prerequisite: CS 411. (3-0-3)

CS 512
Computer Vision
Introduction to fundamental topics in computer vision and the application of statistical estimation techniques to this area. Intended to give the student a good basis for work in this important field. Topics include: Feature extraction, Probabilistic modeling, Camera calibration, Epipolar geometry, Statistical estimation, Model reconstruction, Statistical filtering, Motion estimation, Recognition, Shape from single image cues. Prerequisite: CS 430. (3-0-3)

CS 520
Database Design and Engineering
Overview of database architectures, including the Relational, Hierarchical, Network and Object Models. Database normalization and design. Implementation issues for database management systems, including the processing and parsing of SQL queries, query optimization, integrity, and concurrency control. Distributed and parallel databases and data warehouse issues are addressed. Solid programming skills are required. Implementation of a database management engine prototype is required. No credit is given for both this course and CS 425. Prerequisite: CS 351 or CS 402 and CS 430. (3-0-3)

CS 521
Object-Oriented Analysis and Design
This course describes a methodology that covers a wide range of techniques used in system analysis, modeling and design. These techniques integrate well with software process management techniques and provide a framework for software engineers to collaborate in the design and development process. The methodology features the integration of concepts, including software reusability, frameworks, design patterns, software architecture, software component design, use-case analysis, event-flow analysis, event-message analysis, behavioral-life cycle analysis, feature, multiple-product, risk and rule analysis, and automatic code generation. Prerequisite: CS 425. (3-0-3)

CS 522
Data Mining
Continued exploration of data mining algorithms. More sophisticated algorithms such as support vector machines will be studied in detail. Students will continuously study new contributions to the field. A large project will be required that encourages students to push the limits of existing data mining techniques. Prerequisite: CS 422. (3-0-3)

CS 525
Advanced Database Organization
Comprehensive coverage of the problems involved in database system implementation and an in-depth examination of contemporary structures and techniques used in modern database management systems. Teaches advanced skills appropriate for DBMS architects and developers, database specialists, and the designers and developers of client/server and distributed systems. Focus is on transaction management, database structures and distributed processing. Prerequisite: CS 425. (3-0-3)

CS 529
Information Retrieval
Continued exploration of information retrieval algorithms. Topics will include: Text classification, meta-search, mediators, semi-structured information retrieval, name search, etc. Students will continuously study new contributions to the field. A large project will be required that encourages students to push the limits of existing information retrieval. Prerequisites: CS 429. (3-0-3)

CS 530
Theory of Computation
Computability topics such as Turing machines, nondeterministic machines, undecidability results, and reducibility. Computational Complexity topics such as time complexity, NP-Completeness and intractability, time and space hierarchy theorems. Introduces the complexity classes P, NP, NL, L, PSPACE, NC, RNC, BPP and their complete problems. Prerequisites: CS 430. (3-0-3)

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CS 531
Topics in Automata Theory

Topics selected from mathematical systems and automata theory, decision problems, realization and minimization, algebraic decomposition theory and machines in a category. Prerequisite: CS 430. (3-0-3)

CS 532
Formal Languages

This course provides an introduction to the theory of formal languages and machines. Topics to be covered include: strings, alphabets, and languages; grammars, the Chomsky Hierarchy of languages and corresponding machines (regular sets and finite automata, context free languages of various types, Turing machines and recursive functions, undecidable problems), and computational complexity, polynomial-time reductions, NP-completeness. Prerequisite: CS 430. (3-0-3)

CS 533
Computational Geometry

The course covers fundamental algorithms and data structures for Convex Hulls, Voronoi Diagrams, Delauney Triangulation, Euclidean Spanning Trees, Point Location, Range Searching. Also included are lower bounds and discrepancy theory. Optimization in geometry will be covered. This includes fixed dimensional linear programming and shortest paths. Graphic data structures such as BSP trees will be covered. Prerequisites: CS 430 and a linear algebra course. (3-0-3)

CS 535
Design and Analysis of Algorithms

Design of efficient algorithms for a variety of problems, with mathematical proof of correctness and analysis of time and space requirements. Topics include lower bounds for sorting and medians, amortized analysis of advanced data structures, graph algorithms (strongly connected components, shortest paths, minimum spanning trees, maximum flows and bipartite matching), and NP-Completeness. Prerequisites: CS 430. (3-0-3)

CS 536
Science of Programming

Formal specification of how programs execute operational semantics, how mathematical functions programs compute (denotational semantics) and how to use logic to characterize properties and invariants of the program execution (axiomatic semantics). Prerequisite CS 331 or CS 401. (3-0-3)

CS 537
Software Metrics

Theoretical foundations for software metrics. Data collection. Experimental design and analysis. Software metric validation. Measuring the software development and maintenance process. Measuring software systems. Support for metrics. Statistical tools. Setting up a measurement program. Application of software measurement. Prerequisite: CS 487. (3-0-3)

CS 538
Combinatorial Optimization

Linear programs and their properties. Efficient algorithms for linear programming. Network flows, minimum cost flows, maximum matchings, weighted matchings, and matroids. Prerequisite: CS 430 and a linear algebra course. (3-0-3)

CS 540
Syntactic Analysis
of Programming Languages

Formal definition of syntax with emphasis on context-free languages. Elementary techniques for scanning and parsing programming languages. Symbol table management. Semantic routines and code generation. The class will write a simple translator. Prerequisites: CS 440. (3-0-3)

CS 541
Topics in Compiler Construction

Advanced topics in compiler construction, including incremental and interactive compiling, error correction, code optimization and models of code generation. The objective of the course is to provide an in-depth coverage of compiler optimization techniques, including both classical optimizations and areas of current interest in compiler research. Prerequisite: CS 440. (3-0-3)

CS 542
Computer Networks I:
Fundamentals

This course focuses on the engineering and analysis of network protocols and architecture in terms of the Internet. Topics include content distribution, peer-to-peer networking, congestion control, unicast and multicast routing, router design, mobility, multimedia networking, quality of service, security and policy-based networking. Prerequisite: CS 455. (3-0-3)

CS 544
Computer Networks II:
Network Services

Qualitative and quantitative analysis of networks. A combination of analytical and experimental analysis techniques will be used to study topics such as protocol delay, end-to-end network response time, intranet models, Internet traffic models, web services availability, and network management. Prerequisites: CS 542 or ECE 545. (3-0-3)

CS 545
Distributed Computing Landscape

Introduction to the theory of concurrent programming languages. Topics include formal methods of concurrent computation as process algebra, nets and actors, high-level concurrent programming languages and their operational semantics, methods for reasoning about correctness and the complexity of concurrent programs. Prerequisite: CS 450. (3-0-3)

CS 546
Parallel and Distributed Processing

General issues of parallel and distributed processing including systems, programming, performance evaluation and application of parallel and distributed computers. The influence of communication and parallelism on algorithm design. Prerequisites: CS 430, CS 450. (3-0-3)

CS 547
Wireless Networking

This course introduces cellular/PCS systems, short-range mobile wireless systems, fixed wireless systems, satellites, and ad hoc wireless systems. It explains in detail the underlying technology as well regula-

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tions, politics, and business of these wireless communications systems. It looks beyond the hype, examining just what is and is not possible with present-day and future wireless systems. As an advanced graduate course, it will combine extensive reading and in-class discussion of the research literature with in-depth independent research projects of the students' own choosing. Prerequisite: CS 455. (3-0-3)

CS 548
Broadband Networks

The course studies the architectures, interfaces, protocols, technologies, products and services for broadband (high-speed) multimedia networks. The key principles of the protocols and technologies used for representative network elements and types of broadband network are studied. Specifically, cable modems, Digital Subscriber Lines, Power Lines, wireless 802.16 (WiMax), and broadband cellular Internet are covered for broadband access; for broadband Local Area Networks (LANs), Gigabit Ethernet, Virtual LANs, and wireless LANs (802.11 WiFi and Bluetooth) are discussed; for broadband Wide Area Networks (WANs), the topics covered include optical networks (SONET/SDH, DWDM, optical network nodes, optical switching technologies), frame-relay, ATM, wire-speed routers, IP switching, and MPLS. Also, quality of service issues in broadband networks and a view of the convergence of technologies in broadband networks are covered. Prerequisite: CS 455. (3-0-3)

CS 549
Cryptography and Network Security

This course provides an introduction to the theory and the practice of cryptography and network security. The course covers conventional encryption such as classical encryption techniques, modern encryption techniques, and encryption algorithms. Students are introduced to the basic number theory, which is used as the foundation for public-key encryption. The public-key cryptography such as encryption methods and

digital signatures is covered. Message authentication and hash functions are also discussed. Students will learn techniques of key management, secret sharing and conducting interactive proofs. In addition, the practical network and security protocols are discussed. Prerequisite: CS 430. (3-0-3)

CS 550
Advanced Operating Systems

Advanced operating system design concepts, such as multimedia OS, multiprocessor systems, virtual memory management, process migration, process scheduling, synchronization, file systems. Study of systems highlighting these concepts. Prerequisite: CS 450. (3-0-3)

CS 551
Operating System Design and Implementation

This course covers in detail the design and implementation of processes, interprocess communication, semaphores, monitors, message passing, remote procedure calls, scheduling algorithm, input/output, device drivers, memory management, file system design, network file servers, atomic transactions, security and protection mechanisms. The hardware-software interface is examined in detail. Students modify and extend a multi-user operating system. Prerequisites: CS 450. (3-0-3)

CS 552
Distributed Systems

Advanced distributed system design concepts, such as distributed processes and memory management, distributed file systems, consistency and fault tolerance, security and transaction system structures, and distributed programming. Programming in representative distributed environments. Prerequisite: CS 450. (3-0-3)

CS 553
Pervasive Computing

Concepts in computing that create an ubiquitous environment, combining processors and sensors with network technologies (wireless and otherwise) and intelligent software. Issues of middleware and middleware develop-

ment, including mobility, context awareness, resource discovery, cyber-foraging, agents, QOS, P2P, web services as well as other pervasive and ubiquitous technologies. Prerequisites: CS 450 or CS 455 and 470. (3-0-3)

CS 555
Analytic Models and Simulation of Computer Systems

Analytic and simulation techniques for the performance analysis of computer architecture, operating systems and subsystems. Rigorous development of queuing models. Study of simulation languages and models. Prerequisites: CS 450. (3-0-3)

CS 560
Computer Science in the Classroom

Preparation and formulation of computer science courses. Detailed weekly materials organized and perfected. The goal being to develop Open Course Ware (OCW). (1-4-3)

CS 561
The Computer and Curriculum Content

Emphasis on the presentation concepts. Selecting the best mode of delivery and using the power of the web page to enhance the presentation. (1-4-3)

CS 565
Computer-Assisted Instruction

Hardware and software for the effective use of the computer in an educational environment, CAI (Computer-Assisted/Aided Instruction) being one of the major areas of investigation. Prerequisite: CS 560 or CS 561. (3-0-3)

CS 566
Practicum in the Application of Computers to Education

Provides supervised experience in the development of computer-based teaching units. Evaluation of different theoretical and/or technical approaches to use of computer in the classroom. Prerequisite: CS 560 or CS 561. (1-4-3)

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CS 570
Advanced Computer Architecture
Advanced computer system design and architecture, such as pipelining and instruction-level parallelism, memory-hierarchy system, interconnection networks, multiprocessors, and clusters of servers. Selected study on current experimental computer systems. Prerequisite: CS450 and CS470. (3-0-3)

CS 572
Advanced Topics in Computer Architecture
Current problems in computer architecture. Prerequisite: CS 570. (3-0-3)

CS 580
Medical Informatics
This course provides an introduction to computer applications in health care with an emphasis on the contributions of artificial intelligence and database analysis. Topics will include medical expert systems, medical decision analysis, reasoning under uncertainty, medical tutoring systems, medical language processing, medical record systems, hospital and office information systems, laboratory, pharmacy, radiology and bibliographic information retrieval systems. Presentations and papers or projects will be required. Prerequisites: CS 425, CS 480. (3-0-3)

CS 581
Topics in Artificial Intelligence
Covers various advanced topics in AI, including both theory and practice. Content may vary by instructor. Possible topics include: Planning: STRIPs planning; Partial-order planning; Situation calculus; Theorem proving; GraphPlan/SatPlan; Transformational planning; Simulated annealing; Motion planning; Case-based reasoning; Multi-agent coordination; Negotiation planning; Representation and Reasoning: Logical representation; Frame problem; Probabilistic reasoning; Bayesian networks; Game Playing: Minimax search; Evaluation functions; Learning evaluation functions; Markov Decision Processes; Reinforcement learning for games;

Developing AI agents; Multi-agent planning. Prerequisite: CS 480. (3-0-3)

CS 582
Computational Robotics
Covers basic algorithms and techniques used in Computational Robotics, to give the student a good basis for work in this highly relevant field. Topics include: Locomotion, Non-visual sensors and algorithms, Uncertainty modeling, data fusion, State space models, Kalman filtering, Visual sensors, Sampling theory, Image features, Depth reconstruction, Multiple view geometry, Ego-motion, Active vision, Reasoning, Spatial decomposition, Geometric representations, Topological representations, Path planning, Spatial uncertainty, Active control, Pose maintenance, Dead reckoning, Correlation-based localization, Sensorial maps, Task planning and task interference, Multi-agent coordination. Prerequisite: CS 430. (3-0-3)

CS 583
Expert Systems
Medical expert systems and clinical decision analysis. Decision making under uncertainty. Inference mechanisms for expert systems: production rules, pattern recognition, automatic theorem proving, fuzzy logic. Expert system architecture. Knowledge engineering. Information retrieval. Natural language interfaces. Prerequisite: CS 480. (3-0-3)

CS 584
Machine Learning
Covers basic algorithms and techniques used in Machine Learning, to give the student a good basis for work in this highly relevant field. Topics include: Version space learning, Computational learning theory, PAC-learning, VC-dimension, On-line learning, Winnow, Perceptrons, Neural Networks, Backpropagation, Genetic algorithms, Bayesian learning, Experimental design, Decision-tree learning, Covering algorithms for learning rule sets, Minimum description length, Clustering algorithms, Reinforcement learning, Markov decision processes. Prerequisite: CS 480. (3-0-3)

CS 585
Natural Language Processing
An introduction to the problems of computing with human languages. Parsing. Semantic representations. Text generation. Lexicography. Discourse. Sublanguage studies. Applications to CAI, database interfaces and information retrieval. Prerequisite: CS 445. (3-0-3)

CS 586
Software Systems Architectures
This course covers the state-of-the-art in architectural design of complex software systems. The course considers commonly used software system architectures, techniques for designing and implementing these architectures, models and notations for characterizing and reasoning about architectures, and case studies of actual software system architectures. Prerequisite: CS 487. (3-0-3)

CS 587
Software Project Management
Concepts of software product and process quality. Role of TQM in software project management. Use of metrics, feasibility studies, cost and effort estimates. Discussion of project planning and scheduling. The project team and leadership issues. The Capability Maturity Model: basic tenets and application of process evaluation. Prerequisite: CS 487. (3-0-3)

CS 588
Advanced Software Engineering Development
Software development process improvement is a major objective of this course. This is achieved through a series of individual programming and process projects. Students learn to plan their projects, apply measurements, estimate size, schedule tasks, and classify defects in order to improve the quality of both their development process and their software products. Prerequisite: CS 487. (3-0-3)

CS 589
Software Testing and Analysis
Concepts and techniques for testing and analysis of software. Software testing at the unit, subsystem, and

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system levels. Specification-based testing. Code-based testing. Model-based testing. Methods for test generation and validation. Static and dynamic analysis. Formal methods and verification. Reliability analysis. Prerequisite: CS 487. (3-0-3)

CS 590
Seminar in Computer Science
Investigation and discussion by faculty and students concentrated on some topic of current interest. May be taken more than once. Prerequisite: Written consent of instructor. (3-0-3)

CS 591
Research and Thesis for M.S. Degree
(Credit: Variable)

CS 595
Topics in Computer Science
This course will treat a specific topic, varying from semester to semester, in which there is particular student or staff interest. May be taken more than once. Prerequisite: Written consent of instructor. (Credit: Variable)

CS 597
Reading and Special Problems
Prerequisite: Written consent of instructor. May be taken more than once. (Credit: Variable)

CS 612
Topics in Computer Vision
Cover advanced topics in computer vision to enhance the knowledge of students interested in this highly important area. The topics in this course may change between semesters depending on the instructor teaching the course and the current state of the art in this area. Possible topics include: Image based modeling and rendering, Multiple view geometry, Auto-calibration, Object recognition, Motion analysis, Tracking, Perceptual user interfaces, Face and gesture recognition, Active vision. Prerequisite: CS 512. (3-0-3)

CS 630
Advanced Topics in Algorithms
Theoretical analysis of various types of algorithms. Topics vary, and may include quantum, approximation, on-line, distributed, randomized, and parallel algorithms. Prerequisite: CS 430 and consent of instructor. (3-0-3)

CS 642
Advanced Topics in Networking
Introduction to advanced networking research. A particular focus area will be considered, keeping current with advances in computer networking. Quantitative methods will be emphasized. Prerequisite: CS 542. (3-0-3)

CS 681
Topics in Computational Linguistics
Covers various topics in linguistics as they may be applied to various computational problems in AI, NLP, or IR. The topics in this course may change between semesters depending on the instructor teaching the course and the current state of the art in this area. Possible topics include: Systemic Functional Linguistics, Clausal structure, Group structure, Complex structure, Cognitive Linguistics, Process semantics. Prerequisite: CS 585. (3-0-3)

CS 689
Advanced Topics in Software Engineering
Course content is variable and reflects the current trends in software engineering. Prerequisite: Consent of instructor. (3-0-3)

CS 691
Research and Thesis for Ph.D. Degree
(Credit: Variable)

CS 695
Doctoral Seminar
(1-0-1)

Courses available for the Master of Computer Science Program

CSP 527
Client-Server Applications Development
Through hands-on experience in developing a client-server database project and developing and managing a client-server Internet project, this course teaches advanced skills for effective design and implementation of client-server applications. Students will examine the architectural and functionality decisions, technologies, configurations, languages, and techniques associated with client-server systems. Active/passive client-server technologies, as well as public, enterprise-wide, and inter-enterprise approaches to decision and operation support are discussed and implemented. Prerequisite: CS 425. (3-0-3)

CSP 541
Internet Technologies
This course focuses on the technologies and protocols used by Internet WAN's and LAN's. The fundamental architecture, organization, and routing principles of the Internet are described. Part of the course will focus on emerging Internet technologies. Prerequisite: CS 455. (3-0-3)

CSP 542
Internet Design and Analysis
This course examines the principles of network design. The design process is studied from requirements gathering to deployment. The student will gain experience in estimating application load, network sizing, component choice, and protocol choice. Internetworking between popular components and protocols will be studied. Analytical and simulation techniques are described and used to design several local- and wide-area networks. Prerequisite: CS 455. (3-0-3)

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CSP 543
Multimedia Networking
This course covers the architectures, protocols, and design issues for multimedia networks. Topics covered include coding, compression, streaming, synchronization, QoS, and adaptation. Current tools for multimedia networking will be surveyed. Issues with multimedia application development will be explored. Students will design and develop multimedia applications. Prerequisites: CS 455 and experience programming in high-level languages. (3-0-3)

CSP 544
System and Network Security
This course will present an in-depth examination of topics in data and network security, such as: Access control, authentication, security assessment, network and data security tools, and security policies. A significant hands-on component includes network incidents to detect and fix. Prerequisites: CS 430, CS 455. (3-0-3)

CSP 545
Wireless Networking Technologies and Applications
This course will present the foundation of wireless technologies and examine state-of-the-art wireless systems, services, network technologies, and security. Prerequisites: CS 542. (3-0-3)

CSP 550
Internet Programming
This course discusses current fundamental concepts and development techniques for distributed applications. Topics covered include multithreaded programs, sockets, message-passing systems, remote method invocation and procedure calls, peer-to-peer networks, and underlying technologies for internet applications. Prerequisite: CS 455. (3-0-3)

CSP 551
Advanced UNIX Programming
This course provides students a hands-on introduction to UNIX programming topics such as standard application programmer interfaces, concurrent programming, UNIX processes and threads, shell programming, UNIX interprocess communications, client-server designs, and application portability. Prerequisites: C programming, CS 450 or equivalent, and user-level knowledge of UNIX. (3-0-3)

CSP 581
Applied AI Programming
To learn AI programming algorithms and techniques in Common Lisp. Time is split between Common Lisp topics and discussions of implementation strategies for AI algorithms. Prerequisite: CS 440 or equivalent. (3-0-3)

CSP 585
Object-Oriented Design Patterns
This course introduces the principles of design patterns for Object-Oriented software systems. A catalog of design patterns is shown, to illustrate the roles of patterns in designing and contracting complex software systems. The catalog of design patterns also provides a pragmatic reference to a well-engineered set of existing patterns currently in use. Also discussed is the impact of post-object-oriented software development on design patterns. Prerequisite: CS 445. (3-0-3)

CSP 586
Software Modeling and Development with UML
Students will obtain a significant exposure to the UML technology. This will include exposure to modeling, model-driven development, executable models, and round-trip engineering. These technologies will be explained at the application level. Prerequisite: CS 487 or CS 445. (3-0-3)

CSP 587
Software Quality Management
Students will learn methods of software quality management. This will include exposure to software quality assurance, quality measures, and quality control. These quality management methods will be explained at the applications level. Prerequisite: CS 487 or equivalent. (3-0-3)

Fundamental Prerequisite Courses in Computer Science

Students whose background in computer science is deficient are required to take the following courses and earn a grade "B" or better. The credits for these courses may not be used for any degree program in computer science, computer information systems or computer engineering.

CS 401
Introduction to Advanced Studies I
First course in a two-course sequence that is designed to prepare students for graduate study in computer science. The course covers advanced programming concepts including pointers, recursion and inheritance, as well as data structures and algorithms including linked lists, stacks, queues, heaps, graphs, and sorting techniques. Prerequisite: CS 201 or equivalent. (3-0-3)

CS 402
Introduction to Advanced Studies II
Second course in a two-course sequence that is designed to prepare students for graduate study in computer science. The course consists of two parts. The first part introduces the students to computer organization and architecture, numbering systems, logical operations and fundamentals of assembly language programming. The second part of the course is devoted to event driven programming concepts using Java as the programming tool. Multithreading programming concepts are also covered using Java. Prerequisite: CS 401 or consent of instructor. (3-0-3)

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**Undergraduate Courses
Available to Graduate Students
in Computer Science**

**CS 411
Computer Graphics**

**CS 422
Introduction to Data Mining**

**CS 425
Database Organization**

**CS 429
Introduction to Information
Retrieval**

**CS 430
Introduction to Algorithms**

**CS 440
Programming Languages
and Translators**

**CS 441
Current Topics
in Programming Languages**

**CS 445
Object-Oriented Design
and Programming**

**CS 447
Distributed Objects**

**CS 450
Introduction to Operating Systems**

**CS 455
Data Communications**

**CS 458
Information Security**

**CS 470
Computer Architecture I**

**CS 471
Design of Computer Processors**

**CS 480
Artificial Intelligence**

**CS 485
Computers and Society**

**CS 487
Software Engineering**

Institute of Design

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Director:
Patrick F. Whitney

The Institute of Design (ID) is defined by a legacy of experimentation joined with unique academic programs and a systematic, analytical approach to design and problem solving. It has embraced new technology and experimentation since its founding by Laszlo Moholy-Nagy in 1937 as New Bauhaus. In 1944, the school was renamed the Institute of Design, and, in 1949, it merged with Illinois Institute of Technology.

ID's program is markedly different from other graduate design programs because of its insistence on user-centeredness, its development of rigorous, verifiable methods, and its emphasis on placing design at the center of the development process.

Today, the school has the nation's largest full-time, graduate program in design and offers a Ph.D. in design research. Students in the professional master's (M.Des.) program may specialize in design planning, design research, human-centered product design or human-centered communication design. Students in the advanced Master of Design Methods (M.D.M.) program enroll in core and specialty courses and selected workshops focusing exclusively on advanced design methods.

ID's development of separate research and professional degrees addresses the new commitment of the field to the importance of design research, while recognizing the increasing demand for professional education at the mastery level. ID's research community is as unique as its curriculum. Faculty members are active contributors to the design field. The 12 full-time faculty and approximately 20 adjunct members represent specific areas of expertise critical to design, such as product design, communication design, information design, design planning, the history of design, interactive diagrams, cognitive psychology, anthropology, semantics of form, imaging, and computer science. Students draw upon these many perspectives to observe and analyze real-world environments as a means of designing information, visualizations, products and services that shape and are shaped by how people live.

Graduate students typically come to ID from all over the world, often after years spent in their professions. In addition to professional designers who enter the school, ID accepts and encourages students with backgrounds outside of design. The student body draws from backgrounds as diverse as chemistry, engineering, the fine arts, computer science, architecture, anthropology and psychology.

Degrees Offered

Master of Design (M.Des.)
Master of Design Methods (M.D.M.)

Doctor of Philosophy (Ph.D.)

Research Facilities

Research is supported by a networked computing system that enables students to digitize and manipulate photographic images, analyze problems, model forms, create interactive multimedia and individualized publications, and develop new systems and tools. Equipment includes Silicon Graphics, Sun, Dell, and Apple computers and a wide variety of peripherals.

Research Areas

ID provides an unmatched community of faculty and students who are conducting essential design research. Interests are broad, but tend to focus on users' interactions with their environment, methods of innovation within organizations, and the value of design for business and strategy. Doctoral students conduct research regarding the fundamental methods and principles of human-centered design and design planning in both symbolic and real dimensions.

Institute of Design

Faculty

Jeremy Alexis, Assistant Professor. B.Arch, M.Des., Illinois Institute of Technology.

Christopher Conley, Associate Professor, B.S., M.S., Illinois Institute of Technology.

Dale Fahnstrom, Professor. B.F.S., M.F.A., University of Illinois, Urbana-Champaign.

Judith Gregory, Assistant Professor. B.A., Antioch College. Ph.D., University of California-San Diego

John Grimes, Professor. B.A., University of Illinois. M.S., Illinois Institute of Technology.

Vijay Kumar, Associate Professor. B.S., National Institute of Design (India); M.S., Illinois Institute of Technology.

Charles Owen, Distinguished Professor Emeritus. B.S., Purdue University; M.S., Illinois Institute of Technology.

Greg Prygrocki, Associate Professor. B.I.D., University of Manitoba (Canada); M.V.A., University of Alberta (Canada).

Keiichi Sato, Professor. B.S., M.S, Osaka Institute of Technology; M.S., Illinois Institute of Technology.

Patrick F. Whitney, Professor and Director. B.F.A., University of Alberta (Canada); M.F.A., Cranbrook Academy of Art.

Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0
Minimum GRE score: 1000 (verbal & quantitative),
    3.5 (analytical writing)
TOEFL minimum: 550
TSE (Test for Spoken English) minimum: 24

Admission to ID is highly competitive. Meeting the minimum GPA and test score requirements does not guarantee admission. Test scores and GPA are just two of several important factors considered. For admission to the master of design (M.Des.) program, an applicant must hold a baccalaureate degree from an accredited educational institution with a minimum cumulative GPA of 3.0/4.0, must have a strong record of academic achievement, and must be highly recommended. All applicants without an undergraduate degree in design must submit GRE scores. Applicants from countries whose native language is not English must submit scores for TOEFL and TSE. The TOEFL and TSE requirements are waived for applicants with a degree from universities in English-speaking countries.

Portfolios are required for applicants who possess design degrees. Regardless of previous degrees, students may be required to complete prerequisite design courses before starting their M.Des. requirements.

Applicants without design degrees are encouraged to apply to the M.Des. Program. Such applicants must complete a series of specified prerequisite design courses before starting the M.Des. degree requirements.

Applicants to the M.D.M. program must hold a four-year Bachelor's degree from an accredited university, possess outstanding visual skills as demonstrated in a professional portfolio or an exemplary portfolio of non-design innovation projects, and have a minimum of 5 years of management and leadership experience in design or innovation and a demonstrated record of excellence in the field (as in awards from IDSA, AIGA or other associations). Applicants must also submit three letters of recommendation from professional contacts, and have a successful interview with an Institute of Design faculty member.

Applicants to the Ph.D. program must hold a master's degree in design from an accredited educational institution, have a distinguished record of academic achievement and be very highly recommended. Applicants without a master's degree should apply for the M.Des. program.

Doctoral applicants with a Master's degree in design must show evidence of distinguished academic and, if appropriate, professional work in their fields. Applicants with design degrees or degrees from programs in related fields with studio courses must present a portfolio and may be required to complete some design courses as deficiency studies. All Ph.D. applicants must have completed college level courses in mathematics (calculus and statistics) and programming (Fortran, Pascal or C++). Depending on the applicant's academic background and intended area of study, other prerequisite courses also may be required. Admitted applicants who have not completed these courses must take them immediately.

Master of Design

54 credit hours
Project

The Master of Design (M.Des.) program is a two-year, 54-credit-hour degree program intended for those seeking professional mastery at the highest level in the field of communication or product design or design planning. The degree terminates with a project demonstrating the application of new theories and processes to contemporary and developing design problems in a variety of areas.

The program is divided into four concentration areas, or tracks: Human-centered Communication Design, Human-centered Product Design, Design Planning, and Design Research. All four tracks share a common platform of methods developed at ID and other design organizations which focuses on observing and understanding users in specific contexts, analyzing complex information, developing and exploring alternative solutions, and prototyping future innovations and scenarios.

Human-centered Communication Design
The communication design program applies human-centered methods to the creation of new communications, including interactive, electronic and print publications, information systems, software, Web services, and other media. Students explore how people send, receive, analyze, share and interact with information and rich media, and the influences of new technologies on how people can, should and do communicate.

Human-centered Product Design
ID's product design program focuses on physical products and environments. With the underlying goal of maximizing user experience, the program emphasizes both appearance and performance, and explores issues of

material and form, manufacturing, interaction, embedded computing, and product life cycles. Students are encouraged to go beyond designing an individual product, to designing holistic systems of products and environments that work together to meet user needs.

Design Planning
Students in design planning learn to apply design methods to business strategy and achieving competitive advantage. Particular attention is paid to how design, by creating new value for users, can also create economic value for organizations. Students gain an understanding of technological innovation, market forces, and organizational structures, and learn to create innovative solutions in a variety of areas, from products and communications to business strategies, brands, services and organizational processes.

Design Research
The design research track prepares professionals to work in industry, the public sector and academic institutions that seek to build design-related research and development programs from a human-centered perspective. Coursework focuses on the development and implementation of new design methods and tools, exploring and prototyping new concepts, and creating new procedures and standards for design activity. Career paths include corporate research and development, government design and technology agencies, teaching, and preparatory study for application to the Ph.D. program.

Residence
The M.Des. Program requires continuous full-time study at the Institute of Design for a minimum of four semesters. Students must enroll in at least 13.5 credit hours of course work each semester.

Curriculum

Totals 54 credit hours

Core classes
(13 credit hours)
The following eight project/discussion courses that deal with the basics of human-centered design are required for all master's students:

ID 559	Physical Human Factors
ID 551	Cognitive Human Factors
ID 552	Social Human Factors
ID 553	Cultural Human Factors
ID 533	Design Analysis
ID 514	Design Planning
ID 516	Observing Users
ID 517	Design Languages

Professional Sequence
(32 hours)

Students select a series of projects and courses from available workshops and specialty courses to meet the objectives of the student's professional goals in their chosen track. Choices will be made in consultation with the student's adviser and will account for at least 32 credit hours of the required program.

The professional sequence includes eight (8) credit hours of workshops, which are major, semester-long project courses that explore design problems in breadth and depth. Processes and information from the specialty courses are developed here in practical and experimental applications. Choices are made in consultation with the student's adviser from ID 580-589.

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Twelve (12) credit hours in the professional sequence are composed of specialty track courses, which are classes in special branches of design theory process or practice. Selections must include courses from the student's chosen track. Full- or half-semester courses are selected from ID 519–579.

The remaining twelve (12) credit hours in the sequence are composed of a final, one- to two-semester long Research and Demonstration project in the chosen track (ID 592).

Electives
(9 hours)

Full- or half-semester courses selected from the university's course offerings to complement objectives of the student's program. These courses should be at least 400-level and should be selected with adviser approval.

Master of Design Methods

30 credit hours

The Master of Design Methods (MDM) is a nine month (or 2-3 year part-time) executive master's degree for exceptional design, management, engineering and other professionals who wish to acquire robust design methods and frameworks and to apply design thinking to the development of products, communications, services, and systems. MDM courses cover design methods and frame-works in areas like user observation and research; proto-typing of new services, products and businesses; creating systems of innovation; visualizing alternative futures; and linking user innovation to organizational strategy.

Residence
The M.D.M. can be taken in two semesters full-time, four semesters half time, or six semesters at one-third time.

Curriculum
Totals 30 credit hours

Required classes
(13 hours)

The following four, half-semester, project/discussion courses that deal with fundamental aspects of design at an abstract, theoretical level are required for all M.D.M. students:

ID 559	Physical Human Factors
ID 551	Cognitive Human Factors
ID 552	Social Human Factors
ID 553	Cultural Human Factors

Substitutions to these courses may be made according to the student's professional background.

Design Workshops
(0-8 hours)

Workshops are major, semester-long project courses that explore design problems in breadth and depth. Processes and information from the specialty courses are developed here in practical and experimental applications. Choices are made in consultation with the student's adviser from ID classes numbered 580-589.

Specialty Courses
(9-17 hours)

Specialty courses are courses in special branches of design theory, process or practice, and are normally selected from half-semester courses, ID 519-579.

Dual degree programs

M.Des./M.B.A.

The Master of Design/Master of Business Administration (M.Des./M.B.A.) dual degree program is a two year plus one quarter, full-time program of study culminating in the awarding of both an M.Des. degree from the Institute of Design, and an M.B.A. degree from the Stuart School of Business.

Pursued separately, earning both degrees would require more than three years of continuous study, as well as separate application processes. The M.Des./M.B.A. dual degree option allows students to earn both degrees in less time, through an efficient selection of courses.
Prospective students may submit one application to apply to both the Institute of Design and the Stuart School of Business programs.

Doctor of Philosophy

116 credit hours
Language examination
Comprehensive examination
Dissertation

The Ph.D. in design is a research program for those who wish to teach or conduct research in design. The program culminates with a dissertation that extends the body of knowledge about design theory and process. With the approval of their advisers, students may elect to study within the design planning or human-centered design tracks, or they may develop a different area of study that is important to the evolution of new knowledge in design theory or process.

Candidacy

Early in their studies, admitted doctoral students will be required to submit and obtain approval for a program of study and pass a foreign language requirement. Within two years of being admitted, and after approval of the program of study and passage of the foreign language examination, the student must take a comprehensive examination. This examination is intended as a rigorous review of the level of competence achieved by the student as a result of the entire program of graduate study (except for the dissertation) as approved by the advisory committee and specified in the program of study form. Students are not considered candidates for the Ph.D. degree until after the comprehensive examination is passed.

Residence

The Ph.D. program normally requires a minimum of three years of study beyond the master's degree. The first four semesters must be continuous study at the Institute of Design. Students must enroll in at least 15 credit hours of course work for each of the first three semesters.

Language

Satisfactory reading knowledge of German, Japanese, French or Russian must be met before the student applies to take the comprehensive examination.

Curriculum

Totals 116 credit hours

Masters program in design
(32 hours or greater)

Research Sequence
(21 hours)

The research sequence is a series of projects and courses selected from available design workshops and specialty courses to meet the objectives of the student's research goals. Choices will be made in consultation with the student's adviser and will account for at least 21 credit hours of the required program beyond the M.S. degree.

Design Workshops
Workshops are major, semester-long project courses that explore design problems in breadth and depth. Processes and information from the specialty courses are developed here in practical and experimental applications. Choices are made in consultation with the student's adviser from ID classes numbered 580-589.

Specialty Courses
Specialty courses are courses in special branches of design theory, process or practice, and are normally selected from half-semester courses, ID 500–559 and ID 568–576.

Seminars
(6 hours)

Seminars are discussion courses that consider topics of contemporary interest and provide a continuing meeting ground and forum for students during their course and project work.

Electives
(12 hours)

Electives include full- or half- semester courses selected from the university's course offerings to complement objectives of the student's program. These courses should be at least 400-level and should be selected with adviser approval. Note: Summer research on projects designated by the department may substitute for up to three hours of elective or research sequence credit requirements.

Dissertation
(48 hours)

A distinct, substantial and original contribution to design knowledge. ID 691 Research and Thesis for the Ph.D.

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Course Descriptions

Numbers in parentheses indicate class, lab and credit hours, respectively. Graduate standing in the Institute of Design is a prerequisite for all courses.

ID 428
Advanced Architectural Photography

Offers basic instruction in architectural photography primarily for upper level undergraduate and graduate level architecture students. Covers basic camera operation and exposure, photography of flat art and studio lighting, interior and exterior photography, and the photography of distinguishing features of the urban landscape. (1-2-2)

ID 482
Graduate Intro to Design

Instills familiarity with the professional practice of design in its main forms, disciplines and applications, including product design, communication design, design planning, design research, interaction design, service design and design education. Covers the skills required, activities, challenges, common tools and leading players in these areas of practice. Also covers design industry employment skills and basic drawing and visualization. (1-2-2)

ID 483
Graduate Intro to Communication Design 1

Provides a sound understanding of two-dimensional form and introduces basic concepts of graphic design, including factors of visual perception and syntax, principles of creating order and meaning, compositional techniques, aesthetic properties of visual form, information processing, and understanding the environmental, cultural and personal context of the viewer. Considerable emphasis is placed on typography. (1-2-2)

ID 484
Graduate Intro to Communication Design 2

Provides fundamentals for planning and editing information and communicating it in print, web, and three-dimensional exhibition form, from concept generation to visualization. Relevant perceptual and cognitive principles are discussed. (1-2-2)

ID 485
Graduate Intro to Product Design 1

Teaches the fundamental principles and processes of product design through simple projects and skill building exercises, and study of more advanced projects and case studies. Skills taught include diagramming, orthographic sketching and rendering, basic three-dimensional model building, and documenting intent for presentation. (1-2-2)

ID 486
Graduate Intro to Product Design 2

Prepares students to practice basic product design and instills professional understanding of the responsibilities and value of product design to manufacturing organizations and end-users. Key topics include establishing design criteria, design ideation, geometry, structure and assembly, materials and fabrication, drawing, prototyping and solid modeling, and final presentation. (1-2-2)

ID 487
Graduate Intro to Photography

Acquaints design students with the field of photographic image making, how images are constructed and the ways they are used to communicate. Students learn the fundamental principles of image making, color theory, lighting, and digital image processing through the practice of creating images. All work is performed using digital cameras and softare. (1-2-2)

ID 488
Graduate Intro to Digital Media

Surveys the basic media types used in interactive software. Includes a culminating project that demonstrates basic principles of screen design and computer-human interaction using a variety of media. Projects require use of common software applications for creating and editing six data types: text, bitmap, geometry, sound, animation and video. (1-2-2)

ID 510
Principles and Methods of Design Research

Introduces the basic principles and methods for assembling, developing and analyzing information in the tasks of design research. Techniques for collecting data, testing hypotheses and presenting conclusions are learned in the context of conducting a pilot research project. (3-0-1.5)

ID 511
Philosophical Context of Design Research

Explores the philosophical framework for conducting research and building knowledge in the field of design. Topics include concepts from epistemology, phenomenology and structuralism. Comparisons are made between design research and research in other fields. (3-0-1.5)

ID 514
Design Planning

Introduces students to the context of design planning. It includes a discussion of the general forces acting upon an organization—competition, technological developments, channels of information and product distribution and ways to understand the people who use design. Particular attention is paid to how, within the context of all of these forces, design can benefit an organization. (3-0-1.5)

ID 515
Design Policy

Investigates the formation and intent of design policy by governments across the world. Particular attention is focused on the relationship of organizations implementing these policies to the political and economic structure of different countries and on measures assessing their success. (3-0-1.5)

ID 516
Observing Users

Introduces observational and ethnographic methods in design.

Ethnographic methods are used in fieldwork to help researchers develop a deeper understanding of the everyday activities of people's lives. In other words, their goal is to help researchers understand what people do -- not just what they say they do. In the design field, there is an added goal: to initiate practical changes in the ways people do things in the real, material world -- not just to make theoretical discoveries. Applied methods help designers conduct research projects and develop design solutions for customers, clients, or employers who seek out their expertise. (1-2-2)

ID 517
Design Languages
Covers the rhetoric of design case making using verbal, quantitative, visual, and spatial modes of persuasion. Includes a survey of document and presentation types useful in the product development process. (1-2-2)

ID 518
Business Frameworks
A descriptive course in business strategy for designers covering new venture strategy, competitive strategy, marketing strategy and tactics, decision sciences, entrepreneurship, private equity, business plan writing, innovation, introductory finance and "self-discovery." This course will build a series of non-mathematical models of success and failure in both entrepreneurial and corporate settings. (3-0-1.5)

ID 519
Economics & Design
This course will consider the relationship between theories and practice in the two very different realms of economics and design. Economic theory is a vital body of knowledge with many variations and emphases. It has fundamentally influenced a wide spectrum of both governmental and business policy and procedure and has enormous influence on how design is viewed in these contexts. (3-0-1.5)

ID 520
Communication Planning
Presents and demonstrates the principles and methods of formulating a plan for a communication project, especially the relationship between the project plan and the organization's overall design strategy and policy. (3-0-1.5)

ID 521
Product Planning
Presents and demonstrates the principles and methods of formulating a plan for a new product, especially the relationship between the project plan and the organization's overall design strategy and policy. (3-0-1.5)

ID 522
Technological Development and Design Innovation
Concentrates on the exploitation of developments in material and manufacturing technology as a critical component in innovative design. Case studies are used to analyze the development of new products from precursor advancements in the technologies of materials and/or manufacturing. Product development is considered from perspective of project management, interactions among different technological domains, and the metaphoric transformation of design problems by design and development personnel aware of the technological advancements. (3-0-1.5)

ID 524
Strategic Design Planning
Focuses on how the processes and goals of design planning can relate to the overall strategic plan of an organization. It includes topics related to technological innovation, market trends, financial analysis and other forces that influence the future of an organization. (3-0-1.5)+

ID 525
Design Planning and Technological Innovation
Shows how design relates to technological change in media, manufacturing and products. Special attention is paid to the confluence of computing and communication, flexible production systems and the increased use of sophisticated electronics in control systems of products. (3-0-1.5)

ID 526
Design Planning and Market Forces
Focuses on methods in design planning that build information about how products and information should be used. It includes a comparison of marketing and design planning as distinct processes for developing new products, services and information. (3-0-1.5)

ID 528
Advanced Design Planning
Presents students with background information about the forces influencing a design problem. Using knowledge about planning processes, students will be asked to write a design plan that describes the relevant methods and predicted solution to the problem. (3-0-1.5)

ID 529
Structured Planning
Introduces the basic principles and methods of Structured Planning, a set of tools used in the planning phase of the design process. Procedures are developed for exploring the issues relevant to a project, obtaining detailed functional requirements and insights, organizing this information, synthesizing innovative concepts and describing them in a Plan for the subsequent designing phase. (3-0-1.5)

ID 531
Computer Applications in Design
Introduces students to the construction of computer programs for design. Issues of program design are considered, including modularity, data structures, computer graphic modeling, interface design and other aspects of programming for the support of design processes. Prerequisite: ID 468 or consent of instructor. (3-0-1.5)

ID 532
Computer-Supported Design Processes
Continuation of ID 531, with emphasis on advanced graphic techniques and artificial intelligence procedures for the support of design processes. Primary emphasis is on writing a complete design software application program. Prerequisite: ID 531 or consent of instructor. (3-0-1.5)

Institute of Design

ID 533
Design Analysis
A survey of design methods from many fields concentrating on problem definition, description and analysis. Among the topics covered are diagrammatic techniques for process and organizational description, semantic differential techniques, means/ends analysis and morphological analysis. (3-0-1.5)

ID 534
Design Synthesis
A survey of design methods for enhancing creativity and developing concepts. Topics include morphological synthesis, a wide variety of creativity stimulation techniques, synectics and other group creativity processes. (3-0-1.5)

ID 535
Decision Support Techniques
Covers methods for decision making and evaluation in design. Topics include criterion function analysis, decision making under varying conditions of certainty, utility theory, Delphi techniques for obtaining group consensus, and game and metagame theoretic processes for competitive decision making. (3-0-1.5)

ID 537
Artificial Intelligence and Design Problem Solving
Introduces a variety of problem-solving and heuristic paradigms from artificial intelligence and cognitive science and explores their application in different types of design problem-solving processes. (3-0-1.5)

ID 540
Advanced Communication Design
Involves students in practicing methods for rapidly developing prototypes that demonstrate appearance and/or functional aspects of potential messages. The class will include evaluation methods that are useful in the process of iteratively developing and testing alternate solutions. (3-0-1.5)

ID 541
Advanced Product Development
Familiarizes students with the nature, methods, and design implications of current mass production practice and trends. Addresses the translation of product concepts into actual production by anticipating development needs in all portions of the manufacturing organization. (3-0-1.5)

ID 542
Interaction Design Methods
This course focuses on a role of design to bring technologies to human contexts by creating interaction mechanisms for better user experiences. The content includes the concept of interaction, underlying theories, as well as methods for understanding user needs and contexts, representing different aspects of interaction, and designing and evaluating interactive systems. (3-0-1.5)

ID 543
Intelligent Products
Introduces students to the professional and theoretical aspects of defining new products. Covers the process of creating a new product definition in detail, the characteristics of new product definition documents, and aspects of organizational structure and dynamics as they relate to developing new product definitions. (3-0-1.5)

ID 544
Interface Design
Focuses on user-computer interface design. Topics included are cognitive models, interactive techniques, sign systems, display organization and prototyping methods. Prerequisite: Working knowledge of computer programming. (3-0-1.5)

ID 545
Interactive Media
Introduces students to the principles of integrating electronic publishing, interactive video and computer graphics. Particular emphasis is on social and cognitive human factors and the use of multiple sign systems. Prerequisite: ID 544 or consent of instructor. (3-0-1.5)

ID 546
Diagram Development
Explores the language of diagrams and alternative techniques for increasing communication effectiveness. Subjects of study include computer-based diagrams that introduce interaction and motion to convey meaning. (3-0-1.5)

ID 547
Product Architecture and Platform
Product architecture is the structure that integrates components and subsystems of a product into a coherent mechanism to perform intended behavior and functions. It also reflects rationale and intentions of the design from different perspectives. In order to accommodate a wide range of user requirements and social concerns as well as fast changing technologies, strategic approaches and methodologies for designing product architecture and platform need to be incorporated in the design process. This course introduces the concept of product architecture and platform to explore their possible applications to different types of products from different viewpoints. (3-0-1.5)

ID 548
Life Cycle & Sustainable Design
Life Cycle & Sustainable Design introduces students to the issues, resources, and methods of designing product systems with consideration for their environmental and social impact throughout their lifecycle. The course is formatted to help students develop a professional point of view and set of references for assessing lifecycle and sustainable issues when developing new products. (3-0-1.5)

ID 549
Prototyping Methods
The ability to make prototypes and experiment with them before a final product is developed greatly enhances the product development process. This course introduces and explores a wide variety of prototypes and how they can be used to inform new product development. How prototyping affects understanding of the project goals, management of the

process, project risk, learning, and quality are explored. Paper prototypes, architecture & platform prototypes, behavioral prototypes, interactive prototypes, visualizations, simulations are examples of the types of prototypes that are examined. (3-0-1.5)

ID 551
Cognitive Human Factors
Presents the advanced ideas and methods that can be used to design information and products that fit the cognitive abilities of people. Important topics include designing information that corresponds to mental models of users, control systems that help users develop appropriate mental models and the analysis of different methods of representing information. (3-0-1.5)

ID 552
Social Human Factors
Presents advanced ideas and methods used to design information, products and environments that fit the social patterns of groups. Particular attention is paid to understanding and designing systems that support group work. (3-0-1.5)

ID 553
Cultural Human Factors
Presents ideas and principles used to understand the relationship between design and cultural values and behavior. Emphasis is placed on designing information and products for people who are from significantly different cultures. (3-0-1.5)

ID 554
Visual Language
Discusses pictures, abstract symbols, text, numbers, diagrams, three-dimensional form and other sign systems. Particular attention is paid to the relative advantages of each representation system for conveying different types of information. (3-0-1.5)

ID 555
Metaphor and Analogy in Design
Investigates the ideas and methods for creating visual messages through comparing, juxtaposing and substituting images within specific

contexts. Discussion will include issues of similarity, such as isomorphism and analogy, the connotative attributes of images, and the dissonance found in metaphors and other rhetorical forms. (3-0-1.5)

ID 557
Dynamic Diagrams
The study and development of real-time, computer-based diagrams for pattern finding and pattern communicating. Particular attention is paid to the roles of motion, interaction, sound, and modes of manipulation that can be combined with 3-D models and traditional diagrammatic sign systems. Prerequisite: ID 546 or consent of instructor. (3-0-1.5)

ID 558
Theories of Information and Communication
Describes general paradigms of information and communication. Particular attention is paid to models that consider the importance of the values, behavior and knowledge of the people for whom the information is intended. (3-0-1.5)

ID 559
Physical Human Factors
The physical aspect of human experience and interaction design is investigated through topics such as "learning by doing": interaction between actions and cognition, physical interface: enhancement of cognitive activities, spatio-temporal dimensions of interaction design, and the "shared reality" concept for multi-modal communication. (3-0-1.5)

ID 567
Economics of Product Development
Successful new products drive the growth and profitability of organizations. But the development of these new products relies on considered investments, quality development processes, and an expected return on the investment. This course introduces the numerous economic considerations and measures with which the successful new product developer must be familiar. Project budgeting, return on investment, net present value, cash flow analysis, product pricing, and budgeting are

among the concepts explored from a design and development viewpoint. (3-0-1.5)

ID 568
Research Methods for New Product Development
The design and development of new products requires rigorous research throughout the process to improve insight and reduce the risk of innovation. Ethnographic and activity-based methods are used early to identify latent needs. Behavioral testing with prototypes is used to understand the quality of emerging concepts. Quantitative and qualitative validation studies help understand final concepts in detailed ways. This course examines research methods used throughout the design and development process from process, financial, and results standpoints. (3-0-1.5)

ID 569
Intellectual Property
The opportunity to protect one's unique and valuable ideas is a core tenet of the global economic system and is embodied in the laws of intellectual property. Disciplines such as design and engineering that are involved in the development of new ideas must actively purse this protection. This course introduces the principles and methods for securing intellectual property rights. Topics covered include utility and design patents, trademark, copyright, and trade dress. Emphasis is placed on the ability to articulate novelty, the appropriate process of securing intellectual property, and common ways intellectual property can be valued. (3-0-1.5)

ID 572
Systems and Systems Theory in Design
Investigates principles and methods for exploring the behavior of systems. System dynamics techniques are used to model design concepts with the goal of revealing complex, noninceptive relationships. Important topics include general systems theory, modeling, causality and formalisms. (3-0-1.5)

Institute of Design

ID 577
Product Form

The form of a product is a result of resolving technical conditions, organizing the product for use, and a means for communicating. In this course students examine what technical and social dimensions impact product form and conversely, how product form can be controlled by the designer to improve the product's performance. Topics include the relationship between a product's form and corporate identity, visual trends, new materials, semantics, product architecture, ergonomics, specific industries, and others. (3-0-1.5)

ID 578
Design Planning Implementation

Introduces frameworks and methods for effectively implementing change in organizations. Using cases, students will explore key failure modes, which undermine initiatives. In addition, students will identify principles, actions and measures that mitigate risk, improve implementation success, and inform stronger designs. (3-0-1.5)

ID 579
Production Methods

An introduction to the common methods used to produce or manufacture products. Alternative processes, materials and finishing methods, relative costs and applicability to design of products will be explored. (3-0-1.5)

ID 580
Design Workshop

Involves students from across the programs in projects that demonstrate how new theories and processes can be applied to complex design projects. (Credit: Variable)

ID 581
Photography Workshop

Involves students in a major project that is in the context of contemporary ideas in photography. (Credit: Variable)

ID 582
Communication Design Workshop

A project-oriented workshop focusing on design principles that link theoretical methods to practice in the area of human-centered communication design. Prerequisite: Graduate standing in design. (Credit: Variable)

ID 583
Product Design Workshop

A project-oriented workshop focusing on design principles that link theoretical methods to practice in the area of human-centered product design. Prerequisite: Graduate standing in design. (Credit: Variable)

ID 584
Design Planning Workshop

A project-oriented workshop that involves students in analyzing user needs, conceiving of innovations, and developing plans for new communications, products and businesses. Students will present their ideas through plans, prototypes and demonstrations. Prerequisite: Graduate standing in design. (Credit: Variable)

ID 588
Interactive Media Workshop

A project oriented survey of the methods and issues in the creation of interactive multimedia software. Methods will cover the use of several authoring systems and the effective use and combination of the five basic data types: text, graphics, sound, animation and video. Issues addressed will be metaphor, mapping, informational organization, interactive strategies, navigation, tailoring and alternative communication models for user-controlled environments. Prerequisite: Graduate standing in design. (Credit: Variable)

ID 589
Systems Design Workshop

Introduces the application of structured planning methods to complex design problems at the system level. Team techniques are emphasized, and formatted information handling and computer-supported structuring processes are used at appropriate stages of project definition, information development, structuring, concept development and communication. Corequisite: ID 529. (Credit: Variable)

ID 592
Research and Demonstration Project for M.Des. Degree
(Credit: Variable)

ID 598
Special Problems
(Credit: Variable)

ID 685
Research Seminar

Investigation and discussion by faculty and students of topics of interest from different perspectives such as building a design research discourse (reading research papers critically, selecting among publication venues); investigating alternative philosophical bases for design research (comparing empirical, pragmatic, and phenomenological approaches); or exploring methodological and theoretical conflicts in design research. (3-0-3)

ID 691
Research and Thesis for Ph.D.
(Credit: Variable)

Department of Electrical and Computer Engineering

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Department Chair:
Mohammad Shahidehpour

Graduate Program Director:
Jafar Saniie

The Department of Electrical and Computer Engineering offers academic programs in advanced study to graduates with technical background in preparation for careers in industry and in academic research. In addition to the doctoral and master's degrees, which are granted in recognition of research contribution and course work, the department offers a number of professional master's degrees and certificate programs to enable practicing engineers to pursue continuing education in their areas of interest.

Faculty members are engaged in research in the forefront of their fields, with funding derived from industrial and government research grants and contracts, which provide support to graduate students in the form of research assistantships, in addition to the development and the maintenance of the research facilities. The department also offers a number of fellowships and teaching assistantships on a competitive basis.

Admission to graduate study in one of the programs requires the completion of an undergraduate degree or its equivalent in electrical engineering, computer engineering, or other engineering disciplines from an accredited university. Individuals with background in other fields of engineering are required to complete courses in the core undergraduate curriculum before commencing graduate work.

For many years, the graduate programs offered by the department have facilitated the professionals in industry to advance their knowledge through the pursuit of graduate degrees. IIT Online, the interactive distance learning facility of IIT, provides support to continuing education by making numerous courses accessible via the Internet and a regional multi-channel television network serving over 50 industrial organizations in the metropolitan Chicago area.

Degrees Offered

Master of Science in Electrical Engineering
Master of Science in Computer Engineering
Master of Science in Computer Engineering and
    Electrical Engineering (dual degree)
Master of Electrical and Computer Engineering
Master of Biomedical Imaging and Signals

Master of Power Engineering
Master of VLSI and Microelectronics
Master of Network Engineering
Doctor of Philosophy in Electrical Engineering
Doctor of Philosophy in Computer Engineering

Joint-Degree Programs

With the Department of Computer Science:
Master of Telecommunications and Software Engineering

With Center for Financial Markets:
Master of Electricity Markets

Certificate Programs

Advanced Electronics
Applied Electromagnetics
Communication Systems
Computer Engineering
Control Systems

Electricity Markets
Power Electronics
Power Engineering
Signal Processing
Wireless Communications Engineering

Interdisciplinary Programs

Master of Science in Electrical Engineering with specialization in energy/environment/economics (E^3)

Master of Manufacturing Engineering
Master of Science in Manufacturing Engineering

Research Centers and Facilities

The department operates research laboratories for work in CAD for VLSI and SoC design, communications, computer networking, embedded computing, image processing and medical imaging, microwave electronics, power systems, signal processing and ultrasonic imaging. The Electric Power and Power Electronics Center supports research initiatives with support from industry and government in the areas of power systems, power electronics, electric machines, motor drives, and vehicular power systems. The department also collaborates with and utilizes the research resources of the Pritzker Institute of Biomedical Science and Engineering and nearby national laboratories.

Department of Electrical and Computer Engineering

Research Centers and Facilities continued

The department has state-of-the-art computer systems to enhance and extend the generally available system in the university. A primary resource is a network of more than 100 high-performance workstations, file servers, and computer servers, running the Unix/Linux operating system. With mass storage, CD-ROM drives, tape drives, and accelerated graphics, these systems provide students and researchers with an array of software tools including: programming languages (C, C++, Java, FORTRAN, Python, Perl, etc.), software development tools, software and hardware simulators, and electronic computer-aided design packages from companies such as Cadence, Synopsys, Avanti, Synplicity, Xilinx, Altera, Mentor Graphics, EPRI, and ESCA.

In addition to the workstations, the department maintains a collection of PCs for ECE students, including a set of machines that can be dedicated to hardware/software projects. The computers are connected via high-speed Ethernet, which in turn is connected to the university's backbone and the Internet.

Research Areas

Active research programs are conducted in the general areas of communication systems; computer systems and VLSI; electromagnetics and electronics; power and control systems; signal and image processing.

Faculty

Tricha Anjali, Assistant Professor. M. Tech. in Electrical Engineering, Indian Institute of Technology; Ph.D., Georgia Institute of Technology. Broadband networks, adaptive network management and optical networks.

Robert Arzbacher, Emeritus Professor. Ph.D., University of Illinois, Urbana-Champaign, Instrumentation, signal procesing and control.

Guillermo E. Atkin, Associate Professor. B.S., Universidad F. Santa Maria (Chile); Ph.D., University of Waterloo (Canada). Modulation and coding, digital mobile and wireless communication, spreadspectrum and optical communication systems.

Suresh Borkar, Senior Lecturer. B. Tech (EE) Indian Institute of Technology (India); MS and Ph.D., Illinois Institute of Technology, Wireless and wireline telecommunications, operating systems, architecture, and performance of computer and network systems.

Jovan G. Brankov, Research Assistant Professor. Dipl. Ing., Electrical Engineering, University of Belgrade; M.Sc., Ph.D., Illinois Institute of Technology. Medical imaging, image sequence processing, pattern recognition and data mining.

Yu Cheng, Assistant Professor. B.E. and M.E., Tsinghua University (China); Ph.D. the University of Waterloo (Canada), Computer network management, Internet measurement, performance analysis, and quality of service provisioning, wireless networks, and wireless/wireline interworking.

Ali Emadi, Professor, B.S., M.S., Sharif University of Technology (Iran); Ph.D., Texas A&M University. Power electronics, motor drives, electric machines, vehicular power systems.

Alexander J. Flueck, Associate Professor. B.S., M.E., Ph.D., Cornell University. Power systems, computational methods, control systems.

Zuyi Li, Assistant Professor. B.S. (EE), Shanghai Jiaotong University (China); M.S., Tsinghua University (China); Ph.D., Illinois Institute of Technology. Market operation of electric power system, security-constrained unit commitment, arbitrage in electricity market, market power analysis and risk management, ancillary services auction, transmission pricing.

Joseph L. LoCicero, Professor. B.E.E., M.E.E., City College of New York; Ph.D., City University of New York. Communication and digital signal processing, speech and image processing, discrete multitone communications, automatic speech recognition, ultra-wideband communications.

Erdal Oruklu, Assistant Professor. B.S., Technical University of Istanbul (Turkey); M.S., Bogazici University (Turkey); Ph.D., Illinois Institute of Technology. VLSI and SoC design, signal processing architectures, digital arithmetic, computer systems.

Gerald F. Saletta, EmeritusProfessor. B.S., M.S., University of Notre Dame; Ph.D., Illinois Institute of Technology. Electronics, digital systems.

Jafar Saniie, Professor, Graduate Program Director, and Computer Engineering Director. B.S., University of Maryland; M.S., Case Western Reserve University; Ph.D., Purdue University. Embedded computing, DSP architectures, signal and image processing, detection and estimation, ultrasonic imaging for both medical and industrial applications.

Marco Saraniti, Associate Professor. B.A., University of Modena (Italy); Ph.D., Techniche University Munich (Germany) Computational electronics and numerical methods applied to particle-based 2-D and 3-D physical simulation of semiconductor devices.

Mohammad Shahidehpour, Carl and Paul Bodine Professor, and Department Chair. B.S., Arya-Mehr University of Technology (Iran); M.S., Ph.D., University of Missouri, Columbia. Large-scale power systems, nonlinear stochastic systems, optimization theory.

Henry Stark, Motorola Professor. B.E.E., City College of New York; M.S., D.Eng.Sc., Columbia University. Image reconstruction, medical imaging, pattern recognition, signal processing and sampling theory, optics.

Donald R. Ucci, Associate Professor and Associate Provost. B.E., M.E., Ph.M., City College of New York; Ph.D., City University of New York. Adaptive systems, signal processing, communications, stochastic processes.

Dimitrios Velenis, Assistant Professor. B.S., Technical University of Crete (Greece), M.S., Ph.D. University of Rochester. Noise tolerant clock distribution network, VLSI.

Department of Electrical and Computer Engineering

Faculty continued

Albert Z. Wang, Associate Professor. B.E., Tsinghua University (China); M.S., The Chinese Academy of Sciences (China); Ph.D., State University of New York at Buffalo. Analog/Mixed-Signal/RF/low-power integrated circuits, IC reliability engineering, VLSI CAD, semiconductor devices and modeling.

Erwin W. Weber, Emeritus Professor, B.S., M.S., Ph.D., Illinois Institute of Technology, Electromagnetics, RF electronics, antenna theory.

Miles Wernick, Professor and Director of Medical Imaging. B.A., Northwestern University; Ph.D., University of Rochester. Medical imaging, image processing, pattern recognition.

Geoffrey Williamson, Professor. B.S., M.S., Ph.D., Cornell University. Adaptive filtering, signal processing and control, parameter estimation and system identification, control systems, robust control theory.

Thomas T. Y. Wong, Professor. B.S., University of Hong Kong; M.S., Ph.D., Northwestern University. Microwave communications systems, nonlinear device measurement, semiconductor device theory, microwave electronics and instrumentation.

Yongyi Yang, Associate Professor. B.S., M.S., Northern Jiatong University (China); M.S., Ph.D., Illinois Institute of Technology. Image and signal processing, data compression, applied mathematical and statistical methods.

Imam Samil Yetik, Assistant Professor. B.S., Bogazici University (Turkey), M.S., Bilkent University (Turkey), Ph.D., University of Illinois at Chicago, Statistical signal and image processing with applications to biomedicine.

Chi Zhou, Assistant Professor. B.S., Tsinghua University (China), M.S. and Ph.D., Northwestern University, Resource allocation and power control for multimedia cellular networks, integration of 3G, WLAN, WiMAX and SONET, sensor networks, jamming avoidance over OFDM or MIMO systems.

Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0
GRE minimum score:
For tests taken prior to Oct.1, 2002, M.S./MAS/Ph.D.: 1500 (combined)
For tests taken on or after Oct.1, 2002, M.S./MAS: 1100 (quantitative + verbal) 3.5 (analytical writing)
For tests taken on or after Oct.1, 2002 Ph.D.: 1100 (quantitative + verbal) 3.5 (analytical writing)
TOEFL minimum score: 550/213*

Meeting the minimum GPA and test score requirements does not guarantee admission. Test scores and GPA are just two of several important factors considered. Professional Master s degrees in electrical and computer engineering, network engineering, telecommunication and software engineering, and electricity markets do not require GRE scores for applicants who hold undergraduate degrees from universities in the United States with a minimum cumulative GPA of 3.0/4.0.

Admission to the master s degree programs normally requires a bachelor s degree from an accredited institution in electrical engineering or computer engineering. Applicants with backgrounds in other fields with proficiency in engineering sciences, physics, mathematics or computer science, gained through prior coursework or professional experience, are also eligible for admission, but will be required to demonstrate proficiency in the subject matter covered in undergraduate courses that are prerequisites for the chosen graduate program.

Proficiency may be demonstrated by passing a written exam or by taking and passing, with a grade of "B" or better, prerequisite undergraduate courses at IIT. Specific course prerequisites for each degree program are listed within the program description.

Admission to the doctoral program requires a master s degree. Each entering degree-seeking graduate student is assigned a temporary academic adviser who will provide initial guidance to the candidate. As their research and other academic interests become defined, students may opt to select a new permanent adviser.

Non-degree graduate students should consult with the department adviser. Students are responsible for following the guidelines of the graduate programs set by the department, in conjunction with the regulations of the Graduate College.

*Paper-based test score/computer-based test score.

Department of Electrical and Computer Engineering

Master of Science in Electrical Engineering

32 credit hours
Thesis option

The purpose of this degree is to prepare students for advanced study and/or research and industry in the field of electrical engineering. The Master of Science in Electrical Engineering (M.S.E.E.) is a degree program combining breadth across several areas of study within electrical engineering and specialization within one area, which includes an option to pursue thesis research under the guidance of a faculty adviser. Areas of study include communication and signal processing; electronics and electromagnetics; power and control systems; and computer engineering. The program is normally completed in three semesters of full-time study.

Students whose accredited B.S. degree is not in electrical engineering may pursue the M.S.E.E. provided that they have an adequate background and can demonstrate proficiency in the material contained in undergraduate courses equivalent to IIT s ECE 211 and ECE 213 (Circuit Analysis I and II), ECE 218 (Digital Systems), ECE 307 (Electrodynamics), ECE 308 (Signals and Systems), ECE 311 (Engineering Electronics), MATH 251 (Multivariate and Vector Calculus), and MATH 252 (Introduction to Differential Equations). A student may demonstrate proficiency by successfully completing the courses or by demonstrating satisfactory performance in one or more special examinations administered by the department.

The program of study includes a minimum of 32 credit hours of acceptable graduate coursework, with a minimum of 20 credit hours of ECE courses at the 500-level or higher, excluding masters seminars. Up to two credits of Master's Seminar (ECE 595 or ECE 596) and up to six credits of ECE short courses may be applied to the degree. Students, with their adviser, select courses appropriate to their needs and interests.

The program of study must include four courses within one of the electrical engineering (EE) areas of concentration listed below and one course from two of the remaining three areas. (For example, a student might elect to take four courses in communication theory and signal processing; one course in networks, electronics and electromagnetics; and one course in computer engineering.) Courses listed in more than one area (e.g., ECE 545) may be applied to only one area to fulfill the academic requirements.

One advanced mathematics course is also required (unless such a course was completed in the student's undergraduate program). Acceptable courses include ECE 505 (Applied Optimization for Engineers); any 400- or 500-level mathematics course, excluding MATH 474 (Probability and Statistics), MATH 475 (Probability), ECE 475 (Random Phenomena in Electrical Engineering), MATH 490 (History of Mathematics), and any variable-credit course; CHE 536 (Computational Techniques in Engineering); MMAE 504 (Engineering Analysis Ia); MMAE 501 (Engineering Analysis Ib); MMAE 502 (Engineering Analysis II); MMAE 503 (Advanced Engineering Analysis); MMAE 505 (Numerical Methods in Engineering); MMAE 506 (Computational Methods in Engineering Analysis); and MMAE 508 (Perturbation Methods).

An M.S.E.E. candidate may, with permission of a thesis adviser, include in his or her program a thesis of six to eight credit hours. The master's thesis is recommended for pre-doctoral students. The thesis option requires a written thesis and an oral defense of the thesis. Thesis format and deadlines are set by the Graduate College.

Department of Electrical and Computer Engineering

EE Areas of Concentration

I. Communication Theory and Signal Processing

ECE 401	Communication Electronics
ECE 403	Communication Systems
ECE 404	Digital and Data Communications
ECE 406	Digital and Data Communications with Laboratory
ECE 407	Introduction to Computer Networks
ECE 409	Communication Electronics with Laboratory
ECE 436	Digital Signal Processing I with Laboratory
ECE 437	Digital Signal Processing I
ECE 481	Image Processing
ECE 504	Wireless Communication System Design
ECE 508	Signal and Data Compression
ECE 511	Analysis of Random Signals
ECE 513	Communication Engineering Fundamentals
ECE 514	Digital Communication Principles
ECE 515	Modern Digital Communications
ECE 519	Coding for Reliable Communications
ECE 541	Performance Evaluation of Computer Networks
ECE 542	Design and Optimization of Computer Networks
ECE 545	Advanced Computer Networks
ECE 565	Computer Vision and Image Processing
ECE 566	Statistical Pattern Recognition
ECE 567	Statistical Signal Processing
ECE 568	Digital Speech Processing
ECE 569	Digital Signal Processing II
ECE 570	Fiber Optic Communication Systems
ECE 584	VLSI Architectures for Signal Processing and Communications

II. Electronics and Electromagnetics

ECE 401	Communication Electronics
ECE 409	Communication Electronics with Laboratory
ECE 411	Power Electronics
ECE 414	Audio and Electroacoustics
ECE 415	Solid-State Electronics
ECE 421	Microwave Circuits and Systems
ECE 423	Microwave Circuits and Systems with Laboratory
ECE 425	Analysis and Design of Integrated Circuits
ECE 429	Introduction to VLSI Design
ECE 470	Photonics
ECE 471	Photonics with Laboratory
ECE 502	Basic Network Theory
ECE 509	Electromagnetic Field Theory
ECE 521	Quantum Electronics
ECE 522	Electromagnetic Compatibility
ECE 524	Advanced Electronic Circuit Design
ECE 525	RF Integrated Circuit Design
ECE 526	Active Filter Design
ECE 527	Performance Analysis of RF Integrated Circuits
ECE 529	Advanced VLSI Systems Design
ECE 530	High Performance VLSI/IC Systems
ECE 550	Power Electronic Dynamics and Control
ECE 551	Advanced Power Electronics
ECE 570	Fiber Optic Communication Systems
ECE 571	Nanodevices and Technology
ECE 575	Electron Devices
ECE 576	Antenna Theory
ECE 577	Advanced Antenna Theory
ECE 578	Microwave Theory
ECE 579	Numerical Methods in Electromagnetics and Solid-State Electronics

III. Power and Control Systems

ECE 411	Power Electronics
ECE 412	Electric Motor Drives
ECE 419	Power Systems Analysis
ECE 420	Analytical Methods in Power Systems
ECE 434	Control Systems with Laboratory
ECE 438	Control Systems
ECE 506	Analysis of Nonlinear Systems
ECE 531	Linear System Theory
ECE 535	Discrete Time Systems
ECE 537	Optimal Feedback Control
ECE 540	Reliability Theory and System Implementation
ECE 549	Motion Control Systems Dynamics
ECE 550	Power Electronic Dynamics and Control
ECE 551	Advanced Power Electronics
ECE 552	Adjustable Speed Drives
ECE 553	Power System Planning
ECE 554	Power Systems Relaying
ECE 555	Power Market Operations
ECE 556	Power Market Economics and Security
ECE 557	Fault-Tolerant Power Systems
ECE 558	Power System Reliability
ECE 559	High-Voltage Power Transmission
ECE 560	Power Systems Dynamics and Stability
ECE 561	Deregulated Power Systems
ECE 562	Power System Transaction Management
ECE 563	Computational Intelligence in Engineering
ECE 564	Control and Operation of Electric Power Systems

IV. Computer Engineering

ECE 407	Introduction to Computer Networks
ECE 425	Analysis and Design of Integrated Circuits
ECE 429	Introduction to VLSI Design
ECE 441	Microcomputers
ECE 446	Advanced Logic Design
ECE 448	Computer Systems Programming
ECE 449	Object-Oriented Programming and Computer Simulation
ECE 485	Computer Organization and Design
ECE 529	Advanced VLSI Systems Design
ECE 530	High Performance VLSI/IC Systems
ECE 541	Performance Evaluations of Computer Networks
ECE 542	Design and Optimization of Computer Networks
ECE 543	Computer Network Security
ECE 545	Advanced Computer Networks
ECE 565	Computer Vision and Image Processing
ECE 583	High Speed Computer Arithmetic
ECE 584	VLSI Architectures for Signal Processing and Communications
ECE 585	Advanced Computer Architecture
ECE 586	Fault Detection in Digital Circuits
ECE 587	Hardware/Software Codesign
ECE 588	CAD Techniques for VLSI Design

Department of Electrical and Computer Engineering

Master of Science in Computer Engineering

32 credit hours
Thesis option

The purpose of this degree is to prepare students for advanced study and/or research and industry in the field of computer engineering. The Master of Science in Computer Engineering (M.S.CP.E.) program builds a strong foundation in all aspects of the design and development of computer systems, with a specialization in a major area. Students have the option to pursue thesis research under the guidance of a faculty adviser. Areas of study include computer hardware design, computer networking and telecommunications, and computer system and application software. The program is normally completed in three semesters of full-time study. Students whose accredited B.S. degree is not in computer engineering may pursue the M.S.CP.E.,provided that they have an adequate background and can demonstrate proficiency in the material contained in the following undergraduate courses: ECE 211 and ECE 213 (Circuit Analysis I and II), ECE 218 (Digital Systems), ECE 242 or CS 350 (Digital Computers and Computing), ECE 311 (Engineering Electronics), CS 201 (i.e., CS 115 and CS 116 combined, Object Oriented Programming I-II), CS 401 (Introduction to Advanced Studies in CS), and MATH 252 (Introduction to Differential Equations). A student may demonstrate proficiency by successfully completing the courses or by demonstrating satisfactory performance in one or more special examinations administered by the department.

The program of study includes a minimum of 32 credit hours of acceptable graduate coursework, with a minimum of 21 credit hours of ECE coursework. A minimum of 20 credit hours must be taken at the 500-level or higher excluding short courses and Master's Seminar. Up to two credits of master's seminar (ECE 595 or ECE 596), and up to six credits of ECE short courses may be applied to the degree. Students, in consultation with their adviser, select courses appropriate to their needs and interests. The program of study must include two core and two elective courses within one of the following computer engineering (CPE) areas of concentration, and at least one core course from the remaining two areas.

An M.S.CP.E. candidate may, with permission of a thesis adviser, include in his or her program a thesis of six to eight credit hours. The master's thesis is strongly recommended for pre-doctoral students. The thesis option requires a written thesis and an oral defense of the thesis. Thesis format and deadlines are set by the Graduate College.

CPE Areas of Concentration and Curriculum

Computer Hardware Design
Core courses

ECE 529	Advanced VLSI Systems Design **AND/OR**	
ECE 429	Introduction to VLSI Design	
AND		
ECE 585	Advanced Computer Architecture	

Elective courses

ECE 425	Analysis and Design of Integrated Circuits
ECE 441	Microcomputers
ECE 446	Advanced Logic Design
ECE 485	Computer Organization and Design
ECE 530	High Performance VLSI/IC Systems
ECE 583	High Speed Computer Arithmetic
ECE 584	VLSI Architectures for Signal Processing and Communications
ECE 585	Advanced Computer Architecture
ECE 586	Fault Detection in Digital Circuits
ECE 587	Hardware/Software Codesign
ECE 588	CAD Techniques for VLSI Design

Computer Systems Software
Core courses

CS 550	Comparative Operating Systems
CS 551	Operating System Design and Implementation

Elective courses

ECE 448	Computer Systems Programming
ECE 449	Object-Oriented Programming and Computer Simulation
ECE 587	Hardware/Software Codesign
CS 487	Software Engineering I
CS 545	Distributed Computing Landscape
CS 546	Parallel and Distributed Processing
CS 555	Analytic Models and Simulation of Computer Systems
CS 586	Software Systems Architectures
CS 587	Software Project Management
CS 588	Advanced Software Engineering Development
CS 589	Software Testing and Analysis

Networks and Telecommunications
Core courses

ECE 407	Introduction to Computer Networks AND/OR	
ECE 545	Advanced Computer Networks	
AND		
ECE 541	Performance Evaluation of Computer Networks	
AND/OR		
ECE 542	Design and Optimization of Computer Networks	

Elective courses

ECE 504	Wireless Communication System Design
ECE 508	Signal and Data Compression
ECE 511	Analysis of Random Signals
ECE 513	Communication Engineering Fundamentals
ECE 514	Digital Communication Principles
ECE 515	Modern Digital Communications
ECE 519	Coding for Reliable Communications
ECE 543	Computer Network Security
ECE 570	Fiber Optic Communication Systems
ECE 584	VLSI Architectures for Signal Processing and Communications
CS 455	Data Communications
CS 544	Computer Networks II: Network Services

Department of Electrical and Computer Engineering

Master of Science in Computer Engineering and Electrical Engineering

(dual degree)
45 credit hours
Thesis option

The purpose of the Master of Science in Computer Engineering and Electrical Engineering (M.S.CP.E./E.E.) is to prepare students for advanced study and/or research, or for industry in the field of both computer and electrical engineering. The M.S.CP.E./E.E. program provides for a strong foundation in all aspects of the design and development of computer systems, and also offers several areas of study within electrical engineering. There is also an option to pursue thesis research under the guidance of a faculty adviser.

There is a growing need for engineers with a strong educational background in both computer engineering and electrical engineering. In the M.S.CP.E./E.E. program students will be introduced to topics important to the computer engineering field such as computer hardware design, computer networks and software engineering, as well as topics in electrical engineering such as communications and signal processing, electronics and electromagnetics, and power and control systems. The program of study includes a minimum of 45 credit hours of acceptable graduate coursework in both computer engineering and electrical engineering. M.S.CP.E./E.E. degree requirements are described in the section below. Requirements for the M.S.CP.E./E.E. fully satisfy the existing requirements for an M.S. in Computer Engineering and an M.S. in Electrical Engineering. The program is normally completed in four semesters of full-time study.

Admission requirements for the CPE/EE are the same as those for admission to the Master of Science in Computer Engineering or electrical engineering. Students whose accredited B.S. degree is not in computer and/or electrical engineering may pursue the CPE/EE degree, provided that they have an adequate background and can demonstrate proficiency in the material contained in the following undergraduate courses: ECE 211 and ECE 213 (Circuit Analysis I and II), ECE 218 (Digital Systems), ECE 242 or CS 350 (Digital Computers and Computing), ECE 311 (Engineering Electronics), CS 201 (i.e., CS 115 and CS 116 combined, Object Oriented Programming I-II), CS 401 (Introduction to Advanced Studies in CS), and MATH 252 (Introduction to Differential Equations). A student may demonstrate proficiency by successfully completing the courses or by demonstrating satisfactory performance in one or more special examinations administered by the department.

The description of the CPE areas of concentration is in the Master of Science in Computer Engineering section. A description of the EE areas of concentration is in the Master of Science in Electrical Engineering section. In addition to all university requirements for a Master of Science degree, the M.S.CP.E./E.E. degree has the following requirements:

1. A minimum of 45 credit hours of graduate level coursework including:

    Two core courses in a CPE major area, chosen from among the CPE areas of concentration.

    Two elective courses in the CPE major area, chosen from among the CPE areas of concentration.

    One core course from each of two remaining areas of CPE concentration.

    Four (or more) courses within an EE major area, chosen from among the EE areas of concentration (Areas I, II and III).

    One (or more) course(s) in each of two EE minor areas, chosen from among the Areas I, II and III outside the major.

    One advanced mathematics course required for EE major area unless included in the B.S. degree.

    Additional coursework approved by the academic adviser

The CPE/EE Program is subject to the following restrictions: a minimum of 30 credit hours of coursework at the 500-level or higher; at least 30 credit hours of ECE courses excluding short courses and Master's Seminars; no more than six credit hours of ECE short courses; six to eight credit hours of research work (ECE 591) leading to an M.S. dissertation may be included with the approval of a thesis adviser; and a maximum of two credits of a Master's Seminar (ECE 595 and ECE 596)

2. A GPA of at least 3.0/4.0 (excluding prerequisites and proficiencies).

Courses classified in two areas may be applied to only one area to fulfill requirements. Intersession short courses may not be used to satisfy distribution requirements in major and minor areas.

Each regular (matriculated) graduate student is assigned an academic adviser, indicated in his/her formal letter of admission to the master's program.

Students should consult with their academic adviser to file a program of study meeting these requirements prior to four months after initial registration for full-time students and prior to enrolling beyond 12 credits for part-time students.

Department of Electrical and Computer Engineering

Master of Electrical and Computer Engineering

30 credit hours

The purpose of this degree is to prepare students for leading edge positions in industry in the field of electrical and computer engineering. The Master of Electrical and Computer Engineering (M.E.C.E.) is a course-only degree program that prepares students for professional practice in electrical and computer engineering. The program can be completed in one year of full-time study. Students whose accredited B.S. degree is not in electrical engineering or computer engineering may pursue the M.E.C.E. provided that they have an adequate background and can demonstrate proficiency in the material contained in undergraduate courses equivalent to IIT's ECE 211 and ECE 213 (Circuit Analysis I and II), ECE 218 (Digital Systems), ECE 307 (Electrodynamics), ECE 308 (Signals and Systems), ECE 311 (Engineering Electronics), MATH 251 (Multivariate and Vector Calculus), and MATH 252 (Introduction to Differential Equations). Students should visit the appropriate department for course descriptions.

A student may demonstrate proficiency by successfully completing the courses or by demonstrating satisfactory performance in one or more special examinations administered by the department.

The program of study includes a minimum of 30 credit hours of acceptable graduate coursework, with a minimum of 24 credit hours in electrical and computer engineering and a minimum of 18 credit hours at the 500-level or higher. Up to two credits of Master's Seminar (ECE 595 or ECE 596) and up to six credits of ECE short courses may be applied to the degree. Students arrange their program of study in consultation with their adviser and typically elect to build their program to emphasize one or more areas of specialization. No formal distribution requirements are imposed. Areas of specialization include communication systems, computer communication, computer engineering, control systems, electromagnetics, electronics, networks, photonics and optics, power systems and signal processing.

Master of Biomedical Imaging and Signals

30 credit hours

The purpose of this degree program is to prepare students for leading edge positions in industry in the areas of biomedical imaging and signal processing. The Professional Master of Biomedical Imaging and Signals is a course-only degree program that prepares students for professional practice.

The interdisciplinary nature of bioengineering generally involves many facets of electrical and computer engineering. The Department of Electrical and Computer Engineering offers several courses and research opportunities that engage students interested in biomedical engineering. In addition, there are a significant number of courses offered by the Biomedical Engineering Department and other disciplines at IIT which are of great importance to students interested in the professional master's degree in biomedical engineering with specialization in medical imaging and bio-signals.

The admission requirements for the proposed degree will follow the existing admission requirements for such professional master's degrees in ECE Department. Students whose accredited B.S. degree is not in electrical and computer engineering may pursue the professional master's degree provided that they have an adequate background and can demonstrate proficiency in the material contained in undergraduate courses equivalent to IIT's ECE 211 and ECE 213 (Circuit Analysis I and II), ECE 218 (Digital Systems), ECE 307 (Electrodynamics), ECE 308 (Signals and Systems), ECE 311 (Engineering Electronics), BIOL 107 (General Biology Lectures), MATH 251 (Multivariate and Vector Calculus), and MATH 252 (Introduction to Differential Equations). A student may demonstrate proficiency by successfully completing the courses or by demonstrating satisfactory performance in one or more special examinations administered by the department.

Students can pursue a professional master's degree in the area of Biomedical Imaging and Signals by completing the required core and elective courses.

Required Core Courses

ECE 511	Analysis of Random Signals
ECE 565	Computer Vision and Image Processing and/or ECE 481 Image Processing
ECE 569	Digital Signal Processing II and /or ECE 437 Digital Signal Processing I
BME 450	(or BIOL 430) Physiology

ECE Elective Courses
minimum of 2 courses

ECE 508	Data Compression
ECE 505	Applied Optimization For Engineers
ECE 566	Statistical Pattern Recognition
ECE 567	Statistical Signal Processing
ECE 568	Digital Speech Processing
ECE 597	Special Project in Biomedical Imaging and Signals

BME Elective Courses
minimum of 1 course

BME 430	Concepts of Medical Imaging
BME 501	Biomedical Instrumentation
BME 532	Medical Imaging Science
BME 535	Magnetic Resonance Imaging
BME 538	Neuroimaging
BME 551	Physiological Signal Analysis & Control Theory I
BME 552	Physiological Signal Analysis & Control Theory II
BME 597	Wave Physics and Applied Optics for Imaging Scientist

With advisor's approval, students may take up to two senior or graduate level courses in biology, chemistry, mathematics, physics, chemical engineering, or mechanical engineering on subjects related to biomedical engineering.

Department of Electrical and Computer Engineering

Master of Power Engineering

30 credit hours

The purpose of this degree program is to prepare students for leading edge positions in industry in the areas of electric power, power electronics, motor drives, and electric machines. The Professional Master of Power Engineering is a course-only degree program that prepares students for professional practice in power engineering.

The admission requirements for the proposed degree will follow the existing admission requirements for such professional master's degrees in ECE Department. Students whose accredited B.S. degree is not in electrical engineering may pursue the professional master's degree provided that they have an adequate background and can demonstrate proficiency in the material contained in undergraduate courses equivalent to IIT's ECE 211 and ECE 213 (Circuit Analysis I and II), ECE 311 (Engineering Electronics), ECE 319 (Fundamentals of Power Engineering), MATH 251 (Multivariate and Vector Calculus), and MATH 252 (Introduction to Differential Equations). A student may demonstrate proficiency by successfully completing the courses or by demonstrating satisfactory performance in one or more special examinations administered by the ECE department.

The program of study includes a minimum of 30 credit hours of acceptable coursework with a minimum of 24 credit hours from the following list of core and elective courses (up to 6 credit hours may be selected from other ECE courses). A minimum of 18 credit hours at the 500-level or higher must be selected. Up to 2 credit hours of theMaster's Seminar (ECE 595 or ECE 596), up to 3 credit hours of a Graduate Special Project in power engineering (ECE 594 or ECE 597), and up to 6 credit hours of ECE short courses may be applied to the degree.

Required Core Courses

(minimum of 3 courses):

ECE 564	Control and Operation of Electric Power Systems and/or ECE 420 Analytical Methods in Power Systems
ECE 551	Advanced Power Electronics and/or ECE 411 Power Electronics
ECE 419	Power Systems Analysis
ECE 412	Electric Motor Drives

Elective Courses in Power Systems

(minimum of 2 courses):

ECE 553	Power System Planning
ECE 554	Power Systems Relaying
ECE 555	Power Market Operations
ECE 556	Power Market Economics and Security
ECE 557	Fault-Tolerant Power Systems
ECE 558	Power System Reliability
ECE 559	High-Voltage Power Transmission
ECE 560	Power Systems Dynamics and Stability
ECE 561	Deregulated Power Systems
ECE 562	Power System Transaction Management
ECE 563	Computational Intelligence in Engineering
CHE 543	Energy, Environment and Economics

Elective Courses in Power Electronics and Motor Drives

(minimum of 2 courses):

ECE 437	Digital Signal Processing I
ECE 438	Control Systems
ECE 531	Linear System Theory
ECE 549	Motion Control Systems Dynamics
ECE 550	Power Electronic Dynamics and Control
ECE 552	Adjustable Speed Drives
ECE 752	Industrial Applications of Power Electronics and Motor Drives
ECE 764	Vehicular Power Systems
CHE 541	Renewable Energy Technologies
CAE 524	Design Building Enclosures

Department of Electrical and Computer Engineering

Master of VLSI and Microelectronics

30 credit hours

The purpose of this degree program is to prepare students for leading edge positions in industry in the areas of VLSI and microelectronics. The Professional Master of VLSI and Microelectronics is a course-only degree program that prepares students for professional practice. Students can pursue a professional master's degree in the area of VLSI and Microelectronics by completing the required core courses; ECE 425, ECE 429, ECE 529, and ECE 575 (and/or ECE 415) and selecting six additional courses from a combination of computer engineering electives, electronics electives, and other areas in electrical and computer engineering. A minimum of 18 credit hours at the 500-level or higher must be selected. With advisor approval the student may take up to two ECE courses in other areas of electrical and computer engineering such as signal processing, communications, power and control.

The admission requirements for the proposed degree will follow the existing admission requirements for such professional master's degrees in ECE Department. Students whose accredited B.S. degree is not in electrical engineering may pursue the professional master's degree provided that they have an adequate background and can demonstrate proficiency in the material contained in undergraduate courses equivalent to IIT's ECE 211 and ECE 213 (Circuit Analysis I and II), ECE 218 (Digital Systems), ECE 307 (Electrodynamics), ECE 308 (Signals and Systems), ECE 311 (Engineering Electronics), MATH 251 (Multivariate and Vector Calculus), and MATH 252 (Introduction to Differential Equations). A student may demonstrate proficiency by successfully completing the courses or by demonstrating satisfactory performance in one or more special examinations administered by the ECE department.

Required Core Courses

(minimum of 4 core courses)

ECE 425	Analysis and Design of Integrated Circuits
ECE 429	Introduction to VLSI Design
ECE 529	Advanced VLSI Systems Design
ECE 575	Electron Devices and/or ECE 415 Solid-State Electronics

Computer Engineering Elective Courses

(minimum of one course)

ECE 485	Computer Organization and Design
ECE 530	High Performance VLSI/IC Systems
ECE 542	Design and Optimization of Computer Networks
ECE 545	Advanced Computer Networks
ECE 583	High Speed Computer Arithmetic
ECE 584	VLSI Architectures for Signal Processing and Communications
ECE 585	Advanced Computer Architecture
ECE 586	Fault Detection in Digital Circuits
ECE 587	Hardware/Software Codesign
ECE 588	CAD Techniques for VLSI Design

Electronics Elective Courses

(minimum of one course)

ECE 521	Quantum Electronics
ECE 524	Advanced Electronic Circuit Design
ECE 525	RF Integrated Circuit Design
ECE 526	Active Filter Design
ECE 527	Performance Analysis of RF Integrated Circuits
ECE 551	Advanced Power Electronics
ECE 570	Fiber Optic Communication Systems
ECE 571	Nanodevices and Technology
ECE 578	Microwave Theory
ECE 579	Numerical Methods in Electromagnetics and Solid-State Electronics

Department of Electrical and Computer Engineering

Master of Network Engineering

30 credit hours

The Master of Network Engineering (M.N.E.) is a course-only degree program that prepares students for professional practice in network engineering and information technologies. The program offered by the Department of Electrical and Computer Engineering (ECE) can be completed in one year of full-time study. A person holding a B.S.E.E. or a B.S.CP.E degree has the necessary background to undertake the M.N.E. program. A student without adequate background is required to demonstrate proficiency in the following courses: ECE 211 (Circuit Analysis I), ECE 213 (Circuit Analysis II), ECE 308 (Signals and Systems), MATH 252 (Introduction to Differential Equations) MATH 474 (Probability), and CS 401 (Introduction to Advanced Studies in Computer Science). A student may demonstrate proficiency by successfully completing the courses or by demonstrating satisfactory performance in one or more special examinations administered by the department.

The M.N.E. is a focused professional master's degree requiring a minimum of 30 credit hours of adviser-approved coursework. The M.N.E. program of studies must include a minimum of 24 credit hours of ECE coursework, 12 credit hours of required core courses, 12 credit hours of MNE elective courses, and six credit hours of adviser approved elective courses. At least 18 credit hours of the courses must be at the 500 level. A maximum of six credit hours may be taken from the ECE 700-level short courses.

Required courses

(12 credit hours)

ECE 407   Introduction to Computer Networks
AND/OR
ECE 545   Advanced Computer Networks
AND
ECE 511   Analysis of Random Signals

ECE 513   Communication Engineering Fundamentals
ECE 541   Performance Evaluation of Computer Networks
AND/OR
ECE 542   Design and Optimization of Computer Networks

Elective courses

(12 credit hours)

This coursework is taken from the 400-, and 500-level courses listed below, and approved by the M.N.E. adviser. A maximum of six credit hours of ECE short courses can be included in the M.N.E. program of studies.

ECE 403   Communication Systems
ECE 404   Digital and Data Communications
ECE 437   Digital Signal Processing I
ECE 470   Photonics
ECE 485   Computer Organization and Design
ECE 504   Wireless Communication System Design
ECE 508   Signal and Data Compression
ECE 514   Digital Communication Principles
ECE 515   Modern Digital Communications
ECE 519   Coding for Reliable Communications
ECE 543   Computer Network Security
ECE 565   Computer Vision and Image Processing
ECE 568   Digital Speech Processing
ECE 569   Digital Signal Processing II
ECE 570   Fiber-Optic Communication Systems
ECE 583   High Speed Computer Arithmetic
ECE 584   VLSI Architectures for Signal Processing and Communications
ECE 585   Digital Computer Design
CS 455   Data Communications
CS 544   Computer Networks II: Network Services
CS 548   Broadband Networks

Department of Electrical and Computer Engineering

Master of Telecommunications and Software Engineering

30 credit hours

The Master of Telecommunications and Software Engineering (M.T.S.E.) is a course-only degree program that prepares students for professional practice in telecommunications and information technologies. The program, jointly offered by the Department of Electrical and Computer Engineering (ECE) and Department of Computer Science (CS), can be completed in one year of full-time study.

Eligibility: A person holding a B.S.E.E., a B.S.CP.E. or a B.S.C.S. degree has the necessary broad background to undertake the M.T.S.E. program. A student without adequate background in specific areas is required to demonstrate proficiency in prerequisite courses; an abbreviated list is given below.

Specific proficiency courses will be detailed for each student at the time of admission to the M.T.S.E. program. A student may demonstrate proficiency by successfully completing the courses or by demonstrating satisfactory performance in one or more special examinations administered by the department.

Computer science prerequisites

CS 201	(i.e., CS 115 and CS 116 combined, Object Oriented Programming I-II)
CS 401	Introduction to Advanced Studies

Electrical and computer engineering prerequisites

ECE 211	Circuit Analysis I
ECE 213	Circuit Analysis II
ECE 308	Signals and Systems
MATH 252	Introduction to Differential Equations
MATH 474	Probability

The M.T.S.E. is a professional master's degree requiring a minimum of 30 credit hours of adviser-approved coursework. The M.T.S.E. program of studies must include a minimum of 15 credit hours of ECE coursework (excluding short courses and seminars) and a minimum of 12 credit hours of computer science coursework.

Five required courses and one elective course from each of the three categories given below must appear on the M.T.S.E. program of studies.

M.T.S.E. Curriculum

Required courses

ECE 407	Introduction to Computer Networks **AND/OR** ECE 545
ECE 545	Advanced Computer Networks
ECE 513	Communication Engineering Fundamentals
ECE 541	Performance Evaluation of Computer Networks **AND/OR** ECE 542
ECE 542	Design and Optimization of Computer Networks
CS 586	Software Systems Architecture
CS 587	Programming Project Management

Elective categories

I. Software Engineering

CS 521	Object-Oriented Analysis and Design
CS 537	Software Metrics
CS 589	Software Testing and Analysis

II. Telecommunication Systems

ECE 543	Computer Network Security
CS 544	Computer Networks II: Network Services
CS 548	Broadband Networks
CS 555	Analytic Models and Simulation of Computer Systems

III. Telecommunications

ECE 504	Wireless Communication System Design
ECE 514	Digital Communication Principles
ECE 515	Modern Digital Communications
ECE 519	Coding for Reliable Communications

The remaining nine credit hours of coursework may be taken from courses listed above, or other courses approved by the M.T.S.E. adviser. Students without a background in communications or software engineering should consider including in their program of studies:

ECE 403	Communication Systems
CS 487	Software Engineering I
CS 450	Operating Systems I
CS 455	Data Communications

Other courses that students in this program typically choose from include:

ECE 437	Digital Signal Processing I
ECE 508	Signal and Data Compression
ECE 511	Analysis of Random Signals
ECE 515	Modern Digital Communications
ECE 565	Computer Vision and Image Processing
ECE 568	Digital Speech Processing
ECE 569	Digital Signal Processing II
ECE 584	VLSI Architectures for Signal Processing and Communications
CS 588	Advanced Software Engineering Development

With adviser approval, the M.T.S.E. program of studies can include up to two credit hours of Master's Seminar (ECE 595, ECE 596). It can also include up to four credit hours of ECE short courses.

Department of Electrical and Computer Engineering

Master of Electricity Markets

30 credit hours

Deregulation is bringing major changes to the electric power industry. Electricity is now traded in commodity markets, and these new markets affect the way the electric power grid is controlled and operated. Electrical engineers need to understand both the technical and the business sides of these changes in order to address the needs of the electric power industry.

IIT's Department of Electrical and Computer Engineering and Center for Financial Markets have teamed up to develop new master's degree and graduate certificate programs in electricity markets. Combining existing and new courses from the graduate programs in electrical engineering and in financial markets and trading, the programs provide graduate-level education in electricity markets suitable for electric power engineers. The program of study includes a minimum of 30 credit hours of acceptable graduate coursework, with a minimum of 18 credit hours at the 500 level or higher (excluding accelerated courses and master's seminars). Up to two credits of Master's Seminar (ECE 595 or ECE 596) and up to six credits of accelerated courses may be applied to the degree. A background in finance is not required.

Curriculum

Core courses

ECE 555	Power Market Operations
ECE 561	Deregulated Power Systems
ECE 562	Power System Transaction Management
ECE 564	Control and Operation of Electric Power Systems
FM 553	Valuing Energy Derivatives
FM 552	Introduction to Energy Markets

Select two additional courses from the following:

ECE 419	Power System Analysis
ECE 420	Advanced Power System Analysis
ECE 550	Power Electronic Dynamics and Control

ECE 553	Power Systems Planning
ECE 554	Power Systems Relaying
ECE 556	Power Market Economics and Security
ECE 557	Fault-Tolerant Power Systems
ECE 558	Power System Reliability
ECE 559	High Voltage Power System Relaying
ECE 560	Power Systems Dynamics and Stability
ECE 563	Computational Intelligence in Engineering
ECE 531	Linear System Theory
ECE 537	Optimal Feedback Control

Six additional credit hours of electives are chosen from the offerings of the Department of Electrical and Computer Engineering, including the list of power courses above.

Department of Electrical and Computer Engineering

Doctor of Philosophy in Electrical Engineering

84 credit hours, including master's degree studies
Qualifying exam
Comprehensive exam (dissertation proposal defense)
Dissertation
Oral dissertation defense

The doctorate degree in electrical engineering is awarded in recognition of mastery in the field of electrical engineering and upon demonstration of an ability to make substantial creative contributions to knowledge in that field. The Ph.D. recipient will be capable of a continuing effort toward the advancement of knowledge and achievement in research and other scholarly activities. This program is appropriate for those students with master's degrees who are interested in pursuing an academic or industrial research career.

The Ph.D. program requires a minimum of 84 credit hours beyond the bachelor's degree, including the master's degree studies. A minimum of 24 credits are devoted to the student's research work, and a minimum of 24 credits are devoted to coursework in electrical and computer engineering and in such basic sciences as mathematics and physics. The selection of courses is considered and approved by the student's adviser and the department s graduate program director on the basis of relevance of course content, rather than along a predetermined sequence announced by the department. All students must complete the two doctoral seminar courses (ECE 695 and ECE 696), preferably early in their Ph.D. programs. Work toward the Ph.D. generally takes a minimum of three years of study beyond the master's degree. Upon admission to graduate study leading to the Ph.D. degree, each student is assigned an academic adviser, who may eventually serve as the thesis adviser and guides the student's research.

The department requires a qualifying examination within the first three semesters of full-time Ph.D. studies. This is a written examination consisting of several areas in electrical and computer engineering. This examination is intended to explore both the depth and breadth of the student's academic abilities. At an early stage in the student's research program, and usually about a year after passing the qualifying examination, a comprehensive examination is held in the area of specialization.

The comprehensive examination takes the form of an oral presentation and defense of a thesis research proposal. At this time a thesis committee is appointed by the graduate program director, in consultation with the thesis adviser, to guide the remainder of the program. A written dissertation, oral defense and publication requirement constitute completion of the Ph.D. degree. The defense takes place no earlier than one year after passing the comprehensive examination. Dissertation format and deadlines are established by the Graduate College.

Doctor of Philosophy in Computer Engineering

84 credit hours, including master's degree studies
Qualifying exam
Comprehensive exam (dissertation proposal defense)
Dissertation
Oral dissertation defense

The doctorate degree in computer engineering is awarded in recognition of mastery in the field of computer engineering and upon demonstrating the ability to make fundamental contributions to knowledge in that field. The Ph.D. recipient will be capable of making a continuing effort toward the advancement of knowledge and achievement in research and other scholarly activities. This program is appropriate for those students with a master's degree in computer and/or electrical engineering who are interested in pursuing an academic or industrial research career.

The Ph.D. program requires a minimum of 84 credit hours beyond the bachelor's degree, including the master's degree studies. A minimum of 24 credits are devoted to the student's research work, and a minimum of 24 credits are devoted to course work in computer and electrical engineering and in basic sciences, such as computers, mathematics, and physics. The selection of courses is considered and approved by the student's adviser and the department's graduate program director on the basis of relevance of course content, rather than along a predetermined sequence announced by the department. All students must complete the two doctoral seminar courses (ECE 695 and 696), preferable early in their Ph.D. programs. Generally, it takes a minimum of three years of study beyond the master's degree to obtain a Ph.D.

Upon admission to graduate study leading to the Ph.D. degree, each student is assigned an academic adviser, who many eventually serve as the thesis advisor and guide the student's research. The department requires a qualifying examination within the first three semesters of full-time Ph.D. study. This is a written examination consisting covering topics in the area of digital and computer systems and at least one minor area in the field of electrical engineering. This examination is intended to explore both the depth and breadth of the student's academic abilities. At an early stage in the student's research program, and usually about a year after passing the qualifying examination, a comprehensive examination is held in the area of digital and computer systems. The comprehensive examination takes the form of a defense of a thesis research proposal. At this time a thesis committee is appointed by the graduate program director, in consultation with the thesis adviser, to guide the remainder of the program. A written dissertation, oral defense, and publication requirement constitute completion of the Ph.D. degree. The defense takes place no earlier than one year after passing the comprehensive examination. Dissertation format and deadlines are established by the Graduate College.

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Certificate Programs

Certificate programs provide a student with post bac-calaureate knowledge in an area of specialization within electrical and computer engineering. Students in these programs register as certificate non-degree seeking students. Certificates are granted upon completion of all course requirements in the chosen specialization area, as listed below with a minimum GPA of 3.0. Certificate programs must be completed within five years.

It is the student's responsibility to meet all course prerequisites. Any student admitted to a master's degree program offered by the department may apply coursework completed in the certificate program toward the master's degree requirements.

Advanced Electronics

This program is composed entirely of elective courses and provides advanced study in electronic design and device theory for those who wish to enhance their analog and digital design skills, while increasing their knowledge of the underlying device physics. A maximum of two 400 level courses may be taken.

Elective courses

(Four from the following)

ECE 411	Power Electronics
ECE 414	Audio and Electroacoustics
ECE 425	Analysis and Design of Integrated Circuits
ECE 521	Quantum Electronics
ECE 524	Electronic Circuit Design
ECE 525	RF Integrated Circuit Design
ECE 526	Active Filter Design
ECE 527	Performance Analysis of RF Integrated Circuits
ECE 529	Advanced VLSI Design
ECE 530	High Performance VLSI/IC Systems
ECE 571	Nanodevices and Technology
ECE 575	Electron Devices

Applied Electromagnetics

In this certificate program, students receive advanced preparation for careers in electromagnetic engineering, particularly in areas of RF circuits and systems, electromagnetic wave propagation, antenna theory, and electromagnetic compatibility.

Required courses

ECE 421	Microwaves Circuits and Systems
OR	
ECE 423	Microwave Circuits and Systems with Laboratory
ECE 509	Electromagnetic Theory

Elective courses

(Two from the following)

ECE 522	Electromagnetic Compatibility
ECE 571	Nanodevices and Technology
ECE 576	Antenna Theory
ECE 577	Advanced Antenna Theory
ECE 578	Microwave Theory

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Communication Systems

For those who want to become proficient in communication system principles and applications, this certificate program contains two fundamental courses and a large number of elective courses for emphasis in data compression, computer networks, and analog/digital communications. No more than one course may be a 400-level course.

Required courses

ECE 511   Analysis of Random Signals
ECE 513   Communication Engineering Fundamentals

Elective courses

(Two from the following)

ECE 403   Communication Systems
ECE 404   Digital Data Communications OR
ECE 406   Digital Data Communications with Laboratory
ECE 508   Signal and Data Compression
ECE 514   Digital Communication Principles
ECE 515   Modern Digital Communications
ECE 519   Coding for Reliable Communications
ECE 541   Performance Evaluation of Computer Networks
ECE 542   Design and Optimization of Computer Networks
ECE 543   Computer Network Security
ECE 545   Advanced Computer Networks

Computer Systems

Graduates of this program gain proficiency in one of several areas, including VLSI design, computer networks, computer hardware and software design. A maximum of one 400-level course may be taken, including ECE 429 if selected as a required course.

Required courses

ECE 429   Introduction to VLSI Design AND/OR
ECE 529   Advanced VLSI Systems Design
AND
ECE 585   Advanced Computer Architecture

Elective courses

(Two from the following)

ECE 441   Microcomputers
ECE 446   Advanced Logic Design

ECE 448   Computer Systems Programming
ECE 449   Object-Oriented Programming and Computer Simulation
ECE 485   Computer Organization and Design
ECE 530   High Performance VLSI/IC Systems
ECE 541   Performance Evaluation of Computer Networks
ECE 542   Design and Optimization of Computer Networks
ECE 543   Computer Network Security
ECE 545   Advanced Computer Networks
ECE 583   High Speed Computer Arithmetic
ECE 584   VLSI Architectures for Signal Processing and Communications
ECE 586   Fault Detection in Digital Circuits
ECE 587   Hardware/Software Codesign
ECE 588   CAD Techniques for VLSI Design

Control Systems

Engineers who deal with the control and optimization of systems will benefit from the focused coursework in this program, providing intensive studies in linear and non-linear systems, optimized control, controllability and stability of systems, and analysis and synthesis of control systems.

Required courses

ECE 531   Linear System Theory
ECE 535   Discrete Time Control Systems

Elective courses

(Two from the following)

ECE 438   Control Systems OR
ECE 434   Control Systems with Laboratory
ECE 506   Analysis of Nonlinear Systems
ECE 537   Optimal Feedback Control
ECE 550   Power Electronic Dynamics and Control

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Electricity Markets

This program is an introduction to both the technical and business sides of a deregulated electric power industry.

Required courses

ECE 561	Deregulated Power Systems
FMT 540	Valuing and Managing Energy Derivatives
FMT 542	Introduction to Energy Markets

Two ECE accelerated courses

Power Electronics

In this certificate program, students receive professional preparation in the areas of power electronic converters, industrial electronics, switching power supplies, electric/electronic motor drives, and electric power quality. This certificate program would be useful managers, engineers, and students who are seeking in power electronics related industry. A minimum credit hours including no more than four credit any one elective area must be taken. A maximum 400-level courses may be taken.

Required courses

(Choose at least two)

ECE 550	Power Electronic Dynamics and Control
ECE 551	Advanced Power Electronics
ECE 552	Adjustable Speed Drives
ECE 411	Power Electronics OR
ECE 412	Electric Motor Drives

Elective areas

I. Power area

ECE 561	Deregulated Power Systems
ECE 563	Computational Intelligence in Engineering
ECE 564	Control and Operation of Electric Power Systems

II. Electronics area

ECE 437	Digital Signal Processing I
ECE 575	Electron Devices

III. Control area

ECE 438	Control Systems
ECE 531	Linear System Theory
ECE 535	Discrete Time Systems

IV. Special topics area

Accelerated course(s) in power electronics

Power Engineering

This program provides power engineers with a solid foundation in the design and analysis of large-scale power systems and state-of-the-art power conversion systems, including power systems control, power electronics, motor drives, design of fault-tolerant systems, power markets, and fundamentals of power system operation and planning.

Required course

(Choose one)

ECE 411	Power Electronics
ECE 412	Electric Motor Drives
ECE 419	Power Systems Analysis
ECE 420	Analytical Methods in Power Systems

Elective courses

(Choose three)

ECE 540	Reliability Theory and System Implementation
ECE 549	Motion Control Systems Dynamics
ECE 550	Power Electronic Dynamics and Control
ECE 551	Advanced Power Electronics
ECE 552	Adjustable Speed Drives
ECE 553	Power System Planning
ECE 554	Power Systems Relaying
ECE 555	Power Market Operations
ECE 556	Power Market Economics and Security
ECE 557	Fault-Tolerant Power Systems
ECE 558	Power System Reliability
ECE 559	High-Voltage Power Transmission
ECE 560	Power Systems Dynamics and Stability
ECE 561	Deregulated Power Systems
ECE 562	Power System Transaction Management
ECE 563	Computational Intelligence in Engineering
ECE 564	Control and Operation of Electric Power Systems

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Signal Processing

Those seeking expertise in the areas of signal and image processing should take this program, which offers a wide range of advanced courses in the areas of digital signal processing, data compression, image and speech processing, and pattern recognition.

Required courses

ECE 511   Analysis of Random Signals
ECE 569   Digital Signal Processing II

Elective courses

(Choose two; no more than one may be a 400-level course.)
ECE 436   Digital Signal Processing I with Laboratory
ECE 437   Digital Signal Processing I
ECE 481   Image Processing
ECE 508   Signal and Data Compression
ECE 565   Computer Vision and Image Processing
ECE 566   Statistical Pattern Recognition
ECE 567   Statistical Signal Processing
ECE 568   Digital Speech Processing
ECE 584   VLSI Architectures for Signal Processing
           and Communications

Wireless Communications Engineering

For communications engineers who want a focused program providing state-of-the-art instruction in the growing field of wireless communications, this program offers fundamental coursework in traditional telecommunications system design as well as computer communication networks.

Required courses

ECE 504   Wireless Communication System Design
ECE 513   Communication Engineering Fundamentals

Elective courses

(Choose two; no more than one may be a 400-level course.)
ECE 403   Communication Systems
ECE 404   Digital & Data Communications
ECE 515   Modern Digital Communications
ECE 519   Coding For Reliable Communications
ECE 541   Performance Evaluation of Computer Networks
ECE 545   Advanced Computer Networks
ECE 576   Antenna Theory

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Course Descriptions

Numbers in parentheses indicate class, lab and credit hours, respectively.

ECE 502
Basic Network Theory
Steady-state analysis of linear networks. Introduction to topology and the derivation of mesh, nodal and terminal pair relations using topological concepts with applications to computer-aided analysis of networks. Network interconnections. Indefinite admittance matrix. Prerequisite: B.S.E.E. degree. (3-0-3)

ECE 504
Wireless Communication System Design
Fundamentals of wireless communications, with emphasis on the underlying theory, design techniques, and analytical tools. Overview of wireless systems. Characteristics of wireless channels and their capacity limits. Audio, image and video coding standards. Modulation and coding for wireless channels. Diversity and Equalization techniques. Multiuser communications. Spread spectrum techniques. Multicarrier modulation. Wireless systems: Cellular systems: AMPS, TDMA, CDMA, and WCDMA - design, standards, performance studies. Wireless LAN systems (WiFi, WiMAX): design and standards. Prerequisite: ECE 513

ECE 505
Applied Optimization for Engineers
Principles of optimization for practical engineering problems, linear programming, nonlinear unconstrained optimization, nonlinear constrained optimization, dynamic programming. Prerequisite: B.S. degree in engineering, math orscience, or permission of instructor. (3-0-3)

ECE 506
Analysis of Nonlinear Systems
Graphical and analytical methods, phase plane and singular points, periodic oscillations and limit cycles, forced nonlinear systems, jumps, subharmonics and frequency entrainment; stability analysis using Liapunov, Popov and circle criteria; introduction to describing functions. Prerequisite: Math 488. (3-0-3)

ECE 508
Signal and Data Compression
Elements of random signal processing and information theory. Noiseless compression techniques. Rate-distortion theory. Scalar and vector quantization; basic structures, asymptotic quantization theory, optimality criteria and design techniques. Structured vector quantization, product codes, tree/trellis codes, linear and nonlinear prediction, transform and subband coding, classified VQ. Selected applications: speech, audio, image and video coding. Prerequisites: ECE 437, ECE 511. (3-0-3)

ECE 509
Electromagnetic Field Theory
Electric and magnetic fields produced by charge and current distributions. Solution of Laplace's and Poisson s equations, time-varying fields and electromagnetic waves. Applications to waveguides and antennas. Prerequisite: ECE 307. (3-0-3)

ECE 511
Analysis of Random Signals
Probability theory, including discrete and continuous random variables, functions and transformations of random variables. Random processes, including correlation and spectral analysis, the Gaussian process and the response of linear systems to random processes. Prerequisites: ECE 308 and ECE 475 or MATH 475. (3-0-3)

ECE 513
Communication Engineering Fundamentals
Review of probability and random processes. AM with noise, FM with noise. Introduction to digital communication. Source coding, signal space analysis, channel modulations, optimum receiver design, channel encoding. Prerequisites: ECE 403 and ECE 475 or MATH 475. (3-0-3)

ECE 514
Digital Communication Principles
Information transmission fundamentals, including capacity, entropy, Shannon's theorems and source coding. Introduction to rate distortion theory. Advanced digital modulation and demodulation techniques, performance measures. Carrier and symbol synchronization. Signal design for band-limited channels. Prerequisites: ECE 511, ECE 513. (3-0-3)

ECE 515
Modern Digital Communications
Review of modulation and coding. Trellis coded modulation. Digital signaling over fading multipath channels. Spread spectrum signals for digital communications. Multichannel and multicarrier signals for digital communications. Multiuser communications, time-division multiple access, code-division multiple access, frequency-division multiple access. Advanced communications systems. Prerequisite: ECE 511, ECE 513. (3-0-3)

ECE 519
Coding for Reliable Communications
Encoders and decoders for reliable transmission of digital data over noisy channels. Linear block codes, cyclic codes, BCH codes, convolutional codes. Burst error correcting codes. Maximum likelihood decoding of convolutional codes. Performance of block and convolutional codes in additive white Gaussian channel. Turbo codes and low density parity check codes. Prerequisite: ECE 475 or MATH 475. (3-0-3)

ECE 521
Quantum Electronics
The Schrodinger equation. Matrix formulation. Quantization of lattice vibrations and electromagnetic fields. Optical beams and resonators. The interaction of radiation and atomic systems. Lasers. Optical waveguides and devices. Frequency conversion. Quantum noise. Same as PHYS 521. Prerequisite: ECE 307. (3-0-3)

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ECE 522
Electromagnetic Compatibility
Development of design procedures for minimizing interference between electronic circuits and systems. sources of conducted and radiated interference. Interference coupling mechanisms. Shielding theory. Grounding, bonding and filtering methods. special equipment design procedures. Problems associated with digital equipment. Measurement methods. Prerequisites: ECE 307 or equivalent. (3-0-3)

ECE 524
Advanced Electronic Circuit Design
RF amplifiers and oscillators. Low and high power RF amplifier design techniques. Stability of amplifiers. LC and crystal oscillators. FM demodulators and limiters. Mixer design. Circuit design to minimize intermodulation and other forms of distortion. Prerequisites: ECE 309, ECE 312. (3-0-3)

ECE 525
RF Integrated Circuit Design
Essentials of contemporary RF CMOS integrated circuit analysis and design. Typical RF building blocks in CMOS and BiCMOS technologies, including passive IC components, MOS transistors, RLC tanks, distributed networks, RF amplifiers, voltage reference and biasing circuits, LNA, mixers, power amplifiers, and feedback networks. RF device modeling, Smith chart, bandwidth estimation and stability analysis techniques. RF IFC team design projects. Prerequisites: ECE 312 and senior or graduate standing.

ECE 526
Active Filter Design
Analysis and design of linear active filters with emphasis on realizations using operational amplifiers. Sensitivity analysis. Switched capacitor filters. Prerequisites: ECE 308, ECE 312. (3-0-3)

ECE 527
Performance Analysis of RF Integrated Circuits
Essentials of analysis techniques for nonlinear effects and noises in contemporary RF integrated circuit design. Nonlinear and distortion behaviors including inter-modulation, cross-modulation, harmonics, gain compression, desensitization, spurious, etc. Noise effects including thermal, short, Flicker, burst noises, etc. RF IC devices and circuits including resistors, capacitors, inductors, diodes, BJTs, FETs, low-noise amplifiers, mixers, power amplifiers, etc. Analysis skills for single-stage and multiple-stage networks. RF IC team design projects. Prerequisites: ECE 312, Senior or Graduate student standing. (3-0-3)

ECE 529
Advanced VLSI Systems Design
Advanced design and application in VLSI Systems. The topics of this course include design tools and techniques, clocking issues, complexity management, layout and floorplanning, array structures, testing and testability, advanced arithmetic circuitry, transcendental function approximations, architectural issues, signal processing architectures, submicron design. Design project are completed and fabricated by student teams. Prerequisites: Graduate standing and ECE 429 or equivalent. (3-0-3)

ECE 530
High Performance VLSI/IC Systems
Background and insight into some of the most active performance-related research areas of the field is provided. Issues covered include CMOS delay and modeling, timing and signal delay analysis, low power CMOS design and analysis, optimal transistor sizing and buffer tapering, pipelining and register allocation, synchronization and clock distribution, retiming, interconnect delay, dynamic CMOS design techniques,

asynchronous vs. synchronous trade-offs, BiCMOS, low power design, and CMOS power dissipation. Historical, primary, and recent papers in the field of high-performance VLSI digital and analog design and analysis are reviewed and discussed. Each student is expected to participate in the class discussions and also lead the discussion surveying a particular topic. Prerequisites: Graduate standing and ECE 529 (3-0-3)

ECE 531
Linear System Theory
Linear spaces and operators, single and multivariable continuous dynamical systems, controllability and observability. Canonical forms, irreducible realizations. Synthesis of compensators and observers. Composite systems, elements of stability. Prerequisite: ECE 308. (3-0-3)

ECE 535
Discrete Time Systems
Discrete systems. Sampling and reconstruction procedures.Transform techniques of analysis andsynthesis. State space techniques. Discrete controllability,observability and stability.Compensation and digital controllers.Prerequisite: ECE 438. (3-0-3)

ECE 537
Optimal Feedback Control
Principles of feedback design for multivariable systems. Sensitivity functions, principal gains, operator norms and performance specification. Linear quadratic Gaussian (LQG) optimal control, loop transfer recovery (LTR) and design procedures with LQG/LTR methods. H-infinity optimal control, Hankel norm approximation, the 4-block problem, the Youla parameterization and design procedures with H-infinity methods. Prerequisites: ECE 438, ECE 531. (3-0-3)

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ECE 540
Reliability Theory and System Implementation
Basic probability and modeling techniques on component, subsystem and system levels. MTBF, MTTR and downtime. Hardware, software and cost considerations. Switching systems. Multicomputer and memory configurations. Prerequisites: ECE 308 and ECE 475 or MATH 475. (3-0-3)

ECE 541
Performance Evaluation of Computer Networks
Introduction to performance evaluation techniques for computer and communication networks. Little s theorem, birth-death processes, M/G/1 queue, product form queueing networks, approximation techniques for G/G/1 queues and non-product form queueing networks. Discrete event simulations, generation of random variables, variance reduction techniques and general purpose simulation languages. Prerequisite: ECE 475 or MATH 475. (3-0-3)

ECE 542
Design and Optimization of Computer Networks
This course provides comprehensive introduction to network flows with an integrative view of theory, algorithms, and applications. It covers shortest path, maximum flow, and minimum cost flow problems, including a description of new and novel polynomial-time algorithms. It also covers topics from basic network design to protection and restoration design, to multi-layer network design while taking into account routing and flow requirement as applicable in different network architecture, protocol and technologies. Prerequisite: ECE 407. (3-0-3)

ECE 543
Computer Network Security
This course introduces network security by covering topics such as network-related security threats and solutions, private- and public-key encryptions, authentication, digital signatures, Internet Protocol security

architecture (IPSEC), firewalls, network management, email and web security. Prerequisite: ECE 407. (3-0-3)

ECE 545
Advanced Computer Networks
Fundamentals of computer communication networks. Overview of data communication networks and protocol architectures with emphasis on the Internet protocols and network elements. Principles of network and protocol design; error detection and correction, flow control and congestion control, delay and throughput models, QoS, service support and application interface (including remote procedure call mechanisms). Local and Wide Area Networks (Ethernet, FDDI, Wireless LAN, ATM and Internet). LAN and WAN interconnection using bridges, routers, switchers and gateways. Routing in data networks. Network and protocol design to support multi-media and multicasting connections. Network application security. Prerequisite: ECE 407. (3-0-3)

ECE 549
Motion Control Systems Dynamics
Fundamentals and applications of motion control systems, control techniques for high precision motion control, state variable feedback of linear and nonlinear systems, multivariable systems, physical system modeling, graphical analysis, and numerical analysis, and system performance analysis. Prerequisites: ECE 438 or permission of instructor. (3-0-3)

ECE 550
Power Electronic Dynamics and Control
Modeling and analysis of solid-state switching circuits, parallel module dynamics, multi-converter interactions, resonant converters, feedback control, stability assessment, reduced parts converters, integrated structures, programmable switching regulators, digital switch-mode controllers, and power electronic converter-on-a-chip development. Prerequisite: ECE 411. (3-0-3)

ECE 551
Advanced Power Electronics
Advanced power electronic converters, techniques to model and control switching circuits, resonant converters, multi-level converters, Pulse-Width-Modulation (PWM) techniques, soft switching methods, and low-voltage high-current design issues are studied. Single-phase and multi-phase, controlled and uncontrolled rectifiers and inverters with different operating techniques and their design and control issues are explained. Prerequisite: ECE 411. (3-0-3)

ECE 552
Adjustable Speed Drives
Fundamentals of electric machines, basic principles of variable speed controls, field orientation theory, direct torque control, vector control of AC drives, induction machines, switched reluctance and synchronous reluctance motors, permanent magnet brushless DC drives, converter topologies of DC and AC drives, and sensorless operation. Prerequisite: ECE 411. (3-0-3)

ECE 553
Power System Planning
Model development. Interchange capability, interconnections, pooling. Economic generator size and site selection. Concept of reserves, transformers, relays and circuit breakers. Reactive planning AC and DC systems are explored thoroughly from a planning standpoint. Prerequisite: ECE 419. (3-0-3)

ECE 554
Power Systems Relaying
Principles of relay protection for faults on transmission lines and in transformers, rotating machines and other equipment. Use of overcurrent, differential, distance, wire-pilot, carrier-pilot and microwave-pilot relaying systems. Solid-state relays and computer control of relaying. Determination of short-circuit currents and voltages from system studies. Prerequisite: ECE 419. (3-0-3)

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ECE 555
Power Market Operations
Market design in restructured power systems, artificial neural network applications to power systems, short-term load forecasting, electricity price forecasting, price-based unit commitment, arbitrage in electricity market, gaming and market monitoring, asset valuation and risk analysis, security-constrained unit commitment, ancillary services auction, transmission pricing and regional transmission organizations. Prerequisite: ECE 419 (3-0-3)

ECE 556
Power Market Economics and Security
This course covers simulation and scheduling tools used in restructured power system for studying the economics and security of power systems. Topics include modeling of generating units (thermal units, combined-cycle units, fuel-switching/blending units, hydro units, pumped-storage units, photovoltaic, wind), Lagrangian Relaxation-based scheduling, mixed integer programming-based scheduling, and Benders decomposition-based transmission security analyses. The simulation and scheduling tools consider different time scales including on-line security, day-ahead, operational planning, and long-term. The simulation and scheduling tools consider interdependency of supply (such as gas, water, renewable sources of energy) and electricity systems. Prerequisites: ECE 420 or consent of instructor. (3-0-3).

ECE 557
Fault-Tolerant Power Systems
Critical fault events in a large power system, sparsity techniques. Contingency screening process. Modeling of local controls in load flow. Adaptive localization method. Injection outage analysis. Security constrained dispatch. LP-based OPF. Real-time security analysis. Dynamic security analysis. Prerequisite: ECE 419. (3-0-3)

ECE 558
Power System Reliability
The concept of reliability, reliability indices, component reliability, generation capacity reserve evaluation, transmission system reliability, bulk power system reliability, distributed system reliability, reliability modeling in context. Prerequisite: ECE 419 (3-0-3)

ECE 559
High Voltage Power Transmission
Detailed analysis of transmission and distribution systems. Design of high voltage transmission lines and cables, as well as distribution lines. Flexible AC Transmission Systems (FACTS) and high voltage DC links. Prerequisite: ECE 419. (3-0-3)

ECE 560
Power Systems Dynamics and Stability
The transient stability problem, acceleration equations, stability criteria, two-machine and multi-machine problems. Perturbation analysis, eigenvalue sensitivity, Liapunov theory and application to power systems stability. Prerequisite: ECE 419. (3-0-3)

ECE 561
Deregulated Power Systems
Overview of key issues in electric utilities restructuring, Poolco model, bilateral contracts, market power, stranded costs, transmission pricing, electric utility markets in the United States and abroad, OASIS, tagging electricity transactions, electric energy trading, risk in electricity markets, hedging tools for managing risks, electricity pricing, volatility in power markets, RTO. Prerequisite: ECE 419. (3-0-3)

ECE 562
Power System Transaction Management
Power interchange transaction management in the deregulated electric power industry. Course topics include power system security assessment, total and available transfer capability (TTC/ATC), transaction management system (TMS), transac-
tion information system (TIS), tagging, interchange distribution calculator (IDC), congestion management, transmission loading relief (TLR). Prerequisite: ECE 419. (3-0-3)

ECE 563
Computational Intelligence in Engineering
Introduction to soft computing, fuzzy set theory, neural networks, genetic algorithms, intelligent software agents, comparisons with traditional alternatives, advanced engineering applications. Prerequisite: Graduate standing. (3-0-3)

ECE 564
Control and Operation of Electric Power Systems
Unit commitment and application of dynamic programming, fuel budgeting and planning, probabilistic production cost modeling, hydrothermal coordination, power system security and application of expert systems, state estimation, optimal power flow, interchange evaluation and power pools, reactive power planning. Prerequisite: ECE 419. (3-0-3)

ECE 565
Computer Vision and Image Processing
Multi-dimensional signal sampling and discrete Fourier transform; Image segmentation; Object boundary (edge) detection and description; Shape representation and extraction; Matching and recognition; Image registration; Camera geometry and stereo imaging; Morphological processing; Motion detection and compensation; Image modeling and transforms; Inverse problems in image processing (restoration and reconstruction). Prerequisite: ECE 437 and ECE 475 or MATH 475. (3-0-3)

ECE 566
Statistical Pattern Recognition
Review of appropriate math: multidimensional probability, covariance matrices, whitening transformation, diagonalization, eigenvectors, eigenvalues. Two-class and multi-class pattern separation using maximum

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likelihood and MAP. Linear discriminant analysis. Perception algorithm and its extensions. Feature extraction algorithms. Clustering algorithms. Introduction to neural nets. Hopfield, Hamming, feedforward models. Training of neural nets. Prerequisite: ECE 511. (3-0-3)

ECE 567
Statistical Signal Processing
Detection theory and hypothesis testing. Introduction to estimation theory. Properties of estimators, Gauss-Markov theorem. Estimation of random variables: conditional mean estimates, linear minimum mean-square estimation, orthogonality principle, Wiener and Kalman filters. Adaptive filtering. LMS algorithm: properties and applications. Prerequisites: ECE 511, MATH 333. (3-0-3)

ECE 568
Digital Speech Processing
Review of discrete statistical signal analysis. Acoustic aspects of speech and hearing. Digital models of speech production. Short-time processing in time and frequency domains. Waveform encoding and linear predictive coding of speech. Estimation of fundamental speech parameters. Applications including automatic speech recognition and enhancement. Prerequisites: ECE 437, ECE 511. (3-0-3)

ECE 569
Digital Signal Processing II
Review of basic DSP theory. Design of digital filters: FIR, IIR, frequency-transformation methods, optimal methods. Discrete Fourier Transform (DFT) and Fast Fourier Transform algorithms. Spectral estimation techniques, classical and parametric techniques. AR, MA, ARMA models. Estimation algorithms. Levinson, Durbin-Levinson and Burg s algorithms. Eigenanalysis algorithms for spectral estimation. Prerequisites: ECE 437 and ECE 475 or MATH 475. (3-0-3)

ECE 570
Fiber-Optic Communication Systems
Physics of optical fiber, composition, dimensioning, coupling, attenuation, dispersion. Electro-optical conversion devices (ILDs, LEDs, APDs, PINs). Circuit considerations. Modulation techniques and implications. Overall system considerations. Coherent techniques. Prerequisites: ECE 307, ECE 309, ECE 312, ECE 403. (3-0-3)

ECE 571
Nanodevices and Technology
Electronic properties and quantum effects; Dielectric, magnetic and optical properties and their characterizations; Individual nanoparticles and clusters; Carbon nanotubes; Solid disordered nanostructures; Nanostructured crystals; Quantum wells, wires and dots; Giant magnetoresistance; Material processing techniques; Devices and systems based on nanostructures. Prerequisites: B.S. degree with knowledge on quantum mechanics and thermodynamics. (3-0-3)

ECE 575
Electron Devices
Electronic properties of solids. Properties of p-n junctions and junction devices. Gunn diode and IMPATT devices. Junction transistors. Schottky diode and MESFET. The MOS capacitor and MOSFET. Light-emitting diodes and junction lasers. Velocity modulation and bunching in electron beams. Klystrons, magnetrons and other microwave thermionic devices. Prerequisites: ECE 307, ECE 312. (3-0-3)

ECE 576
Antenna Theory
Plane and spherical waves. Electric and magnetic dipoles. Radiation patterns and impedance characteristics of antennas in free space and over perfect ground. Linear and planar driven antenna arrays. Yagi-Uda parasitic arrays. Prerequisites: ECE 309, ECE 421 or ECE 423. (3-0-3)

ECE 577
Advanced Antenna Theory
Optimal design of Yagi antennas, traveling wave antennas and large loops. Broadband antennas based on log periodic principles. Numerical methods to solve antenna problems. Aperture antennas. Prerequisite: ECE 576. (3-0-3)

ECE 578
Microwave Theory
Microwave field theory. Propagation, reflection and refraction of plane waves. Anisotropic media. Impedance concept. Hollow, surface-wave and dielectric wave guides. Discontinuities in wave guides. Microwave resonators. Transmission lines. Microwave circuit theory. Prerequisite: ECE 421 or ECE 423. (3-0-3)

ECE 579
Numerical Methods in Electromagnetics and Solid-State Electronics
Complete and self-contained treatment of the numerical methods used in the design and analysis of high frequency devices and components. The numerical techniques applicable to electromagnetic field theory and charge transport models are thoroughly discussed by integrating them in a global modeling frame-work. After introducing Maxwell's equations and Boltzmann's transport equation, a detailed discussion will be offered of numerical techniques, such as classic iterative methods, finite differences, finite elements, multigrid, particle-based models, and automative mesh generation. Prerequisite: ECE 307 or instructor's consent.

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ECE 583
High Speed Computer Arithmetic
This course covers computer arithmetic as applied to general-purpose and application-specific processors. The focus is on developing high-speed arithmetic algorithms and understanding their implementation in VLSI technology. Topics include fixed and floating point number systems, algorithms and implementations for addition, subtraction, multiplication, division, and square root, floating point operations, elementary function approximation, low-power design, error analysis, and interval arithmetic. Prerequisites: ECE 485. (3-0-3)

ECE 584
VLSI Architectures for Signal Processing and Communications
This course aims to convey knowledge of advanced concepts in VLSI signal processing. Emphasis is on the architectural research, design and optimization of signal processing systems used in telecommunications, compression, encryption and coding applications. Topics covered include the principles of datapath design; FIR and IIR filtering architectures; communication systems including OFDM, multirate signal processing; fast transforms and algorithms including fast Fourier Transform; Discrete Cosine Transform; Walsh-Hadamard Transform; and Wavelet kernels. Furthermore, advanced computer arithmetic methods including Galois Fields, CORDIC, residue number systems, distributed arithmetic, canonic signed digit systems and reduced adder graph algorithms are examined. Prerequisite: ECE 429 and ECE437. (3-0-3)

ECE 585
Advanced Computer Architecture
Design, Analysis and Performance of High-Performance Computer Architectures; High Speed memory Systems: Cache Design and Analysis; Modeling Cache Performance; Instruction Level Parallelism, Cache-only Memory Architectures, Classification of Parallel Architectures; Systolic and Data Flow Architectures; Multiprocessor Performance; and Multiprocessor Interactions. Prerequisite: Graduate standing or faculty consent. (3-0-3)

ECE 586
Fault Detection in Digital Circuits
Essential elements in testing and testability of digital designs. Automatic test generation algorithms and fault-simulation methods. Design methodologies to increase testability and decrease test generation costs. Techniques for built-in testing. Prerequisite: ECE 446. (3-0-3)

ECE 587
Hardware/Software Codesign
Computer-aided techniques for the joint design of hardware and software: specification, analysis, simulation and synthesis. Hardware/software partitioning, distributed system cosynthesis, application-specific instruction set design, interface cosynthesis, timing analysis for real-time systems. Prerequisites: CS 200, ECE 441, graduate standing. (3-0-3)

ECE 588
CAD Techniques for VLSI Design
Overview of techniques and algorithms used in Computer-Aided Design (CAD) for VLSI circuits. Physical CAD tools, including placement, routing, symbolic layout and compaction. High-level CAD tools, including logic synthesis, silicon compilers and high-level synthesis. Recent developments in the field. Design, implementation and performance analysis of prototype CAD tools. Prerequisite: ECE 427, ECE 429 or ECE 530. (3-0-3)

ECE 591
Research and Thesis for M.S. Degree

ECE 594
Special Projects

ECE 595I
Master's Seminar I
(1-0-1)

ECE 596
Master's Seminar II
(1-0-1)

ECE 597
Special Problems

ECE 604
Advanced Topics in Network Synthesis
A seminar course dealing with current topics in network synthesis. Topics covered include advanced approximation theory, active network synthesis, and research conducted by faculty and students. Prerequisite: ECE 502. (3-0-3)

ECE 622
Advanced Topics in Electronic Systems
Course content is variable, depending on state of the art and design and research trends. Prerequisites: ECE 506. (3-0-3)

Department of Electrical and Computer Engineering

ECE 631
Advanced Topics in Automatic Control
Course content is variable and reflects the current trends in automatic control, system and optimal filtering theory. Prerequisites: ECE 438, ECE 531. (3-0-3)

ECE 643
Advanced Topics in Computer Networks
Course content is variable and reflects the current trends in computer networks. Prerequisite: ECE 545. (3-0-3)

ECE 650
Advanced Topics in Power Systems
Course content is variable and reflects the current trends in power systems. Prerequisite: ECE 419. (3-0-3)

ECE 669
Advanced Topics in Signal Processing
Course content is variable and reflects the current trends in signal processing including digital and optical systems. Prerequisite: ECE 569. (3-0-3)

ECE 671
Advanced Topics in Communication Theory
Course is concerned with modern advances and specialized topics in communication theory. Topics include current research of faculty and students. Prerequisite: ECE 513. (3-0-3)

ECE 691
Research and Thesis for Ph.D. Degree

ECE 695
Doctoral Seminar I
(1-0-1)

ECE 696
Doctoral Seminar II
(1-0-1)

Undergraduate Courses Available to Graduate Students

ECE 401
Communication Electronics

ECE 403
Communication Systems I

ECE 404
Digital and Data Communications

ECE 406
Digital and Data Communications with Laboratory

ECE 407
Introduction to Computer Networks

ECE 409
Communication Electronics with Laboratory

ECE 411
Power Electronics

ECE 412
Electric Motor Drives

ECE 414
Audio and Electroacoustics

ECE 419
Power Systems Analysis

ECE 420
Analytical Methods in Power Systems

ECE 421
Microwaves

ECE 423
Microwave Circuits and Systems

ECE 425
Analysis and Design of Integrated Circuits

ECE 429
Introduction to VLSI Design

ECE 434
Control Systems with Laboratory

ECE 436
Digital Signal Processing I with Laboratory

ECE 437
Digital Signal Processing I

ECE 438
Control Systems

ECE 441
Microcomputers

ECE 446
Advanced Logic Design

ECE 448
Computer Systems Programming

ECE 449
Object-Oriented Programming and Computer Simulation

ECE 470
Photonics

ECE 471
Photonics with Laboratory

ECE 475
Random Phenomena in Electrical Engineering

ECE 481
Image Processing

ECE 485
Computer Organization and Design

Energy/Environment/Economics (E^3)

Faculty Directors

Chemical and Environmental Engineering
Javad Abbasian
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The ongoing evolution of the energy system and related global, environmental and economic issues make necessary a new interdisciplinary approach to the education of energy-industry engineers and management professionals, as well as to the planning and performance of energy research and development. The petroleum, coal, natural gas, nuclear, renewable and electric utility industries and associated resource and raw material extraction, equipment design and manufacturing, and construction industries, are facing not only technological change and environmental constraints, but also drastic changes in the economic, institutional and trade environments in which they operate.

IIT's Energy/Environment/Economics (E^3) program was developed to respond to the rapidly changing needs of the energy industry by providing the interdisciplinary research and training required to produce a new breed of engineer-one who specializes in energy technologies and who understands the associated environmental issues and economic forces that drive technology choice.

E^3 specialization requires an interdisciplinary thesis in an E^3 area of research for M.S. and Ph.D. degrees, and an interdisciplinary graduate project for professional master's degrees. Graduate students in E^3 should also be enrolled in fundamental courses related to the topics of energy, environment and economics. E^3 is designed primarily for students majoring in chemical and environmental, mechanical and aerospace, or electrical engineering who are planning careers in energy-related fields. This interdisciplinary training prepares students to be not only creative and expert in a specialized area of energy extraction, conversion or utilization, but also to possess a broad knowledge base of different energy sources, environmental issues related to energy extraction, conversion and utilization, and of the impact of industrial ecology principles on the design and operation of energy systems. Furthermore, students will gain sufficient knowledge of economic and regulatory issues to enable them to make more viable technology choices.

Degrees Offered

Master of Chemical Engineering with E^3 specialization
M.S. in Chemical Engineering with E^3 specialization
Master of Electrical and Computer Engineering with E^3 specialization
M.S. in Electrical Engineering with E^3 specialization (thesis and non-thesis options)
Master of Environmental Engineering with E^3 specialization
M.S. in Environmental Engineering with E^3 specialization

Master of Mechanical and Aerospace Engineering with E^3 specialization
M.S. in Mechanical and Aerospace Engineering with E^3 specialization
Ph.D. in Chemical Engineering with E^3 specialization
Ph.D. in Environmental Engineering with E^3 specialization
Ph.D. in Electrical Engineering with E^3 specialization
Ph.D. in Mechanical and Aerospace Engineering with E^3 specialization

Research Centers, Facilities and Areas

Students should consult descriptions in the respective departments:

Chemical and Environmental Engineering
Electrical and Computer Engineering
Mechanical, Materials and Aerospace Engineering

Energy/Environment/Economics (E^3)

Admission Requirements

Students should consult listings in the respective departments:

Chemical and Environmental Engineering
Electrical and Computer Engineering
Mechanical, Materials and Aerospace Engineering

General Degree Requirements

Students pursuing a master's degree are required to take 30-32 credit hours beyond the requirements of a B.S. degree program. The Ph.D. program requires 84 credit hours beyond the Bachelor of Science. The curriculum consists of two components: department core courses that provide a strong background in basic principles of the chosen engineering field and E^3 specialization courses. The following section details the E^3 course requirements for M.S., professional master's, and Ph.D. degrees in chemical engineering, environmental engineering, mechanical and aerospace engineering, and electrical engineering. Selected E^3 undergraduate courses may be substituted for graduate courses with the approval of the designated adviser, if the total undergraduate credit hours for the professional master's or M.S. degree do not exceed departmental constraints.

Students are also required to attend interdisciplinary seminars during their first and/or second semesters, which are offered as part of the regular graduate seminars by the departments of Chemical and Environmental Engineering; Mechanical, Materials and Aerospace Engineering; and Electrical and Computer Engineering. A student completing a M.S. or Ph.D. thesis or professional master's project will be a member of an interdisciplinary research team consisting of professors and students from chemical, environmental, electrical and mechanical engineering backgrounds, working in a cross-disciplinary group project. Each interdisciplinary team must include professors from different departments.

Policies and procedures regarding admission, advising, financial aid and comprehensive examinations are established by the individual departments offering this program.

Master of Chemical Engineering with E^3 specialization

32 credit hours
Project

This program has the same requirements as the M.S. degree program, except that, in place of eight credit hours of M.S. thesis research, students are required to register for two to five credits of special projects research (CHE 594), plus additional E^3 courses with the approval of their adviser.

Master of Science in Chemical Engineering with E^3 specialization

32 credit hours
Thesis

Students pursuing the M.S. in Chemical Engineering with E^3 specialization are required to take CHE 543 and select at least one course from Group A and one course from Group B (see course listing on pages 209-219), and register for up to eight credit hours of M.S. thesis preparation (CHE 591) in an interdisciplinary E^3 area. In addition, the students are required to take all required core courses for the M.S. in Chemical Engineeering degree.

Students may apply up to 12 credit hours of 400-level courses to the M.S. degree requirements with their adviser's approval.

Energy/Environment/Economics (E³)

Master of Environmental Engineering with E³ specialization

32 credit hours
Project

This program has the same requirements as the M.S. degree program, except that in place of eight credit hours of M.S. thesis research, students are required to register for two to five credits of special project research (ENVE 594), plus additional E³ courses with the approval of their adviser.

Master of Science in Environmental Engineering with E³ specialization

32 credit hours
Thesis

Candidates for the M.S. in Environmental Engineering with E³ specialization are required to take ENVE 544 and complete the required core courses for the M.S. in Environmental Engineering degree. In addition, students must complete one course from Group A, and one from Group B (see course listings on page 209-210).

Students are also required to register for up to eight credit hours of M.S. thesis research (ENVE 591) in an interdisciplinary E³ area. Students may apply up to two 400-level courses to the M.S. degree requirements with their adviser's approval.

Master of Mechanical and Aerospace Engineering with E³ specialization

30 credit hours
Thesis

Candidates for the Master of Mechanical and Aerospace Engineering are required to take CHE 543 and the following three courses:

MMAE 504   Engineering Analysis Ia
MMAE 505   Numerical Methods in Engineering
MMAE 550   Experimental Methods in Mechanical
            Engineering

In addition, the E³ specialization under MMAE requires 16 credit hours selected from the following Group A courses on pages 209-210:

MMAE 520   Advanced Thermodynamics
MMAE 521   Statistical Thermodynamics
MMAE 522   Air Conditioning Analysis
MMAE 523   Fundamentals of Power Generation
MMAE 524   Fundamentals of Combustion
MMAE 525   Fundamentals of Heat Transfer
MMAE 526   Heat Transfer: Conduction
MMAE 527   Heat Transfer: Convection and Radiation
MMAE 538   Computational Techniques in Finite
            Element Methods
MMAE 539   Nonlinear Finite Element Analysis

E³ requirements include two additional credit hours for MMAE 594 (Project for Professional Master Students).

Master of Science in Mechanical and Aerospace Engineering with E³ specialization

32 credit hours
Project

Candidates for the M.S. in Mechanical and Aerospace Engineering with E³ specialization are required to take CHE 543 and two courses: MMAE 501 (Engineering Analysis Ia) and MMAE 502 (Engineering Analysis II). Also required under the thermal sciences area of MMAE are MMAE 520 (Advanced Thermodynamics) and any three of the following Group A courses:

MMAE 521   Statistical Thermodynamics
MMAE 522   Air Conditioning Analysis
MMAE 523   Fundamentals of Power Generation
MMAE 524   Fundamentals of Combustion
MMAE 525   Fundamentals of Heat Transfer
MMAE 526   Heat Transfer: Conduction
MMAE 527   Heat Transfer: Convection and Radiation

Also required are one course from Group B and six to seven credit hours of MMAE 591 (Thesis).

Master of Electrical and Computer Engineering with E^3 specialization

30 credit hours
Non-thesis option

This program has the same requirements as the M.E.C.E. degree program, except that students are required to reg-

ister for three to six credits of special project research (ECE 594), plus CHE 543, two courses from the electrical engineering courses listed in Group A, one course from Group B, and two power and control courses. At least 24 ECE credits are required.

Master of Science in Electrical Engineering with E^3 specialization

32 credit hours
Thesis option

Candidates for the M.S. in Electrical Engineering are required to take CHE 543 and must select two courses from the electrical engineering courses listed in Group A (see course listings on pages 209-210) and one course from Group B. In addition, students are required to take two power and control courses, and at least one course

from each of two minor areas of study: communication theory and signal processing, network electronics and electromagnetics, or computer engineering. The students also are required to register for six to eight credit hours of M.S. thesis research (ECE 591) in an interdisciplinary E^3 area and one advanced math course (unless this requirement was met in the B.S. degree). Students may apply up to 12 credit hours of 400-level courses toward the M.S. degree with their adviser's approval.

Doctor of Philosophy with E^3 specialization

84 credit hours
Qualifying exam
Comprehensive exam
Dissertation and oral defense

Students interested in the Ph.D. program in all disci-plines (chemical, environmental, mechanical, materials and aerospace, and electrical engineering) are required to take at least 84 credit hours beyond the B.S. degree requirements, including CHE 543 and at least five E^3

courses (four from both groups A and B; see course list-ings on pages 209-210) upon the recommendation of their thesis adviser. Registration for approximately 32 hours of Ph.D. thesis research in E^3 areas of study is also required. Candidates must pass written qualifying and comprehensive examinations and must defend their the-sis in an oral examination. The Ph.D. committee for E^3 students must include at least one E^3 professor from outside the student's department.

E^3 Courses

See descriptions under the respective department course listings.

Group A

CHE 505
Fluid Properties

CHE 512
Heat Transfer

CHE 518
Mass Transfer

CHE 524
Industrial Catalysis

CHE 536
**Computational Techniques
in Engineering**

CHE 540
**Flow Through Porous Media
and Fundamentals
of Reservoir Engineering**

CHE 541
Renewable Energy Technologies

CHE 542
**Fluidization and Gas-Solids
Flow Systems**

CHE 544
Kinetic Theory of Multiphase Flow

CHE 563
Separation Processes

CHE 565
Electrochemical Engineering

CHE 576
**Industrial Chemistry: Catalytic and
Thermal Reactions and Processes**

ECE 550
**Power Electronics Dynamics and
Control**

ECE 551
Advanced Power Electronics

ECE 552
Adjustable Speed Drives

ECE 553
Power Systems Planning

ECE 554
Power Systems Relaying

Energy/Environment/Economics (E³)

ECE 555
Market Operations in Electric Power Systems

ECE 557
Fault Tolerant Power Systems

ECE 558
Power Systems Reliability

ECE 559
High Voltage Power Transmission

ECE 560
Power Systems Dynamics and Stability

ECE 561
Deregulated Power Systems

ECE 562
Power System Transaction Management

ECE 563
Computational Intelligence in Engineering

ECE 564
Control and Operation of Electric Power Systems

MMAE 517
Computational Fluid Dynamics

MMAE 520/CHE 503
Advanced Thermodynamics

MMAE 521
Statistical Thermodynamics

MMAE 522
Air Conditioning Analysis

MMAE 523
Fundamentals of Power Generation

MMAE 524
Fundamentals of Combustion

MMAE 525
Fundamentals of Heat Transfer

MMAE 526
Heat Transfer: Conduction

MMAE 527
Heat Transfer: Convection and Radiation

MMAE 538
Computational Techniques in Finite Element Methods

MMAE 539
Nonlinear Finite Element Analysis

Group B

CHE 541
Renewable Energy Technologies

CHE 560
Statistical Quality and Process Control

CHE 587
Particle Processing and Characterization

EM 507
Industrial Ecology

ENVE 501
Environmental Chemistry

ENVE 506
Chemodynamics

ENVE 520
Environmental Monitoring and Assessment

ENVE 527
Statistical Analysis of Systems

ENVE 542
Physicochemical Processes in Environmental Engineering

ENVE 545
Environmental Regulations and Risk Assessment

ENVE 551
Industrial Waste Treatment

ENVE 561
Design of Sanitary Engineering Processes

ENVE 563
Systems Engineering: Waste Facility Design and Operation

ENVE 570
Air Pollution Meteorology

ENVE 573
Air Pollution Engineering

ENVE 577
Design of Air Pollution Control Devices

ENVE 578
Physical and Chemical Processes for Industrial Gas Cleaning

ENVE 580
Hazardous Wastes Engineering

ENVE 585
Groundwater Contamination and Pollutant Transport

Food Safety and Technology

National Center for Food Safety and Technology
IIT Moffett Campus
6502 S. Archer Road
Summit-Argo, IL 60501
708.563.1576
708.563.1873 (fax)
www.ncfst.iit.edu

NCFST Director:
Martin Cole

Graduate Program Director:
Sadhana Ravishankar

The National Center for Food Safety and Technology
(NCFST), with IIT faculty, U.S. Food and Drug
Administration (FDA) scientists, and food industry scien-
tists, provides a unique training ground for individuals
seeking graduate education in food safety and technology
and food process engineering. Courses are offered at
NCFST with strong support of the following IIT depart-
ments: Biological Chemical and Physical Sciences (BCPS)
and Chemical and Environmental Engineering (ChEE).

The master's degree programs in Food Safety and
Technology are designed to train students with back-
grounds in food science to be food safety experts for the
private sector and for the federal and state public health

agencies. The master's degree programs in Food Process
Engineering are designed as flexible programs to educate
engineers and scientists in different aspects of food pro-
cessing and safety. Students can specialize in food
processing operations, packaging, food safety, food
biotechnology, and process and quality monitoring and
control.

The faculty is drawn from NCFST/IIT faculty and
NCFST/FDA scientists, and is augmented by IIT faculty
from several departments, other federal scientists, and
experts from NCFST member companies. In addition to
formal course requirements, students will participate in
food safety and technology research projects at the
NCFST under the supervision of IIT faculty and FDA sci-
entists. The FDA presence provides a unique opportunity
for students to understand the synergy of scientific phi-
losophy and legal issues involved in the regulatory
process governing the safety and wholesomeness of the
U.S. food supply.

Graduates of the program will be prepared to assume
responsible positions in research and development, food
safety, compliance and regulatory affairs, quality assur-
ance, and quality control in the food industry. Other
career options include positions in federal, state or local
health agencies and private public health organizations
in policy-making, regulatory or research positions.

Degrees Offered

Master of Science in Food Safety and Technology
(Thesis Option)
Master of Food Safety and Technology (Professional,
Non-Thesis Option)

Master of Science Food Process Engineering
(Thesis Option)
Master of Food Process Engineering
(Professional, Non-Thesis Option)

Certificate Programs

Food Process Engineering
Food Safety and Technology

Facilities

The NCFST facilities include a 2,692 square meter mod-
ern industrial scale pilot plant. The pilot plant houses
state of the art equipment such as a computer-controlled
retort, high temperature-short time plate pasteurizer,
batch high pressure food processors for pasteurization
and sterilization studies, equipment for aseptic process-
ing of particulate foods, pulsed electric field apparatus,
ozone processor, UV food processor, homogenizers, and
package recycling pilot plant. Biocontainment pilot plant

laboratory (BL3) provides an opportunity to conduct stud-
ies of pathogenic microorganisms with pilot plant
equipment. Further, microbiological, food engineering,
chemical and packaging laboratories support the pilot
plant facilities. NCFST's food science and technology
library provides both physical and systems access to cur-
rent and retrospective research and technical
publications.

Food Safety and Technology

Faculty

Martin B. Cole, Research Professor and Director of the National Center for Food Safety and Technology. B.S., Manchester Metropolitan University (UK); Ph.D., University of East Anglia (UK). Control measures for food safety; causes and diagnoses of food spoilage in processed foods; emerging concepts in food safety; development and implementation of control mechanisms for foodborne microorganisms; modeling the growth, survival and death of bacterial pathogens; novel processing technologies, including thermal and non-thermal high pressure processing; detection and control of emerging pathogens.

Tatiana Koutchma, Research Associate Professor of Food Process Engineering, Ph.D., Thermal and non-thermal innovative preservation technologies including ultra high pressure; ultraviolet irradiation; microwave and radio frequency heating and combined treatments for improved food safety, shelf life and product acceptability. Developing protocols for food companies on validating novel technologies in the food safety area using new processing approaches.

Samuel Palumbo, Research Professor of Biology. B.S. Biology, Loyola University; M.S., Ph.D., Food Science, University of Illinois, Urbana-Champaign. Growth of foodborne pathogens at low (refrigeration) temperatures; microbiology of food processing operations; interventions to reduce or eliminate pathogens from red meats and meat products; and laboratory and pilot plant detection and enumeration of various foodborne pathogens such as *Listeria monocytogenes, Escherichia coli* O157:H7, *Salmonella, and Campylobacter jejuni.*

Sadhana Ravishankar, Research Associate Professor of Food Safety and Director of Educational Programs. B.S., M.S., Tamilnadu Agricultural University, (India); Ph.D., University of Georgia. Stress tolerance responses of foodborne pathogens, mechanisms of stress response in bacteria, control of foodborne pathogens by non-thermal technology, bacterial attachment, biofilm formation and control, bacterial spoilage detection in food packages by novel methods, bacterial pathogen surrogate evaluation, control of foodborne pathogens in processed foods by multiple hurdle approach, natural antimicrobials.

Peter J. Slade, Research Associate Professor and Director of Research. B.S., University of Leeds (England); Ph.D., University of Guelph (Canada). Investigations of antimicrobial treatments applied to seeds and vegetable sprouts, and ready-to-eat meat products; studies on resistance and injury in food borne pathogens to novel processing technologies, with understanding of underlying mechanisms; development and application of novel rapid methods for the detection of food borne pathogens; development of food safety programs such as hazard analysis critical control points (HACCP); hygienic design of food processing facilities and equipment.

Cynthia M. Stewart, Principal Microbiologist and Assistant Research Professor of Biology. B.S., and M.S., University of Delaware; Ph.D., Rutgers University. High pressure processing and other non-thermal processing technologies, bacterial spore inactivation (including mechanisms of inactivation), predictive microbial modeling, food defense (biosecurity), process validation, food polymer science approach to understanding product safety and stability.

Peter Varelis, Principle Research Chemist, M.S. and Ph.D. University of Western Australia. Application of isotope dilution mass spectrometric techniques to measuring contaminates in food and understanding their fate during food processing.

Darsh Wasan, Professor of Chemical Engineering, Vice President for International Affairs, and Motorola Chair. Ph.D, University of California, Berkeley. Interfacial colloidal phenomena, foams, emulsions and dispersions, and food and environmental technologies.

Wei Zhang, Assistant Professor of Biology, B.En., M.S., Huazhong Agricultural University, (China); Ph.D,.Pennsylvania State University. Microbial food safety and security; PCR detection and molecular tracking of foodborne pathogens; comparative genomics; study of bacterial pathogenesis, epidemiology, evolution and emergence of new pathotypes; identification of novel bacterial virulence factors; DNA microarray analysis of global gene expressions of foodborne pathogens under environmental or food processing stresses; MALDI-TOF mass spectrometry analysis of bacterial proteomes; applications of DNA fingerprinting technology; development of high-throughput SNP genotyping for foodborne disease surveillance and bioterrorism investigations.

Adjunct Faculty

Upasana Abbott, Adjunct Professor, Food Analysis. B.S. Home Science, M.S., Ph.D. Food Technology, Punjab Agricultural University (India). Single and multiple laboratory validation of analytical methods, detection of pesticide residues, microbial and environmental toxins in foods, and food product development to promote health and longevity.

Eric F. Greenberg, Adjunct Professor of Food Law and Regulations. B.A., Northwestern University; J.D., Cornell Law School. Partner in the law firm of Ungaretti & Harris, which is concentrated in food and drug law, packaging law, and commercial litigation. Work has included regulatory counseling, new product development, negotiation with the U.S. Food and Drug Administration on numerous levels, handling recalls, and defending enforcement actions.

Alfredo C. Rodriguez, Adjunct Professor, Advanced Food Process Engineering. B.S. and M.S. ,National Polytechnic Institute (Mexico); Ph.D. ,University of Florida. Dr. Rodriguez is the Engineering Specialist, Sterilization Science Center, at Baxter Healthcare Corporation, Round Lake, IL. Kinetics, transport phenomena, statistics and system analysis as applied to sterilization process engineering. Applied research interests correspond to the use of high pressure, radiation, moist-heat; and ethylene oxide and other disinfectants to sterilize pharmaceutical and biological products.

Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0
GRE score minimum: 1400 (combined score, for tests
taken prior to Oct. 1, 2002); 900 (quantitative + verbal)
and 2.5 (analytical writing, for tests taken on or after
Oct. 1, 2002).
TOEFL minimum: 550/213*

Meeting the minimum GPA and test score requirements
does not guarantee admission. GPA and test scores are
just two of several important factors considered.
Admission to graduate study in food safety and technol-
ogy requires the completion of a program leading to a
bachelor's degree in food science and technology, agricul-
tural engineering, chemical engineering or related
disciplines from an accredited institution. The applicant
must have a minimum cumulative undergraduate grade
point average of 3.0/4.0. Prerequisites for the program
are food processing, chemistry, microbiology, calculus and
statistics. Students without appropriate prerequisites are
expected to take deficiency courses suggested by their

academic advisers. For admission requirements in the
Food Process Engineering program, please refer to the
Department of Chemical and Environmental Engineering
section.

A limited number of supported graduate half-dean's
scholarships are available. Consideration is given based
on the quality of previous academic work, evidence of
research ability and intellectual capacity. These are
awarded on a competitive basis to qualified students who
have submitted completed applications by January 30 for
admission in the fall semester or by September 1 for
admission in spring semester. Graduate Research
Assistantship will be available depending on grants
received by the faculty. Assistantship appointments are in
general for one year and renewed upon satisfactory
research progress and funding availability. Additional
information is available from NCFST.

* Paper-based test score/computer-based test score.

Program Descriptions

Students in Food Safety and Technology programs should
consult with their faculty adviser to plan a program of
study best suited to their background and interests. The
Food Safety and Technology program is directed toward
students with backgrounds in food science and related
fields. The Food Process Engineering (FPE) programs are
directed toward students with background and career objec-
tives in engineering-related disciplines. Students enrolled
in FST Master of Science programs must register for six to
eight credit hours of research. This work will usually be
done at the Moffett Campus; research topics will be selected

from food safety, food process engineering, food biotechnol-
ogy, or related topics. Attendance will also be required in a
graduate seminar where students are expected to actively
participate and present reports on their research. Students
enrolled in Master of Food Safety and Technology and
Master of Food Process Engineering are strongly encour-
aged to do an independent project up to four credit hours.
Details on food process engineering program requirements
are in the section on the Department of Chemical and
Environmental Engineering.

Master of Science in Food Safety and Technology

32 credit hours
Thesis

Candidates are required to take a total of 32 credit hours,
14 credits of which must be selected from the core food
safety and technology courses listed below, and six to
eight credit hours must be in research and thesis work.

Core courses

FST 505	Food Microbiology
FST 506	Food Microbiology Laboratory
FST 507	Food Analysis
FST 521	Food Process Engineering
FST 541	Principles of Food Packaging
FST 524	Fundamentals of Food Science and Technology
	(For Students with Non-Food Background)
FST 541	Principles of Food Packaging

Electives

FST 504	Food Biotechnology
FST 511	Food Law and Regulation
FST 531	HACCP Planning and Implementation
FST 507	Food Analysis

The student must have a minimum grade point average
of 3.0/4.0 in the core courses. In addition to the core
courses required of all students, further courses may be
selected with the approval of the adviser to fit the back-
ground and needs of the individual student.

Research for the thesis must be carried out under the
direct supervision of a participating faculty member.
Based on the requirements of the research project, thesis
committee members may be chosen from IIT faculty
members from various departments, NCFST/FDA scien-
tists and the food industry scientists. The final thesis
examination consists of submission of a written thesis
report followed by an oral presentation open to all
NCFST staff and the university community. As a part of
the thesis, the student is expected to contribute to one or
more high quality peer-reviewed journal article(s). The
student is also encouraged to present the research at a
national professional society meeting.

Food Safety and Technology

Master of Science in Food Process Engineering
Master of Food Process Engineering

32 credit hours
Thesis (for Master of Science program)
Project Option (for Master of Food Process Engineering)

Students should refer to the section on the Department of Chemical and Environmental Engineering for details on food process engineering program requirements.

Certificate Programs

12 credits

Certificate programs provide a student with post baccalaureate knowledge of food safety and technology and its applications in the food industry, and in federal and state public health agencies. Certificate programs typically require a set of three to four courses that must be

completed in three years with minimum GPA of 3.0/4.0. Students who are admitted to master's degree programs may apply coursework previously taken in a certificate program towards the requirements for the master's degree.

Food Process Engineering (FPE)

Provides an introduction to the field of food engineering with application of chemical engineering to food manufacturing and food safety (four courses, 12 credits). Offered in collaboration with Chemical and Environmental

Engineering program. Students should refer to the Department of Chemical and Environmental Engineering section for additional details.

Food Safety and Technology (FST)

The following is a list of suggested courses students may choose for the certificate program in Food Safety and Technology.

The certificate requires four courses (12 credits).

FST 504   Food Biotechnology
FST 505   Food Microbiology
FST 506   Food Microbiological Laboratory
FST 507   Food Analysis

FST 521   Food Process Engineering
FST 523   Food Engineering Laboratory
FST 524   Fundamentals of Food Science and Technology (For students with a (Non-Food background)
FST 531   HACCP Planning and Implementation
FST 541   Principles of Food Packaging

Numbers in parentheses after course descriptions indicate weekly class, lab and total credit hours, respectively.

Course Descriptions

FST 504
Food Biotechnology
Introduction of biotechnology in the food industry including genetic engineering of microorganisms. Fundamentals of microbial genomics and proteomics. Practice of a variety of software and bioinformatics tools including database search, sequence alignment, phylogenetic and cluster analyses, gene prediction, genomic map construction, structural and functional prediction of proteins. Applications of DNA fingerprinting techniques in food safety and public health. Prerequisite: Biology or Microbiology. (3-0-3)

FST 505
Food Microbiology
Microorganisms of importance to food safety, spoilage and food fermentations. Principles of occurrence and control. Importance of sanitation and prevention of public health problems. Microbiological contaminants and methods for their detection. Mechanisms of microbial inactivation. Prerequisites: Introductory Microbiology, Food Science and Biochemistry. (3-0-3)

FST 506
Food Microbiological Laboratory
Basic microbiological techniques and safe laboratory practices. Introductory Food Microbiology. Isolation of pathogenic bacteria. Spoilage microorganisms. Fermentation. Environmental Monitoring. Rapid Identification tests. Sporeformers. Prerequisites: Introductory Microbiology and Biochemistry. (0-3-3)

FST 507
Food Analysis
Techniques for analyzing food toxins, food constituents of public health concern, intentional and unintentional food additives, modern separation and analytic techniques. Prerequisites: chemistry, analytic chemistry. (3-0-3)

FST 511
Food Law and Regulation
Legal and scientific issues in regulating the nation's food supply and nutritional status. Rules of regulatory agencies; Federal Food, Drug and Cosmetic Act; definitions and standards for food and adulterated foods. Manufacturing processed foods in compliance with regulations. (3-0-3)

FST 521
Food Process Engineering
Food engineering fundamentals, heat transfer in food processing, food rheology, freezing of foods, food dehydration, kinetics of chemical reactions in foods, refrigeration and thermal process calculations, alternative methods of food processing. (3-0-3)

FST 522
Advanced Food Process Engineering
Process calculations for food processing methods such as canning, aseptic processing, ohmic heating, microwave processing and pulsed energy processing. Extrusion techniques in food processing. Discussion of new food processing techniques and safety implications. Prerequisite: FST 521 or permission of the instructor. (3-0-3)

FST 524
Fundamentals of Food Science and Technology
This course will cover the central food science issues encountered with storage and processing of all major American food commodities including meats, grains, confections, vegetables, eggs, dairy. It will also review the relevant chemistry, physics and engineering required to understand common food-related unit operations such as drying, freezing, sterilization and radiation treatment of foods. An introduction to microbial and chemical issues of food quality and safety will also be covered. (3-0-3)

FST 531
HACCP Planning and Implementation
Examination of the hazard analysis and critical control point (HACCP) principles; microbiological and process overviews; generic HACCP models, good manufacturing practices; monitoring of critical control points, process control and implementation. (3-0-3)

FST 541
Principles of Food Packaging
Type and application of packaging materials. Migration Theories. Food Package interaction. Package testing to ensure safety. Special design considerations. Recycling of package materials. (3-0-3)

FST 591
Research and Thesis
Students conduct their research on a particular topic and write a thesis. Students are also required to write manuscripts from his/her thesis work for publication. (Credit: Variable 1-10 hours)

FST 593
Seminar on Food Safety and Technology
Students attend seminars offered during the semester. Each student is also required to give a 30 minute presentation on a topic of his/her interest or a research project on which she/he has worked. (Credit: 1 Hour)

FST 594
Special Projects
Advanced projects involving analysis of food safety processing, packaging and biotechnology systems. (Credit: 1-6 hours)

FST 597
Special Problems
Independent study focusing on current problems, issues of professional relevance. Topics selected from food process engineering, food safety, packaging, biotechnology. Repeatable to a maximum of six credit hours. (Credit: 1-6)

Information Technology & Management

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The Master of Information Technology & Management is designed primarily for working professionals who seek a hands-on, laboratory based program that broadens and deepens their knowledge of new and emerging information technologies, the application and integration of these technologies, and the administrative practices used in the effective management of these technologies.

Degree Offered

Master of Information Technology & Management

Certificate Program

Computer and Network Security Technologies

Faculty

C. Robert Carlson, Professor, Director of the Center for Professional Development and Academic Director, Information Technology and Management Degree Programs. B.A. Augustana College, Ph.D. University of Iowa. Database design, object-oriented modeling and design, software engineering, and IT entrepreneurship.

Carol Davids, Alva C. Todd Professor and Director of the VoIP Laboratory, Center for Professional Development. B.S.E.E. Cornell, M.I.T.M. Illinois Institute of Technology. Voice over IP, networks, and digital and voice communications.

Dennis Hood, Lecturer. B.S. Rensselaer Polytechnic Institute, M.S. Stevens Institute of Technology. Project Management, process engineering, information technology management.

William Lidinsky, Alva C. Todd Professor and Assistant Director, Information Technology and Management Degree Programs. B.S.E.E., M.S.E.E. Illinois Institute of Technology, M.B.A. University of Chicago. Computer networking, computer and network security, and computer and network forensics.

Alexander K. Manov, Senior Lecturer. Ph.D. Illinois Institute of Technology. Database systems, operating systems, database and system security.

Raymond E. Trygstad, Lecturer and Director of Information Technology, Center for Professional Development. B.S. United States Naval Academy, M.S.S.M. University of Denver. Online design, Internet application development, multimedia, system administration, information security management, and information technology policy.

Laboratory and Research Facilities

The Center for Professional Development operates and administers over 250 computers and servers in two locations to support teaching and learning. Eleven laboratories include two Sun Solaris facilities, one networking/network security facility, and one dedicated Voice over IP (VoIP) facility which includes an entire CISCO VoIP LAN as well as video and mesh wireless capabilities. The network security and VoIP laboratories provide additional facilities for student projects and applied research, some of which is undertaken in conjunction with industry partners. Additionally one IITV/IIT Online classroom is wired for full network connectivity for notebook computers, which are made available for students who cannot provide their own. All laboratories are normally available for student use outside of class hours, and one or more laboratories are available for student use weekdays between 10 am and 10 pm at the Rice Campus. A wireless network at the Rice Campus provides complete coverage of the campus and operates at all times that the campus is open. Students make extensive use of the network infrastructure provided to support personal notebook computers.

Information Technology & Management

Admission Requirements

Applicants for admission must have earned a four-year bachelor's degree from an accredited institution with a minimum cumulative undergraduate GPA of 3.0/4.0. International applicants are required to submit a GRE score with a minimum score of 1200 (combined score for tests taken prior to Oct. 1, 2002); or 900 quantitative + verbal and 2.5 analytical writing, (for tests taken on or after Oct. 1, 2002) and may be required to submit a TOEFL score (see page 26). Admission as a non-degree student follows the university policy set forth in this bulletin.

Students whose undergraduate degree is not in a computer-related area or who do not have significant experience or certifications in the information technology field will be required to demonstrate proficiency in the undergraduate courses that are prerequisites for the graduate program. Proficiency may be demonstrated by taking and passing a written exam or taking and passing, with a grade of "B" or better, the prerequisite undergraduate courses at IIT. Current prerequisites for the Master of Information Technology & Management include computer hardware and operating system literacy (ITM 301 or ITM 302 or equivalent coursework, certification or experience) and an ability to program at a basic level using a contemporary programming language (ITM 311 or ITM 312 or equivalent coursework, certification or experience).

Master of Information Technology & Management

30 credit hours (Courses may be selected from 400-and 500-level courses; a minimum of 18 credit hours must be at the 500-level or higher.)
GPA of 3.0/4.0 or better

Students whose undergraduate degree is not in a computer-related area or who do not have significant experience or certifications in the information technology field will be required to complete core courses or demonstrate their knowledge through equivalent coursework, certification or experience. These core courses will ensure basic knowledge of networking concepts, protocols and methods (ITM 540); knowledge of the Internet, including the ability to build Web sites and deliver them on

a server (ITM 461); and the ability to create and administer databases using a modern database management system (ITM 421).

The following course groupings are meant to guide students in their course selection, allowing them to focus on a particular area of information technology, depending on their interests, background and career goals: alternative courses in each concentration may be available at the discretion of the student's advisor. Students are not required to choose a specialization for degree completion and can mix courses from different specializations: a general program of study is also available.

Core Courses (9 hours)

Required courses

ITM 421	Data Modeling and Applications	
ITM 561	Internet Technologies & Web Design	
ITM 540	Introduction to Data Networks and the Internet	

Note: Core courses may be waived upon presentation of evidence of equivalent coursework, certification or experience.

Computer and Information Security (18 hours)

Recommended courses (9 hours)

ITM 528	Database Security
ITM 548	System and Network Security
ITM 578	Information Systems Security Management

Plus three courses chosen from the following:

ITM 538	Computer & Network Forensics
ITM 549	System and Network Security: Projects & Advanced Methods
ITM 551	Distributed Workstation System Administration
OR	
ITM 552	Client-Server System Administration
ITM 558	Operating System Security

Information Technology & Management

Healthcare Information Technology (18.6 hours)

HM courses are offered through the Stuart School of Business and are scheduled on a quarter rather than a semester basis; HM course start dates may be different than other courses and each course runs for 10 weeks.

Recommended courses (9.6 hours)

HM 500	Management of Healthcare
HM 510	Healthcare Systems and Technology
HM 520	Health Informatics
HM 530	Organization, Policy and Strategic Health Systems

Plus three courses chosen from the following

ITM 495	Bioinformatics
ITM 521	Client Server Technologies and Applications
ITM 531	Object Oriented System Analysis, Modeling and Design
ITM 571	Project Management for Information Technology Management
ITM 574	Strategic Information Technology Management
ITM 578	Information Systems Security Management

IT Management and Entrepreneurship (18 hours)

Recommended courses (9 hours)

ITM 571	Project Management for Information Technology Management
ITM 574	Strategic Information Technology Management
ITM 581	IT Entrepreneurship

Plus three courses chosen from the following:

ITM 531	Object Oriented System Analysis, Modeling and Design
ITM 532	UML Based Software Development
ITM 572	Process Engineering for Information Technology Managers
ITM 573	Building & Leading Effective Teams
ITM 575	Networking and Telecommunications Management
ITM 578	Information Systems Security Management
ITM 585	Legal and Ethical Issues in Information Technology

Voice and Data Communication Technology (18 hours)

Recommended courses (9 hours)

ITM 540	Introduction to Data Networks and the Internet
ITM 545	Telecommunications Technology
ITM 546	Voice Communications Over Data Networks

Plus three courses chosen from the following:

ITM 541	Network Administration and Operations
ITM 542	Wireless Technologies and Applications
ITM 548	System and Network Security
ITM 549	System and Network Security: Projects & Advanced Methods
ITM 571	Project Management for Information Technology Management
ITM 575	Networking and Telecommunications Management
ITM 594	Special Project in Digital Voice and Data Communication

Date Management (18 hours)

Recommended courses (9 hours)

ITM 421	Data Modeling and Applications
ITM 422	Advanced Database Management

Plus three courses chosen from the following:

ITM 521	Client Server Technologies and Applications
ITM 528	Database Security
ITM 531	Object Oriented System Analysis, Modeling and Design
ITM 534	Human Computer Interaction
ITM 574	Strategic Information Technology Management
ITM 578	Information Systems Security Management
ITM 594	Special Project in Data Management

Information Technology & Management

Internet Development and Electronicc Commerce (18 hours)

Recommended courses (9 hours)

ITM 461	Internet Technologies & Web Design
ITM 562	Web Application Development
ITM 571	Project Management for Information Technology Management

Plus three courses chosen from the following:

ITM 411	Intermediate Object Oriented Programming
ITM 414	Visual Programming Environments
ITM 415	Advanced Object Oriented Programming
ITM 541	Network Administration and Operations
ITM 563	Internet Application Development
ITM 564	Electronic Commerce Applications and Management
ITM 565	Dynamic Web Page Development
ITM 566	Web Services & Service-Oriented Architectures
ITM 567	Enterprise Web Application Development
COM 525	Research and Usability Testing

Software Development (18 hours)

Recommended courses (9 hours)

ITM 521	Client Server Technologies and Applications
ITM 532	UML Based Software Development
ITM 571	Project Management for Information Technology Management

Plus three courses chosen from the following:

ITM 411	Intermediate Object Oriented Programming
ITM 412	Advanced Structured and Object Oriented Programming
ITM 415	Advanced Object Oriented Programming
ITM 511	Application Development Methodologies
ITM 531	Object Oriented System Analysis, Modeling and Design
ITM 536	Software Testing and Maintenance
ITM 567	Enterprise Web Application Development
ITM 572	Process Engineering for Information Technology Managers

Systems Administration (18 hours)

Recommended courses (9 hours)

ITM 541	Network Administration and Operations
ITM 551	Distributed Workstation System Administration
OR	
ITM 552	Client-Server System Administration

Plus three courses chosen from the following:

ITM 456	Introduction to Open Source Operating Systems
ITM 558	Operating System Security
ITM 571	Project Management for Information Technology Management
ITM 574	Strategic Information Technology Management
ITM 575	Networking and Telecommunications Management

Information Technology & Management

Master of Information Technology & Management: General Course of Study

These are selected groupings of courses allowing students enrolled in the Master of Information Technology & Management degree to develop a broad overview knowledge of information technology. Suggested courses in each area are marked with an asterisk (*) with one alternative course listed for each area; more alternatives may be possible at the discretion of the student's advisor.

Internet Development and Electronic Commerce
*ITM 461	Internet Technologies & Web Design
*ITM 562	Web Site Application Development
ITM 574	Strategic Information Technology Management

Data Management
*ITM 421	Data Modeling and Applications
*ITM 521	Client Server Technologies and Applications
ITM 531	Object Oriented System Analysis, Modeling and Design

Networking and Communications
*ITM 540	Introduction to Data Networks and the Internet
*ITM 548	System and Network Security
ITM 541	Network Administration and Operations

System Administration
*ITM 551	Distributed Workstation System Administration
OR	
*ITM 552	Client-Server System Administration

Software Development
*ITM 411	Intermediate Object Oriented Programming
*ITM 532	UML Based Software Development
ITM 571	Project Management for Information Technology Management

Computer & Information Security
* ITM 578	Information Systems Security Management
ITM 528	Database Security
ITM 548	System and Network Security

Certificate Programs

Certificate programs offer working professionals an opportunity to increase their knowledge and skills in the specific areas of information technology. A certificate representing proven academic performance is presented after the required coursework is completed with a GPA of 3.0/4.0.

Courses taken may be later applied toward a degree program. Applicants should have a bachelor's degree from an accredited college or university; the degree need not be in an information technology or computer related field.

Computer and Network Security Technologies

This program is designed for students seeking knowledge that will prepare them for careers in computer and network security and to deal with the challenging computer and network security problems facing society. All courses may be later applied toward the Master of Information Technology and Management degree for those who apply and are accepted to the degree program.

Students in this program must select nine hours of coursework from the following:

ITM 540	Introduction to Data Networks and the Internet
OR	
ITM 421	Data Modeling and Applications

and any two of the following six courses

ITM 528	Database Security
ITM 538	Computer & Network Forensics
ITM 548	System and Network Security
ITM 549	System and Network Security: Projects & Advanced Methods
ITM 558	Operating System Security
ITM 578	Information System Security Management

Students who have already completed coursework or certification equivalent to ITM 540 and/or ITM 421 may substitute a third course from the above list.

Accelerated Courses

The program may offer accelerated courses for credit in several areas of information technology & management. (Students should see the definition of accelerated courses on page 41.)

Accelerated courses provide an opportunity for degree-seeking students at IIT to complete graduate degree requirements in a shorter time period. If taken by non-degree seeking students, all courses may be later applied toward the Master of Information Technology and Management degree for those who apply and are accepted to the degree program.

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Course Descriptions

Numbers in parentheses indicate class, lab and credit hours, respectively.

ITM 511
Application Development Methodologies

Students learn concepts in a systematic approach to the analysis, design, implementation and maintenance of software. Includes studies of the various models of the software life-cycle, software development project management, system requirements analysis, and methodologies for practical application of these models to software development, including the use of CASE (Computer Aided Software Engineering) tools. Students apply these principles in projects to improve the quality of their development process and final products. Prerequisite: ITM 412 or significant software development experience. (2-2-3)

ITM 521
Client/Server Technologies and Applications

This course covers both concepts and practical applications of client server systems, a common form of distributed system in which software is split between server tasks and client tasks. Both central and distributed server models will be studied, with particular focus on middleware, systems planning, and data access. The course includes hands-on development of client-server applications in database systems. Prerequisite: ITM 421. (2-2-3)

ITM 528
Database Security

Students will engage in an in-depth examination of topics in data security including security considerations in applications & systems development, encryption methods, cryptography law, and security architecture & models. Prerequisite: ITM 421. (3-0-3)

ITM 531
Object-Oriented System Analysis, Modeling and Design

This course will cover object-oriented approaches to system analysis, data modeling and design that combine both process and data views of systems. Emphasis is given to practical problems and the techniques needed to create solutions in systems design. (3-0-3)

ITM 532
UML-Based Software Development

Study of software development using the Unified Modeling Language (UML). Covers architecture-driven and component based techniques for modeling object-oriented applications. Particular emphasis is placed on the hands-on application of tools and components used for object-oriented systems modeling. Prerequisite: ITM 412 or significant object-oriented programming experience. (3-0-3)

ITM 534
Human/Computer Interaction

Introduction to human-computer interaction, a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use. Emphasis is given to the structure of communication between people and computers, capabilities of people to use computers, concerns that arise in designing and building interfaces, design trade-offs, and the process of specification, design, and implementation of user interfaces. Particular emphasis is placed on practical design and usability of computer system user interfaces. (3-0-3)

ITM 535
Systems Architectures

The course deals with building integrated information infrastructures, including both hardware, software and network components, as a solutions to particular information management needs and requirements. Students should be able to recognize major architectural styles in existing systems, understand how architecture influences long-term system evolution, describe and document an architecture effectively, and design suitable architectural solutions for a problem. Software integration and security issues are addressed. Prerequisite: ITM 531. (3-0-3)

ITM 536
Software Testing and Maintenance

This course covers the basic concepts of software testing and maintenance. The Testing Maturity Model provides a framework for developing a more mature test process. Testing techniques, test metrics and test plan management concepts are described within this framework. Prerequisites: ITM 471 or ITM 571. (3-0-3)

ITM 538
Computer & Network Forensics

This course will address methods to properly conduct a computer and/or network forensics investigation including digital evidence collection and evaluation and legal issues involved in network forensics. Technical issues in acquiring court-admissible chains-ofevidence using various forensic tools that reconstruct criminally liable actions at the physical and logical levels are also addressed. Prerequisite: ITM 548 (2-2-3)

ITM 540
Introduction to Data Networks and the Internet

This course covers current and evolving data network technologies, protocols, network components, and the networks that use them, focusing on the Internet and related LANs. The state of worldwide networking and its evolution will be discussed. This course covers the Internet architecture, organizations, and protocols including: Ethernet, 802.11, routing, the TCP/UDP/IP suite, DNS, SNMP, DHCP, and more. Students will be presented with Internet-specific networking tools for searching, testing, debugging, and configuring networks and network-connected host computers. There will be opportunities for network configuration and hands-on use of tools. (2-2-3)

ITM 541
Network Administration and Operations
Students learn the details, use, and configuration of network applications. Currently protocols and application technologies considered include: SNMP, SMTP, IMAP, POP, MIME, BOOTP, DHCP, SAMBA, NFS, AFS, X, HTTP, DNS, NetBIOS, and CIFS/SMB. Windows 2000 workgroups and domains: file and printer sharing, remote access, and the Windows Network Neighborhood are addressed. A research paper in the above topic areas is required. Prerequisite: ITM 440 or ITM 540 (2-2-3)

ITM 542
Wireless Technologies and Applications
This course will present the foundation of wireless technologies and examine state-of-the-art wireless systems and services, including digital cellular systems (DCS), wireless asynchronous transfer mode (ATM), infrared data transfer (IrDA), wireless local area network technologies including 802.11b (wireless Ethernet) and Bluetooth, and third-generation (3G) systems such as wireless code division multiple access (W-CDMA) and cdma2000. Security for wireless systems including encryption and authentication issues will also be addressed. Prerequisite: ITM 441 or ITM 541. (3-0-3)

ITM 545
Telecommunications Technology
Introduction to voice and data communications infrastructure design and implementation. Current infrastructure including components of voice networks (such as carrier switches, PBXs, SS7, T1 trunks, and switched versus dedicated circuits), the Public Switched Telephone Network (PSTN), communications industry structure, telephone-data system interfaces and interaction, and convergence of voice and data communications systems will be examined, along with possible alternative approaches. Also examined will be components of data networks

such as modems, multiplexers, virtual circuits, hubs, bridges, and routers and their relationships to voice communications technology will be highlighted. (3-0-3)

ITM 546
Telecommunications Over Data Networks
This course covers a suite of application protocols known as Voice over IP (VoIP). It describes important protocols within that suite including RTP, SDP, MGCP, and SIP and the architecture of various VoIP installations including on-net to on-net, on-net to PSTN and Inter-domain scenarios. The functions of the Network Elements that play significant roles in this architecture will be defined. Examples of network elements that are currently available as products will be examined. Prerequisite: ITM 440 or ITM 540 (3-0-3)

ITM 548
System and Network Security
Prepares students for a role as a network security administrator and analyst. Topics include viruses, worms, other attack mechanisms, vulnerabilities and countermeasures, network security protocols, encryption, identity and authentication, scanning, firewalls, security tools, and organizations addressing security. A component of this course is a self-contained team project that, if the student wishes, can be extended into a full operational security system in a follow-on course (ITM 549). Prerequisite: ITM 440 or ITM 540 (2-2-3).

ITM 549
System and Network Security: Projects and Advanced Methods
Prepares students for a role as a network security analyst and developer and give the student experience in developing a production security system. Topics may include computer and network forensics, advances in cryptography and security protocols and systems; operating system security, analysis of recent security attacks, vulnerability and intrusion detection, incident analysis, and the

design and development of secure networks. This course includes a significant real world team project that results in an fully operational security system. Students should have previous experience with object-oriented and/or scripting languages. Prerequisite: ITM 548 (2-2-3) (C)

ITM 551
Distributed Workstation System Administration
Students learn to set up and maintain PC workstations and servers and to administer PC servers and networks. Topics include hardware requirements; software compatibility; and system installation, configuration and options and post-installation topics; administrative practices required for file system security; process management; performance monitoring and tuning; storage management; back-up and restoration of data; and disaster recovery and prevention. A group project or research paper will demonstrate mastery of the subject. Prerequisite: ITM 301 (4-4-6)

ITM 552
Client-Server System Administration
Students learn to setup and configure a contemporary operating system, including the actual installation of the operating system on the student workstation, in a networked client-server environment. User account management, security, printing, disk configuration, and backup procedures are addressed, with particular attention to coverage of TCP/IP and TCP/IP applications. System installation, configuration and administration issues as well as network file systems, network access and compatibility with other operating systems are also addressed. A group project or research paper will demonstrate mastery of the subject. Prerequisite: ITM 302 (4-4-6)

ITM 555
Handheld Device Technologies
An in-depth introduction to contemporary handheld device technologies such as personal digital assistants

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(PDA), handheld computers, network analysis/security devices and wireless telephone/pager technologies including I-mode and wireless access protocol (WAP). Fundamentals of programming and security considerations for handheld device technology are introduced. Prerequisites: ITM 412, ITM 421, and ITM 461 or 561, or a working knowledge of object-oriented programming, database fundamentals, and HTML (2-2-3)

ITM 558
Operating System Security
This course will address theoretical concepts of operating system security, security architectures of current operating systems, and details of security implementation using best practices to configure operating systems to industry security standards. Server configuration, system-level firewalls, file system security, logging, anti-virus and anti-spyware measures and other operating system security strategies will be examined. Prerequisite: ITM 301 or ITM 302 (2-2-3)

ITM 562
Web Site Application Development
Programming the Common Gateway Interface (CGI) for Web pages is introduced with emphasis on creation of interfaces to handle Web-based form data. CGI programming is taught in multiple languages. Security of Web sites is covered with an emphasis on controlled access sites. Setup, administration and customization of content management systems including blog and portal sites is introduced. Students design and create a major Web site with including basic CGI programs with Web interfaces and process data flows from online forms with basic database structures. Prerequisite: ITM 461 (2-2-3)

ITM 563
Internet Application Development
In-depth examination of the concepts involved in the development of Internet applications. Students will learn the differences and similarities between Internet applications and traditional client/server applications. A discussion of the technologies involved in creating these Internet applications is included, and students will learn to use these technologies to create robust server-side applications. Also addressed is the role of the Application Service Provider (ASP) in enterprise information technology management. Prerequisite: ITM 411 (2-2-3)

ITM 564
Electronic Commerce Applications and Management
Strategies for management of electronic commerce allow students to learn to re-engineer established business processes to increase enterprise competitive advantage, provide better customer service, reduce operating costs, and achieve a better return on investment. Students will learn to evaluate, use, and deploy state-of-the-art tools and techniques needed to develop a reliable e-commerce offering on the Web. The course will cover state-of-the-art programming and development tools. This class will provide students with hands-on exposure needed to design and build a fully functional e-commerce Web site. Prerequisite: ITM 563. (2-2-3)

ITM 565
Dynamic Web Page Development
Students will learn the W3C and major vendor's Document Object Models (DOM) and how to use scripting syntax and techniques to make use of the DOM in the preparation of dynamic web pages. The role of Cascading Style Sheets in dynamic web pages will also be covered in detail. Prerequisite: ITM 461 (2-2-3)

ITM 566
XML and XHTML
The student is introduced to extensible markup languages and associate modeling technique required to develop leading edge Web documentation for a next generation Web site, and learns to design structured and intuitive markup utilizing schema and stylesheets which flexibly augment the underlying extensible markup language infrastructures. Principles of XML use are reinforced by analysis of business case studies including an XML-based Web site. Prerequisite: ITM 461 (2-2-3)

ITM 567
Enterprise Web Application Development
Students learn how to construct large-scale enterprise-level Web applications using current technologies. Areas covered include components, design goals, and architecture as well as integration of databases and directory services; security will be discussed and give rise to topics including persistence, communication, transactions and container services. Students will design, develop and deploy a real-world Web application. Prerequisite: ITM 415 or permission of Instructor (2-2-3)

ITM 571
Networking and Telecommunications Management
Project Management for Information Technology Management Basic principles of project management are taught. Includes software development concepts of requirements analysis, object modeling and design and software testing. Management of application development and major Web development projects will also be addressed. (3-0-3)

ITM 572
Process Engineering for Information Technolgy Managers
This course will provide students with the knowledge and skills to define, model, measure and improve business processes. The course will focus on reengineering processes through the application of technology to achieve significant and measurable improvement. The course will explore the latest industry standards and students will use state-of-the-art software tools for hands-on experiential learning. Prerequisite: ITM 471 or ITM 571 (3-0-3)

Information Technology & Management

ITM 573
Building and Leading Effective Teams

This course will prepare students to be effective IT managers. Students will be introduced to the general challenges of management as well as the challenges unique to leading teams of technology professionals. The course will explore the skills necessary to excel as a leader including dealing with conflict, developing leadership skills, recruiting and developing employees, and leading remote and virtual teams. Students will explore case studies and execute team exercises to enrich their learning experience. Prerequisite: ITM 471 or ITM 571 (3-0-3)

ITM 574
Strategic Information Technology Management

This course defines information technology management strategies, explores the possible information technology strategies of an organization, and provides conceptual frameworks for the development and evaluation of information technology management strategies. It also examines concepts of strategic information technology systems, approaches for analyzing strategic applications, and systems planning as it relates to information technology management strategy and the interface with organizational strategies. (3-0-3)

ITM 575
Networking and Telecommunications Management

This course addresses the design, implementation, and management of computer networks and enterprise telecommunication systems. Design issues in wide area networks and telecommunications with emphasis on Internet connectivity are also addressed. Tools for supporting the distribution and sharing of system resources and information are discussed, along with tools to support network design and management. Prerequisite: ITM 541 (3-0-3)

ITM 578
Information System Security Management

In-depth examination of topics in the management of information technology security including access control systems and methodology, business continuity and disaster recovery planning, legal issues in information system security, ethics, computer operations security, physical security and security architecture and models using current standards and models. (3-0-3)

ITM 581
IT Entrepreneurship

This course prepares students to become leaders in information technology and to build IT enterprises. Students design and develop a prototype IT product and prepare a business plan and venture proposal presentation. (3-0-3)

ITM 585
Legal and Ethical Issues in Information Technology

Current legal issues in information technology are addressed including elements of contracting, payment systems and digital signatures, privacy concerns, intellectual property, business torts and criminal liability including hacking, computer trespass and fraud. Examination of ethical issues including privacy, system abuse, and ethical practices in information technology equip students to make sound ethical choices and resolve legal and moral issues that arise in information technology. (3-0-3)

ITM 593
Embedded Systems

This course introduces embedded systems concepts and technology, illustrates the trade-offs which occur as part of embedded systems design, as well as providing practical applications of embedded systems technology. Particular emphasis is given to embedded systems hardware, software and development tools. The course labs include hands-on development of several stand-alone embedded applications using development tools such as compilers, simulators and evaluation boards. Prerequisite: ITM 301 or equivalent computer architecture course; C/C++ programming experience. (2-2-3)

ITM 594
Special Projects in Information Technology

Capstone project. Prerequisite: Written consent of instructor. (Credit: 1 to 6)

ITM 595
Topics in Information Technology

This course will cover a particular topic, varying from semester to semester, in which there is particular student or staff interest. Prerequisite: consent of instructor. (Credit: variable)

ITM 597
Special Problems in Information Technology

Independent study and project. Prerequisite: Consent of instructor. (Credit: variable)

Information Technology & Management

**Undergraduate Courses
Available to Graduate Students
in Information Technology
& Management**

**ITM 301 (as a prerequisite only)
Introduction to Contemporary
Operating Systems and Hardware I**

**ITM 302 (as a prerequisite only)
Introduction to Contemporary
Operating Systems II**

**ITM 311 (as a prerequisite only)
Introduction to Object Oriented
Programming**

**ITM 312 (as a prerequisite only)
Introduction to Systems Software
Programming**

**ITM 411
Advanced Object-Oriented
Programming**

**ITM 412
Advanced Structured
and Systems Programming**

**ITM 414
Visual Programming Environments**

**ITM 415
Advanced Object Oriented
Programming**

**ITM 421
Data Modeling and Applications**

**ITM 422
Advanced Database Management**

**ITM 423
Advanced Database Management II**

**ITM 456
Introduction to Open
Source Operating Systems**

**ITM 460
Fundamentals of Multimedia**

**ITM 461
Internet Technologies & Web
Design**

**ITM 492
Embedded Systems and
Reconfigurable Logic Design**

**ITM 495
Topics in Information Technology**

Manufacturing Engineering

Departmental Coordinators

Chemical and Environmental Engineering:
David Venerus
312.567.5177

Electrical and Computer Engineering:
S. M. Shahidehpour
312.567.5737

Mechanical, Materials and Aerospace Engineering:
Michael Gosz
312.567.3198

The departments of Chemical and Environmental Engineering, Electrical and Computer Engineering, and Mechanical, Materials and Aerospace Engineering each offer interdisciplinary curricula leading to graduate degrees in manufacturing engineering.

Degrees Offered

Master of Manufacturing Engineering

Master of Science in Manufacturing Engineering

Research Areas, Centers and Facilities

Students should refer to descriptions under the three respective departments:

Chemical and Environmental Engineering
Electrical and Computer Engineering
Mechanical, Materials and Aerospace Engineering

Admission Requirements

Applicants are admitted to the Department of Chemical and Environmental Engineering, the Department of Electrical and Computer Engineering, or the Department of Mechanical, Materials and Aerospace Engineering. Admission requirements are the same as for the other master's programs in those departments. Students should refer to the specific department for general admission requirements (Chemical and Environmental Engineering pg.111, Electrical and Computer Engineering, pg.183, or Mechanical, Materials and Aerospace Engineering pg.241).

Meeting the minimum GPA and test score requirements does not guarantee admission. Test scores and GPA are just two of several important factors considered.

Coursework includes three components:
Manufacturing core courses
Departmental core manufacturing courses
Electives approved by the department

Students must have an adviser and file a Program of Study that is approved by their respective department Graduate Studies Committee. The program accepts no more than six credit hours of 400-level courses not taken to fulfill an undergraduate degree requirement. In addition to the completion of coursework and thesis, the M.S. student is required to pass a comprehensive examination.

Rules and regulations regarding the comprehensive examination are the same as those for all other M.S. students in their respective departments.

With department approval, up to six hours of accelerated courses may be applied toward the professional master's degree. The department reserves the right to review and approve or deny the application for admission of any prospective degree-seeking student. Non-degree graduate students who intend to seek a graduate degree from the department must maintain a 3.0 GPA and must apply for admission as degree-seeking students prior to the completion of nine credit hours of study. A maximum of nine credit hours of approved coursework earned as a non-degree student and passed with a grade of "B" or better may be applied to the degree. Maintaining the minimum GPA requirement does not guarantee admission to any department graduate program.

Master of Manufacturing Engineering

30 credit hours

The Master of Manufacturing Engineering program (M.M.E.) is a course-only, professionally oriented degree program that requires a minimum of 30 credit hours. There is no thesis or comprehensive examination requirement. Full-time graduate students enrolled in the program should select a permanent adviser prior to completing their first semester of graduate study. A graduate student working for the degree on a part-time basis should select a permanent adviser before registering for the twelfth credit hour. The student, in consultation with the adviser, then prepares a program of study that reflects her or his individual needs and interests. This program must be approved by the adviser, the department's Graduate Studies Committee, the department's chair, and the Graduate College. Students working toward this degree are not eligible for departmental financial support.

Master of Science in Manufacturing Engineering

32 credit hours
Thesis
Oral comprehensive examination

The M.S. degree program is designed to equip students with advanced knowledge and to prepare them for careers in research and development. In line with the department's approach to its graduate programs, a student has considerable flexibility, in consultation with his or her program adviser, in formulating a program. The Master of Science in Manufacturing Engineering requires completion of a minimum of 32 credit hours of approved work, which includes six to eight credit hours of thesis research. Before completion of the first semester of graduate study, full-time students should select an area of specialization and a permanent adviser. Graduate students pursuing the M.S. degree on a part-time basis should select a permanent adviser before registering for their twelfth credit hour. The student, in consultation with the adviser, then prepares a program of study that reflects individual needs and interests. This program must be approved by the adviser, the department's Graduate Studies Committee, the department's chair, and the Graduate College. After completion of the thesis, the student is required to pass an oral comprehensive examination on his or her thesis and related areas. The examination committee consists of at least three appropriate faculty members who are nominated by the thesis adviser and appointed by the department's Graduate Studies Committee.

Manufacturing Engineering

Course requirements for M.S. in Manufacturing Engineering and Master of Manufacturing Engineering

Students must fulfill the manufacturing core courses as well as their respective departmental courses.

Manufacturing core courses
MMAE 547   Computer Integrated Manufacturing
AND
MMAE 560   Statistical Quality and Process Control **OR**
CHE 560   Statistical Quality and Process Control

Departmental core requirements
Chemical and Environmental Engineering
Two courses selected from:
CHE 507   Computer-Aided Design
CHE 528   Analysis and Simulation
                     of Chemical Processing
CHE 530   Advanced Process Control
CHE 555   Polymer Processing

Electrical and Computer Engineering
Two courses selected from:
ECE 426   Linear Integrated Circuits
ECE 433   Real-Time Data Acquisition and Processing
ECE 564   Control and Operation
                     of Electric Power Systems
ECE 481   Image Processing
ECE 581   Computer and Robotic Vision

Mechanical and Aerospace Engineering
MMAE 505   Numerical Methods in Engineering
MMAE 545   Advanced CAD/CAM
MMAE 546   Advanced Manufacturing Engineering
And one materials course.

For mechanical and aerospace engineering M.S. students, six to eight credit hours of MMAE 591 (Research and Thesis) and zero to three elective credit hours are required. For MME students, elective courses in manufacturing comprise the remaining seven credit hours.

Materials Science and Engineering
One course selected from:
MMAE 445   CAD/CAM with Numerical Control
MMAE 545   Advanced CAD/CAM
MMAE 546   Advanced Manufacturing Engineering
MMAE 576   Materials and Process Selection

One course selected from:
MMAE 475   Powder Metallurgy
MMAE 574   Ferrous Transformations
MMAE 575   Ferrous Products: Metallurgy and Manufacture
MMAE 577   Lasers in Manufacturing

For materials science and engineering M.S. students, 12 to 15 credit hours of elective courses and five to eight credit hours of MMAE 591 (Research and Thesis) are required. MME students must take elective courses in manufacturing to comprise the remaining 18 credit hours.

Course Descriptions

Students should consult the three respective department listings:

Chemical and Environmental Engineering (page 111)

Electrical and Computer Engineering (page 183)

Mechanical, Materials and Aerospace Engineering
(page 241)

Industrial Technology and Operations

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Director:
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The Master of Industrial Technology and Operations (MITO) is a professional degree designed for individuals who plan to make a career in industry. The purpose of the MITO program is to enhance the ability of the students to pursue their professional goals by providing up-to-date knowledge of the technologies and modern management approaches used in world-class industrial companies. The MITO curriculum prepares students to move into management, supervisory and staff positions in industry. The MITO is not an MBA or an engineering degree, therefore it is not recommended for those planning to pursue careers in academia or research.

Degree Offered

Master of Industrial Technology and Operations

Admission Requirements

Applicants must hold a four-year bachelor's degree from an accredited institution. Students with a GPA of 3.0/4.0 can be admitted unconditionally. Students with a GPA of 2.5/4.0 can be admitted contingent upon their earning "A"s or "B"s in the first two courses taken at IIT. The GRE is not required for applicants who have completed a degree at a U.S. institution.

Applicants who have completed an undergraduate degree outside the U.S. must complete the GRE and submit scores with the admission application. Minimum required GRE scores are 2.5 for analytical and a combined score of 900 for the verbal and quantitative portions of the exam. Applicants from countries where English is not the primary language also must complete the TOEFL

with a minimum score of 80 on the new Internet-based test (equivalent to 550 PBT or 213 CBT) with no individual section scored below 15.

All applicants must submit a completed application form, the application fee, official transcripts (or certified copies) for all academic work at the college level, two letters of recommendation and a professional statement.

Students accepted into the program must have access to a Windows-based computer, the Internet and software for word processing, spreadsheet and presentation applications. All students will be required to use an IIT-issued email account.

Master of Industrial Technology and Operations

30 credit hours

Each student's program of study is customized to best serve individual career objectives. Of the 30 semester hours of graduate credit required for the MITO, the student must complete at least 18 semester hours of MITO graduate courses. A student may choose to complete up to 12 semester hours of courses offered by other IIT departments, but must be suitably qualified and obtain permission to register from their adviser and the associated course instructor(s). Up to 12 semester hours of senior (400-level) courses can be taken as part of this master's program (see our specializations). A total of 9 semester hours taken at a different university (passed

with the grade of "B" or better) may be transferred to IIT and applied toward the MITO degree if those credits have not been applied toward any earned degree (subject to administrative approval).

MITO courses are presented live and via interactive video at IIT's Main Campus in Chicago and Rice Campus in Wheaton. Also, the MITO program can be completed over the Internet. Using a delayed Internet format (lecture videos are posted within 24 hours after the live session), students can log on and "attend" class at the time and location of their choice. A demonstration of IIT web-based courses is available at www.iit-online.iit.edu.

The MITO Curriculum

The Master of Industrial Technology and Operations requires the completion of 30 credit hours (10 courses). The coursework must include a minimum of 18 hours of 500-level MITO courses. Students may choose to complete six (6) of the general MITO courses listed below and four (4) specialty courses listed at right to earn the MITO degree with an industrial specialization in MT, IF, or IL. Alternately, under the guidance of their adviser, students may choose ten (10) courses of most interest and benefit to their career objectives. Students who wish to pursue a specialization in subjects covered by other departments may do so with the permission of their adviser and the associated course instructor(s).

Each MITO student is expected, in cooperation with their faculty adviser, to structure a program of study that will best serve his or her career objectives. This educational program would take into consideration the student's undergraduate education as well as all professional work experience.

General MITO courses include:

INTM 501	The Industrial Enterprise
INTM 502	Fundamentals of Industrial Engineering
INTM 509	Inventory Control
INTM 511	Industrial Leadership
INTM 512	Quality Systems
INTM 522	Computers in Industry
INTM 534	Resource Management
INTM 545	Strategic International Business

Course Descriptions

Numbers in parentheses indicate class, lab and total credit hours, respectively

INTM 501
The Industrial Enterprise

Introduces students to the variety of industrial operations and organizations. Covers changes within industry over the past decades that have led to today's global competitiveness. The history of industrial development including changing technology and management approaches is reviewed. The interaction of technology, technical systems, and social systems is considered as well as concepts for planning and forecasting. (3-0-3)

INTM 502
Fundamentals of Industrial Engineering

Industrial engineering concepts are introduced and the student prepared to perform basic engineering tasks, including design of workstations, cells and lines. Coverage includes time and motion studies, work measurement, ergonomics, route sheets, plant layout, site selection, equipment selection, MRP, JIT, etc. Scheduling techniques will be covered along with material control techniques. Management Information Systems (MIS) are introduced and options covered. (3-0-3)

INTM 507
Construction Technology

Introduces the full range of technologies involved in construction of both new and modified facilities, including steel, concrete and timber construction as well as supporting specialties such as HVAC, electrical, plumbing, etc. The interactions between the various construction trades will be covered along with the role of the architects and engineers. (3-0-3)

INTM 509
Inventory Control

Fundamentals of inventory control including inventory classifications, i.e. raw materials, work-in-process (WIP) and finished goods. Topics include inventory record keeping, inventory turnover, the 80/20 (or ABC) approach, external and internal lead times, excess/obsolete inventory, and inventory controls. Material Resource Planning (MRP) and Enterprise Resource Planning (ERP) are included. (3-0-3)

INTM 511
Industrial Leadership

Supervision and management practices are key to all components and sectors of industry. People are the key resources and their effective use is critical to a successful operation. As companies move to become high performance organizations, traditional management tools and techniques have to be reviewed and reconsidered. Skills covered include motivation, developing consensus, conflict avoidance and negotiations. Group dynamics along with handling of individual workers is critical. (3-0-3)

INTM 512
Quality Systems

Quality systems covers metrology as well as overall systems for industrial and service companies. Metrology coverage includes electrical, mechanical and chemical systems. SPC, ISO, QS, TQM, MilSpecs and GMP are covered. Emphasis is on selecting alternates and developing the methodology to support those options. Vendor qualification and certification are included as well as techniques for handling quality requirements specified by customers. (3-0-3)

INTM 515
Advanced Project Management

This course covers project management in the PMP framework and provides a structured approach to managing projects using Microsoft Project and Excel. Coverage includes creation of key project management charts (Gnatt, Pert, CPM, timelines and resource utilization), basic statistics used in estimating task times, critical path generation in Excel and Project, project cost justification in Excel, SPC and acceptance sampling for machine acceptance, project analysis via simulation, and management of personnel, teams, subcontractors and vendors. Case studies are utilized to demonstrate core concepts and dynamic scheduling. (3-0-3)

INTM 522
Computers in Industry

Computers are ubiquitous in all industrial sectors. Management Information Systems (MIS) are available for even the most complex of industrial operations. The integration of MIS with operational specialties (such as order entry, production scheduling, quality control, shipping and invoicing) is discussed. A variety of Microsoft Excel tools are introduced and utilized to set up approaches for handling a variety of industrial situations. (3-0-3)

INTM 531
Manufacturing Processes for Metals and Mechanical Systems

Material processing and manufacturing techniques are covered for solid materials, including metals, plastics, ceramics and glass. Making of parts from these materials is covered along with subsequent assembly of these parts into components, subassemblies and final products. Advanced Manufacturing Technologies (AMT) will be covered including robots, lasers, AGVs, etc. The industrial structure that makes up this sector of manufacturing will be covered. (3-0-3)

INTM 532
Manufacturing Processes for Electronics and Electrical Systems
The materials used in Electronic and Electrical (E&E) manufacturing will be reviewed including materials and components that are used to produce chips, PCBs and wiring systems. Focus will be on the processes for producing the range of parts and products included in this broad sector. Automation for producing parts and assemblies will be covered. Techniques covered will include surface mounted technology (SMT), wave soldering, automation insertion, automated inspection, etc. The industrial structure that makes up this sector of manufacturing will be covered. (3-0-3)

INTM 533
Manufacturing Processes for Chemical and Process Systems
This course will cover materials and manufacturing based on process systems. This would include painting, anodizing, plating, plastic preparation, plastics manufacturing, cleaning, etc. along with the processes for producing the chemicals involved. Environmental and hazardous material issues are of importance and "green systems" that minimize the use of resources are encouraged. OSHA, EPA and other regulatory systems will be covered. The industrial structure that makes up this sector of manufacturing will be covered. (3-0-3)

INTM 534
Resource Management
The key in operating a manufacturing facility is to make optimum use of all of the available resources including labor, capital, technology, materials and time. This course will integrate knowledge gained in prior courses into an overall understanding of optimum management of available resources. Financial analy-

sis, cost accounting, Activity Based Costing (ABC), program management, investment and scheduling will be covered. Decision-making and risk analysis are covered. Students will learn about tools for optimizing and prioritizing decisions involved in manufacturing management and workforce assignment. Ethical considerations involved in management and decision-making will be included. (3-0-3)

INTM 540
Supply Chain Management
This course covers the full range of activities involved in the supply chain. This includes management tools for optimizing of supply chains, relationships with other parts of the organization, in-house versus third party approaches, and suitable performance measurements. Topics covered include: Warehouse Management Systems (WMS), Transportation Management Systems (TMS), Advanced Planning and Scheduling Systems (APS), as well as cost benefit analysis to determine the most appropriate approach. (3-0-3)

INTM 542
Warehousing and Distribution
This course covers warehouse layout and usage based on product requirements such as refrigeration, hazardous material, staging area, and value added activities. Processes covered include receiving, put-away, replenishment, picking and packing. The requirement for multiple trailer/rail car loading and unloading is considered as well as equipment needed for loading, unloading, and storage. Computer systems for managing the operations are reviewed. Emphasis is on material handling from warehouse arrival through warehouse departure. (3-0-3)

INTM 543
Purchasing
Purchasing responsibilities, processes, and procedures are included. Topics covered include: supplier selection and administration, qualification of new suppliers, preparing purchase orders, negotiating price and delivery, strategic customer/vendor relationships, and resolution of problems. All aspects of Supplier Relation Management (SRM) are covered. (3-0-3)

INTM 544
Export/Import Management
Internationalization of industry requires special expertise and knowledge, which must be taken into consideration throughout all interactions with overseas companies either as customers or suppliers. Topics covered include custom clearance, bonded shipping, international shipping options, import financing and letters of credit, customer regulations, insurance, import duties and trade restrictions, exchange rates, and dealing with different cultures. (3-0-3)

INTM 545
Strategic International Business
Understanding international business strategies is fundamentally important to businesses of any size in today's competitive, worldwide marketplace. Course objectives include providing a background in international business fundamentals, economics, human resources, cultural issues and interrelationships, as well as understanding the business decision processes involved in product planning, marketing, and organizational planning, structure and performance. Includes development of managerial skills for international business related to strategic planning, marketing and sales policy, and implementation of organizational goals. (3-0-3)

Department of Mathematics and Science Education

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Chair:
N. G. Lederman

Director, Graduate Programs:
N. G. Lederman

Mathematics and science education is primarily concerned with all aspects of the teaching and learning of mathematics and/or science at the secondary levels (i.e., grades 5–12). The department offers Professional Master's, Master of Science, and Ph.D. degrees in mathe-matics and science education. The master's programs are specifically focused on experienced teachers, individuals seeking certification and advanced study, or individuals working in educational settings other than schools (e.g., museums, zoos, etc.). Specific attention is placed on curriculum development, evaluation, advanced instructional models, supervision, learning and cognition, and action research.

The Ph.D. programs are designed for those individuals wishing to become university-level teacher educators and researchers. Extensive attention is given to quantitative and qualitative research design, along with advanced work in evaluation, curriculum analysis, and supervision. Both M.S. and Ph.D. students will be required to complete additional subject matter courses (e.g. science and mathematics) equivalent to 9-12 credit hours.

Degrees Offered

Master of Science in Mathematics Education
Master of Mathematics Education
Master of Science in Science Education
Master of Science Education

Doctor of Philosophy in Mathematics Education
Doctor of Philosophy in Science Education

Research Areas

Research areas include informal science/math education, curriculum development, integration of science/math disciplines and across disciplines, and instructional methods; students and teachers' conceptions of scientific/mathematic inquiry and nature of science/math, instructional models, evaluation, and research design.

Faculty

Zaur Berkaliev, Assistant Professor of Mathematics and Science Education. M.Sc., Moscow State University; Ph,D., Moscow State University; Ph.D., Indiana University. Curriculum development, student attitudes.

J. S. Lederman, Director of Teacher Education, Senior Instructor of Mathematics and Science Education. B.A., Rhode Island College; M.S., Worcester Polytechnic Institute. Informal science education, curriculum development, integration of science disciplines and across disciplines, and instructional methods.

N. G. Lederman, Chair and Professor of Mathematics and Science Education. B.S., Bradley University; M.S. Biology, New York University; M.S. Secondary Education/Biology, Bradley University; Ph.D., Syracuse University. Students' and teachers' conceptions of scientific inquiry and nature of science, instructional models, evaluation, and research design.

Daniel Z. Meyer, Assistant Professor of Mathematics and Science Education. B.A., Swartmore College; Ed.M., Harvard Graduate School of Education; Ph.D., Cornell University.

W. J. Newman, Assistant Professor of Mathematics and Science Education. B.A., Virginia Polytechnic Institute, M.S., University of Connecticut, M.A., College of New Jersey, Ph.D., Purdue University. Discourse in Science Education.

J. S. Zawojewski, Associate Professor of Mathematics and Science Education. B.S.Ed., Northwestern University; M.S.Ed., National College of Education; Ph.D., Northwestern University. Teaching and learning of probability and statistics, evaluation and professional development.

Department of Mathematics and Science Education

Admission Requirements

Bachelor's (or Master's, for Ph.D. programs) degree in mathematics (for mathematics education), science (for science education) or another field with documented evidence of success in working with school-aged youth

GRE score minimum for M.S./MAS/Ph.D. applicants (for tests taken prior to Oct. 1, 2002): 1200 (combined)

GRE score minimum for M.S./MAS applicants (for tests taken on or after Oct. 1, 2002: 900 (quantitative + verbal) 2.5 (analytical writing)

GRE score minimum for Ph.D. applicants (for tests taken on or after Oct. 1, 2002: 1000 (quantitative + verbal) 3.0 (analytical writing)

TOEFL minimum 600/250* if from non-English speaking country

A minimum cumulative undergraduate GPA of 3.0/4.0

Two-page professional statement of goals/objectives
Curriculum Vita
Three letters of recommendation
An interview may be required

Additional requirements for Ph.D. programs:

Three years of teaching experience

Meeting the minimum standards does not guarantee admission. Test scores and GPA are just two of several important factors considered, and admission decisions are made based upon the totality of the application file.

* Paper-based test score/computer-based test score.

Master of Science in Mathematics Education (thesis)

Master of Mathematics Education (Professional Master's, non-thesis)

33 credit hours
Thesis (Master of Science) or non-thesis (Professional Master's) option

The objective of the master's programs is to provide practicing teachers, or individuals in education-related fields, with advanced education in the teaching and learning of mathematics. These advanced studies will enhance graduates' ability to provide meaningful instruction in mathematics; critically analyze and implement empirical research findings in mathematics education; develop and evaluate curriculum; and become a leader in public school education at the state or local levels.

Required courses

Core requirements

MSED 550   Clinical Supervision in Science/Mathematics

MSED 560   Research & Evaluation **OR**
MSED 552   Assessment and Evaluation

MSED 555   Mathematics Curriculum

PSYC 588   Learning, Cognition and Motivation
MSED 503   Advanced Strategies: Mathematics
MSED 540   Informal Education Practicum

Master of Science thesis option
(Six Credits)
MSED 591   Thesis Research

Professional Master's non-thesis option
(Three credits)
MSED 538   Mathematic Problem Solving

And a minimum of three credits from the following:
MSED 571   Problem Solving
             and Nature of Mathematics
MSED 531   Professional Development
             and Practicum in Mathematics
MSED 521   History/Philosophy of Mathematics
MSED 562   Action Research

Nine credits of select coursework
from discipline-specific mathematics courses

Department of Mathematics and Science Education

Master of Science in Science Education (thesis option)

Master of Science Education (Professional Master's, non-thesis)

33 credits
Thesis (Master of Science) or non-thesis
   (Professional Master's)

The objective of the M.S. program is to provide practicing teachers, or individuals in education-related fields, with advanced education in the teaching and learning of science. These advanced studies will enhance graduates' ability to provide meaningful instruction in science; critically analyze and implement empirical research findings in science education; develop and evaluate curriculum; and become a leader in public school education at the state or local levels.

Required courses

Core requirements

MSED 550	Clinical Supervision in Science/Mathematics
MSED 560	Research and Evaluation **OR**
MSED 552	Assessment and Evaluation

MSED 554	Science Curriculum
PSYC 588	Learning, Cognition and Motivation
MSED 502	Advanced Strategies: Science
MSED 540	Informal Education Practicum

Master of Science thesis option
(Six credits)

MSED 591	Thesis Research

Professional Master's non-thesis option:
(Three credits)

MSED 538	Scientific Inquiry

And a minimum of three credits from the following:

MSED 570	Inquiry and Nature of Science
MSED 530	Professional Development and Practicum in Science
MSED 520	History/Philosophy of Science
MSED 562	Action Research

Nine credits of select coursework from discipline-specific mathematics courses

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Master of Science/Mathematics Education

Teacher Certification Option
45 credit hours
The Master of Science/Mathematics Education (Teacher Certification Option) is designed for individuals who already possess a Bachelors degree (preferably in an area of science or mathematics) and wish to pursue both a teaching certification and a Masters degree. This accelerated course of study allows the student to achieve certification and a Masters degree in just 45 credit hours instead of the 54 credit hours that would be required if certification and Masters degree were pursued separately.

Required Courses

MSED 500	Analysis of Classrooms II (Practicum and Seminar)
MSED 554/555	Science/Mathematics Curriculum

MSED 300	Instructional Methods/Strategies I
MSED 400	Instructional Methods/Strategies II
MSED 538	Interprofessional Projects
MSED 540	Informal Education Practicum and Seminar
MSED 450	Professional Internship (6 credit hours)
MSED 501/502	Advanced Strategies: Mathematics/Science
MSED 550	Clinical Supervision in Science/Mathematics
MSED 552	Assessment and Evaluation
PSYC 588	Learning, Cognition, and Motivation

Nine credits from graduate level science/mathematics courses

Total credits for this Masters option: 45

Department of Mathematics and Science Education

Doctor of Philosophy in Mathematics Education

84 credit hours (Minimum of 51 hours of coursework)

Qualifying exam within the first two years of Ph.D. study
  Composed of seven position statements
    (ranked by faculty)
  Position Statement 1: Written defense to support
    position with empirical research
  Position Statements 2, 3, 4: Oral defense
Oral comprehensive exam with the student's graduate
  committee (The dissertation proposal is presented
  orally as part of the comprehensive examination.)
Oral dissertation defense, involving the final thesis exam

The objective of the Ph.D. program is to provide students with advanced education in the teaching and learning of mathematics. These advanced studies will enable graduates to conduct theoretical and practical research in mathematics education, develop and evaluate curriculum, prepare future teachers, provide professional development to in-service teachers, or become a leader in public school education at the state or local levels.

Core requirements

MSED 601	Critical Analysis in Quantitative Research	
MSED 602	Quantitative Research Design and Practicum	
MSED 603	Critical Analysis in Qualitative Research	
MSED 604	Qualitative Research Design and Practicum	
MSED 550	Clinical Supervision in Science/Mathematics	
MSED 552	Assessment and Evaluation	
MSED 555	Mathematics Curriculum	
PSYC 588	Learning, Cognition and Motivation	
PSYCH 545	Statistics I	
PYSCH 546	Statistics II	
Total		**30 credit hours**

Elective requirements

(Minimum of nine credits)

MSED 571	Problem solving and Nature of Mathematics
MSED 503	Advanced Strategies: Mathematics
MSED 521	History/Philosophy of Mathematics
MSED 531	Professional Development and Practicum in Mathematics
MSED 597	Special Problems (Ethics)
MSED 594	Special projects (Independent Studies within MSED)
MSED 560	Research & Evaluation
MSED 562	Action Research

Up to eight hours from discipline-specific graduate coursework

12 credits of select coursework from discipline-specific mathematics courses/related fields

Total minimum coursework	**51 credit hours**

MSED 691	Ph.D. Thesis Research Minimum 25 hours
Total minimum credits	**84 credit hours**

42 maximum transfer of graduate credits from master's
(24 credits from coursework/eight credits from research)

Department of Mathematics and Science Education

Doctor of Philosophy in Science Education

84 credit hours (Minimum 51 hours of coursework)
Qualifying exam within the first two years of Ph.D. study
   Composed of seven position statements
   (ranked by faculty)
   Position Statement 1: Written defense to support position with empirical research
   Position Statements 2, 3, 4: Oral defense
Oral comprehensive exam with the student's graduate committee (The dissertation proposal is presented orally as part of the comprehensive examination.)
Oral dissertation defense, involving the final thesis exam

The objective of the Ph.D. program is to provide students with advanced education in the teaching and learning of science. These advanced studies will enable graduates to conduct theoretical and practical research in science education; develop and evaluate curriculum; prepare future teachers; provide professional development to in-service teachers; or become a leader in public school education at the state or local levels.

Required courses

Core requirements

MSED 601	Critical Analysis in Quantitative Research
MSED 602	Quantitative Research Design and Practicum
MSED 603	Critical Analysis in Qualitative Research
MSED 604	Qualitative Research Design and Practicum
MSED 550	Clinical Supervision in Science/Mathematics
MSED 552	Assessment and Evaluation
MSED 554	Science Curriculum
PSYC 588	Learning, Cognition and Motivation
PSYCH 545	Statistics I
PYSCH 546	Statistics II
Total	**30 credit hours**

Elective requirements

(Minimum of nine credits)

MSED 570	Inquiry and Nature of Science
MSED 502	Advanced Strategies: Science
MSED 520	History/Philosophy of Science
MSED 530	Professional Development and Practicum in Science
MSED 562	Action Research
MSED 597	Special Problems (Ethics)
MSED 594	Special Projects (Independent Studies within MSED)

Up to eight hours from discipline-specific
   graduate coursework

12 hours of select coursework from discipline-specific science courses/related fields

| **Total minimum coursework** | **51 credit hours** |

MSED 691   Ph.D. Thesis Research Minimum of 25 credits

| **Total minimum credits** | **84 credit hours** |

42 maximum transfer of graduate credits from master's (24 credits from coursework/eight credits from research)

Course Descriptions

Numbers in parentheses represent class hours, lab hours, and total credit hours, respectively.

MSED 502
Advanced Strategies: Science
A course that provides additional exposure and development of instructional strategies and models of science teaching. Special emphasis is placed upon promoting critical thinking and decision making. (3-0-3)

MSED 503
Advanced Strategies: Mathematics
A course that provides additional exposure and development of instructional strategies and models of mathematics teaching. Special emphasis is placed upon promoting critical thinking and decision-making. (3-0-3)

MSED 512
Problems in the Philosophy of Science
This course looks at some key issues in the philosophy and history of science, including the rationality of science, the role of values in scientific inquiry, and the use of models and analogies in scientific thinking. Given that experiments and observations alone never suffice to determine theory choice, we seek to understand the values that invluence science and investigate how it is that science can make progress. We build towards a picture of science as a social process in which theoretical models are chosen and developed in such a way as to increase our over-all ability to solve important problems. (3-0-3)

MSED 520
History/Philosophy of Science
A course that stresses the logical status of scientific ideas and the interaction of these ideas with their social and cultural contexts. (3-0-3)

Department of Mathematics and Science Education

Course Descriptions continued

MSED 521
History/Philosophy of Mathematics
A course that stresses mathematics as a way of thinking and knowing. (3-0-3)

MSED 530
Teacher Education/Professional Development in Science
A course that stresses the empirical research on best practices in teacher education and professional development in science. (3-0-3)

MSED 531
Teacher Education/Professional Development in Mathematics
A course that stresses the empirical research on best practices in teacher education and professional development in mathematics. (3-0-3)

MSED 538
Interprofessional Project
A group of authentic inquiry experiences supervised by practicing scientists or mathematicians. (3-0-3)

MSED 540
Informal Education Practicum
Placement in an informal educational setting such as museums and outdoor education. The focus of this course is on the use of informal setting to supplement classroom instruction. (3-0-3)

MSED 550
Clinical Supervision in Science/Mathematics
Provides for the development of a variety of classroom observation techniques and clinical supervision skills. (3-0-3)

MSED 552
Assessment and Evaluation
Contemporary assessment and evaluation theory and the development of valid cognitive, affective, and psychomotor assessment items/tasks. In-depth attention is given to the development and scoring of alternative assessment techniques such as portfolios and projects. (3-0-3)

MSED 554
Science Curriculum
Current trends, history of these trends, and rationale for science curriculum reform. (3-0-3)

MSED 555
Mathematics Curriculum
Current trends, history of these trends, and rationale for mathematics curriculum reform. (3-0-3)

MSED 560
Research and Evaluation
Analysis of qualitative and quantitative empirical research in science and mathematics education. (3-0-3)

MSED 562
Action Research
Reviewing, designing and conducting research studies within the context of the students' own teaching. (3-0-3)

MSED 570
Inquiry and Nature of Science
Developing a functional understanding of nature of science in the context of scientific inquiry. (3-0-3)

MSED 571
Problem Solving and Nature of Mathematics
Developing a functional understanding of the nature of mathematics in the context of problem solving. (3-0-3)

MSED 591
Research and Thesis M.S.
(6-0-6)

MSED 594
Special Projects
Advanced projects involving independent study, and especially fieldwork and modeling projects. (Variable: 1-6)

MSED 597
Special Problems
Independent Study and Project. (Variable: 1-9)

MSED 601
Critical Analysis in Quantitative Research
A study of quantitative research designs and analytical procedures with critical analysis of perspectives of research in science/mathematics education. (3-0-3)

MSED 602
Quantitative Research Design and Practicum
A study of quantitative research designs, analytical procedures, and in-depth analysis with specific applications in science/mathematics education. (3-0-3)

MSED 603
Critical Analysis in Qualitative Research
A study of qualitative research designs and analytical procedures with critical analysis of perspectives of research in science/mathematics education. (3-0-3)

MSED 604
Qualitative Research Design and Practicum
A study of qualitative research designs, analytical procedures, and in-depth analysis with specific applications in science/mathematics education. (3-0-3)

MSED 691
Ph.D. Thesis Research
(Variable: 1-20)

Department of Mechanical, Materials and Aerospace Engineering

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www.mmae.iit.edu

Chair:
Jamal Yagoobi

Associate Chair, Graduate Programs:
Kevin Cassel

The Department of Mechanical, Materials and Aerospace Engineering offers several flexible programs in mechanical and aerospace engineering, with five major areas of study: computer-aided design and manufacturing, dynamics and control, fluid dynamics, solids and structures, and thermal sciences. The department also offers programs in materials science and engineering and an interdisciplinary program in manufacturing engineering.

Degrees Offered

Master of Science in Mechanical and
    Aerospace Engineering
Master of Science in Materials Science and Engineering
Master of Engineering in Manufacturing via Internet
Master of Mechanical and Aerospace Engineering

Master of Materials Science and Engineering
Doctor of Philosophy in Mechanical and
    Aerospace Engineering
Doctor of Philosophy in Materials Science and
    Engineering

Interdisciplinary Programs

With the Department of Chemical and Environmental Engineering and the Department of Electrical and Computer Engineering:

Master of Manufacturing Engineering
Master of Science in Manufacturing Engineering
Master of Science with specialization in
    Energy/Environment/Economics (E^3)

Certificate Programs

Computer Integrated Design and Manufacturing

Product Quality and Reliability Assurance

Research Centers

Fluid Dynamics Research Center (fdrc.iit.edu)

Thermal Processing Technology Center (mmae.iit.edu/~tpc/)

Research Facilities

Mechanical and aerospace engineering laboratories include the Fejer Unsteady Wind Tunnel; the Morkovin Low-Turbulence Wind Tunnel; the National Diagnostic Facility, a computer-controlled, high-speed, subsonic flow wind tunnel; a high-speed jet facility for aeroacoustic research; a hydrodynamics laboratory; flow visualization systems; laser-based measuring equipment; several computer-based data acquisition, processing and display systems of the Fluid Dynamics Research Center; laboratories in experimental mechanics; laboratories for research in robotics, guidance and navigation, computer-integrated manufacturing, Footlik CAD lab, railroad engineering, biomechanics and its instrumentation, combustion, internal combustion engines, two-phase flow and heat-transfer, electrohydrodynamics, and combined heat and mass transfer; and research facilities for atomization, spray flames, and emissions from mobile and stationary combustion sources.

Materials science and engineering laboratories include facilities for research in metallography, heat treatment, and mechanical testing; optical, scanning and transmission electron microscopes; powder metallurgy, and laser machining facilities. The department has numerous computers and workstations available for computational research activities.

Department of Mechanical, Materials and Aerospace Engineering

Research Areas

The faculty conducts research activities in fluid dynamics, including aeroacoustics, flow control, turbulent flows, unsteady and separated flows, instabilities and transition, turbulence modeling, flow visualization techniques, computational fluid dynamics; metallurgical and materials engineering, including microstructural characterization, physical metallurgy of ferrous and non-ferrous alloys, powder materials, laser processing and machinigh, high temperature structural materials, mechanical behavior, fatigue and fracture, environmental fatigue and fracture, computational x-ray diffraction analysis, texture, recrystallization and computational methods in materials processing; solids and structures, including experimental mechanics of composites and cellular solids, high strain rate constitutive modeling and thermomechanical coupling, fracture mechanics, design and testing of prosthetic devices, and holographic interferometry; computational mechanics, fracture mechanics, cable dynamics and analysis of inelastic solids; theoretical mechanics, including wave propagation, fracture, elasticity and models for scoliosis; computer added design and manufacturing, concentrated in the areas of computer-aided design, computer-based machine tool control, computer graphics in design, manufacturing processes, wear and fracture behavior of cutting tols, tribology, frictional wear characteristics of ceramics, dynamic systems and mechanical vibrations; thermal sciences, including phase change heat transfer, enhancement of heat transfer and mass transport in macro and micro scales, electrohydrodynamics, spray combustion, atomization, transport processes within gas-liquid and gas-solid dispersions and suspensions, alternative fuels, mobile and stationary source combustion emissions, and dynamics and control, including guidance, navigation, and control of aircraft and spacecraft, intelligent control for aircraft models, flow fields, robotics devices for laser machining; and dynamic analysis and control of complex systems.

Faculty

Ralph L. Barnett, Professor. B.S., M.S., Illinois Institute of Technology. Structures and safety of machines.

Kevin W. Cassel, Associate Professor and Associate Chair for Graduate Programs. B.S., Messiah College; M.S., Ph.D., Lehigh University. Computational fluid dynamics, unsteady boundary-layer flows, buoyancy-driven flows, supersonic and hypersonic boundary-layer flows.

John C. Cesarone, Lecturer. B.S., M.S., University of Illinois; Ph.D., Northwestern University. Robotics, reliability engineering and manufacturing.

Herek L. Clack, Associate Professor. B.S., Massachusetts Institute of Technology; M.S., Ph.D., University of California, Berkeley. Thermofluid systems: atomization, combustion, hazardous waste incineration, combustion emissions, heat/mass transfer and phase change, ultrasound and sonochemical materials processing.

Michael R. Gosz, Associate Professor and Associate Provost for Undergraduate Affairs. B.S., Marquette University; M.S., Ph.D., Northwestern University. Computational solid mechanics, fracture mechanics, interface effects in composite materials, modeling of composite structures subjected to thermal cycling, and nonlinear dynamic finite element analysis of submerged flexible structures.

John S. Kallend, Professor and Associate Chair of Undergraduate Studies. B.A., M.A., Ph.D., Cambridge University (England). Computational methods of crystallographic texture analysis and properties of polycrystalline aggregates.

Kevin P. Meade, Professor. B.S., M.S., Illinois Institute of Technology; Ph.D., Northwestern University. Solid mechanics, biomechanics, elasticity, fracture mechanics and computational mechanics.

Sheldon Mostovoy, Associate Professor. B.S., Ph.D., Illinois Institute of Technology. Metallurgy, mechanical properties of materials, fatigue and fracture.

Hassan M. Nagib, John T. Rettaliata Professor. B.S., M.S., Ph.D., Illinois Institute of Technology. Fluid dynamics, heat transfer, applied turbulence, wind engineering and aeroacoustics.

Sudhakar E. Nair, Professor and Associate Dean of Academic Affairs, Graduate College. B.Sc., Regional Engineering College (India); M.E., Indian Institute of Science (India); Ph.D., University of California, San Diego. Solid mechanics, stress analysis of composite and inelastic material, dynamics of cable, fracture mechanics and wave propagation theory.

Philip G. Nash, Professor and Director of the Thermal Processing Technology Center. B.S., City College of London Polytechnic (England); Ph.D., Queen Mary College of London University (England). Physical metallurgy, intermetallics, powder metallurgy, composites, phase equilibria and transformations.

Boris Pervan, Associate Professor. B.S., University of Notre Dame; M.S., California Institute of Technology; Ph.D., Stanford University. Dynamics, control, guidance and navigation.

Xiaoping Qian, Assistant Professor. B.S., M.S. Huazhong University, PhD University of Michigan. 3D object digitization, design and manufacturing, heterogeneous object modeling, layered manufacturing.

Department of Mechanical, Materials and Aerospace Engineering

Faculty continued

Ganesh Raman, Associate Professor and Associate Dean for Research in the Graduate College. B.Tech., Indian Institute of Technology (India); M.S., Cleveland State University; Ph.D., Case Western Reserve University. Experimental fluid mechanics, aeroacoustics, active flow control, jet screech, and fluidics.

Dietmar Rempfer, Associate Professor. M.S., Ph.D., Universitaet Stuttgart (Germany). Fluid mechanics, especially theoretical studies of transitional and turbulent shear flows in open systems, numerical fluid mechanics, coherent structures in turbulent flows, nonlinear dynamical systems.

Francisco Ruiz, Associate Professor. B.S.M.E., Universidad Politecnica de Madrid (Spain); M.E., Ph.D., Carnegie-Mellon University. Combustion, atomization, pollution control of engines, fuel economy, alternative fuel, electronic cooling and special cooling.

Sammy Tin, Assistant Professor. B.S. California Polytechnic State University; M.S. Carnegie Mellon University; PhD University of Michigan. Procesing and deformation characteristics of high-temperature structural materials, modeling the microstructure of Ni-base superalloy turbine disks during thermo-mechanical processing, understanding the mechanisms of creep and fatigue deformation in advanced high-refractory content single crystal turbine blades.

Murat Vural, Assistant Professor. B.S., M.S., Ph.D., Istanbul Technical University (Turkey). Experimental solid mechanics with emphasis on high-strain-rate mechanical response, thermomechanical coupling, failure characterization and constitutive modeling of homogeneous and heterogeneous materials.

Candace E. Wark, Professor and Associate Dean of Armour College. B.S., M.S., Michigan State University; Ph.D., Illinois Institute of Technology. Fluid dynamics, turbulence, digital data acquisition and processing.

David R. Williams, Professor and Director of the Fluid Dynamics Research Center. B.S.E., Stevens Institute of Technology; M.S.E., Ph.D., Princeton University. Experimental fluid mechanics with emphasis on flow measurement and flow control techniques.

Jamal S. Yagoobi, Professor and Chair of Department. B.S., Sharif University of Technology (Iran); M.S., Ph.D., University of Illinois, Urbana-Champaign. Experimental and theoretical studies in enhancement of heat transfer and mass transport with electrohydrodynamics, twophase systems, phase-change processes, heat and mass transfer in porous media, drying, and augmentation of heat and mass transfer with innovative impinging jets.

Research Faculty

Joseph C. Benedyk, Research Professor. B.S., M.S., Illinois Institute of Technology; Ph.D., Case Western Reserve University. Metals and materials processing research and development and product development.

Dajun Chen, Assistant Research Professor, Manager of Electron Microscope Lab, B.S. Shanghai University of Technology, M.S. Shanghai Jiao Tong University, Ph.D. South Dakota School of Mines and Technology. Microstructure characterization of materials; electron microscopy; phase transformation theory and applications, fracture mechanics and failure analysis, heat treatment processes, and materials manufacturing processes.

Zhiyong Hu, Research Assistant Professor, B.S. Tianjin University, MS. PhD Institute of Metal Research, Chinese Academy of Sciences. Modeling the material processing (casting, extrusion, carburization, heat treatment), predicting the defects, temperature, stress and strain distribution in materials, optimizing the process parameters.

John Kiedaisch, Research Assistant Professor; B.S., M.S., and Ph.D. Illinois Institute of Technology. Experimental fluid dynamics with emphasis on active control of separated flows in aircraft, helicopter, and tiltrotor applications, actuator development, wind tunnel testing and instrumentation.

Hansen Mansy, Research Associate Professor. B.S., M.S., Cairo University (Egypt); Ph.D., Illinois Institute of Technology. Biomedical acoustics, non-invasive measurement methods, biomedical fluid dynamics, flow-induced oscillations.

Paul Reinhard, Research Associate; B.S. Illinois Institute of Technology; current M.S. student. Control of separated flow through various active techniques in order to reduce drag or enhance operational envelopes.

Cesar A. Sciammarella, Research Professor. Dipl.Eng. C.E., Buenos Aires University (Argentina); Ph.D., Illinois Institute of Technology. Experimental mechanics of solids with particular emphasis on optics applied to mechanics of materials and stress analysis and fracture mechanics.

Federico Sciammarella, Research Assistant Professor. B.S., M.S. and Ph.D., Illinois Institute of Technology. Materials processing and laser-cladding.

Department of Mechanical, Materials and Aerospace Engineering

Admission Requirements

Cumulative minimum undergraduate GPA: 3.0/4.0
GRE score minimum:
For tests taken prior to Oct. 1, 2002: 1600
    (combined)
For tests taken on or after Oct. 1, 2002: 1000
    (quantitative + verbal) 3.0 (analytical writing)
Typical admitted quantitative score is 650 minimum.
TOEFL minimum: 550/213*

Meeting the minimum GPA and test score requirements does not guarantee admission. Test scores and GPA are only two of several important factors considered. Admission as a regular graduate student normally requires a bachelor's degree from an accredited institution in mechanical engineering, aerospace engineering, metallurgical engineering, materials engineering or engineering mechanics. A candidate with a bachelor's degree in another field, and with proficiency in other engineering disciplines, mathematics and physics, may also be eligible for admission. However, students must remove any deficiencies in essential undergraduate courses that are prerequisites for the chosen degree program in addition to meeting the other requirements of the graduate program.

The associate chair for graduate studies serves as a temporary adviser to new full-time and part-time graduate students admitted to the department as matriculated students until an appropriate faculty member is selected as the adviser. Students are responsible for following the departmental procedures for graduate study. A guide to graduate study in the department is available on the departmental Web site (http://mmae.iit.edu) and in the MMAE main office (243 Engineering 1) to all registered MMAE graduate students, and should be consulted regularly for information on procedures, deadlines, forms and examinations. Departmental seminars and colloquia are conducted on a regular basis. All full-time graduate students must register for the MMAE 593 seminar course each semester and attend them regularly.

The department reserves the right to review and approve or deny the application for admission of any prospective degree-seeking student. Non-degree graduate students who intend to seek a graduate degree from the department must maintain a GPA of 3.0 and must apply for admission as a degree-seeking student prior to the completion of nine credit hours of study. A maximum of nine credit hours of approved coursework taken as a nondegree student and passed with a grade of "B" or better may be applied to the degree.

Maintaining the minimum GPA requirement does not guarantee admission to MMAE graduate degree programs. No more than nine credit hours of coursework taken as a non-degree graduate student may be completed before filing a subsequent program of study for an advanced degree.

* Paper-based test score/computer-based test score.

Master of Mechanical and Aerospace Engineering
Master of Materials Science and Engineering

30 credit hours

These programs are designed for working professionals, and are aimed at broadening student potential, enhancing technical versatility and, in some instances, providing the opportunity for changes in career path. The Professional Master's programs are course-only, professionally oriented degree programs and require a minimum of 30 credit hours. There is no thesis or comprehensive examination requirement. Full-time graduate students enrolled in the program should select a permanent adviser prior to completing their first semester of graduate study. A graduate student working for the degree on a part-time basis should select a permanent adviser before registering for the twelfth credit hour. The student, in consultation with his or her advisor, prepares a program of study that reflects individual needs and interests. The advisor, as well as the department's Graduate Studies Committee, the Department Chair, and the Graduate College must approve this program. Students working toward this degree are not eligible for departmental financial support.

Course Requirements for the Master of Mechanical and Aerospace Engineering

Required courses
MMAE504   Engineering Analysis Ia
AND one of the following:
MMAE451   Finite Element Methods in Engineering
MMAE502   Engineering Analysis II
MMAE505   Numerical Methods in Engineering
MMAE517   Computational Fluid Dynamics
MMAE532   Advanced Finite Element Methods
MMAE538   Computational Techniques in Finite Element
           Methods
MMAE539   Nonlinear Finite Element Analysis
MMAE577   Lasers in Manufacturing

Students may choose from a list of courses specific to their area of interest to complete degree requirements. Up to nine credit hours at the 400-level are allowed, assuming the courses were not required for an undergraduate degree. Up to six credit hours of accelerated (700-level) courses are allowed.

Department of Mechanical, Materials and Aerospace Engineering

Course Requirements for the Master of Materials Science and Engineering

Required courses
(for all students not specializing in ferrous metallurgy)
MMAE 563   Advanced Mechanical Metallurgy
MMAE 569   Advanced Physical Metallurgy
AND
MMAE 468   Introduction to Ceramic Materials **OR**
MMAE 486   Properties of Ceramics
AND one course selected from the following:
MMAE 467   Fundamental Principles of Polymeric Materials
MMAE 578   Fiber Composite Materials
MMAE 579   Characterization of Polymers
MMAE 580   Structure and Properties Polymers

Required courses
(for students specializing in ferrous metallurgy)
MMAE 563   Advanced Mechanical Metallurgy
MMAE 569   Advanced Physical Metallurgy
MMAE 574   Ferrous Transformations
MMAE 575   Ferrous Products: Metallurgy and Manufacture

To complete the degree requirements, students may choose from a list of courses and may apply up to nine credit hours of 400-level non-core courses, as long as they were not used to satisfy requirements for an undergraduate degree. Up to six credit hours of accelerated (700-level) courses are allowed.

Master of Science in Mechanical and Aerospace Engineering
Master of Science in Materials Science and Engineering

32 credit hours
Thesis
Oral comprehensive exam

The Master of Science degree program advances knowledge through post-baccalaureate coursework and state-of-the-art research in preparation for careers in industrial research and development. The M.S. degree is also generally acceptable as a prerequisite for study toward the doctorate. In line with the department's approach to its graduate programs, a student has considerable flexibility, in consultation with his or her program adviser, in formulating an M.S. program.

The M.S. in Mechanical and Aerospace Engineering or the M.S. in Materials Science and Engineering requires completion of a minimum of 32 credit hours of approved work, which includes six to eight credit hours of thesis

research. Before completion of the first semester of graduate study, full-time students should select an area of specialization and a permanent adviser. Graduate students pursuing the M.S. degree on a part-time basis should select a permanent adviser before registering for their twelfth credit hour. The student, in consultation with the adviser, prepares a program of study that reflects individual needs and interests. The adviser must approve this program, as well as the department's Graduate Studies Committee, the department chair, and the Graduate College.

After completion of the thesis, the student is required to pass an oral comprehensive examination on his or her thesis and related topics. The examination committee consists of at least three appropriate faculty members who are nominated by the thesis adviser and appointed by the department's Graduate Studies Committee.

Course Requirements for the Master of Science in Mechanical and Aerospace Engineering

Required courses
MMAE 501   Engineering Analysis Ib
MMAE 502   Engineering Analysis II
AND
The required core course in the student's major area of study
AND
Six to 13 credit hours of non-core courses in the major area
AND
Elective courses if needed.

Core courses as determined by area of study
Computer Aided Design and Manufacturing:
MMAE 546   Advanced Manufacturing Engineering

Dynamics and Control:
MMAE 541   Advanced Dynamics

Fluid Dynamics:
MMAE 510   Fundamentals of Fluid Mechanics

Solids and Structures:
MMAE 530   Advanced Mechanics of Solids

Thermal Sciences:
MMAE 520   Advanced Thermodynamics

No more than two 400-level courses that were not required for the completion of an undergraduate degree will be accepted as satisfying part of the program. Students with interdisciplinary programs will be given special consideration. Up to six credit hours of accelerated (700-level) courses are allowed.

Department of Mechanical, Materials and Aerospace Engineering

Course Requirements for the Master of Science in Materials Science and Engineering

Required core courses
(12 credit hours)
MMAE 563   Advanced Mechanical Metallurgy
MMAE 569   Advanced Physical Metallurgy
AND
MMAE 468   Introduction to Ceramic Materials **OR**
MMAE 486   Properties of Ceramics
AND one course selected from the following:
MMAE 467   Fundamental Principles of Polymeric Materials
MMAE 578   Fiber Composite Materials
MMAE 579   Characterization of Polymers **OR**
MMAE 580   Structure and Properties of Polymers
AND
12-14 hours of non-core courses

Up to 12 credit hours of 400-level, non-core courses that were not required for the completion of an undergraduate degree and approved by the Graduate Studies Committee may count toward satisfying this requirement. Up to six credit hours of accelerated (700-level) courses are allowed.

Master of Engineering in Manufacturing via Internet

30 credit hours

The professional Master of Engineering in Manufacturing via Internet is a course-only, professionally oriented degree program that requires a minimum of 30 credit hours. There is no thesis or comprehensive examination requirement. The student, in consultation with the academic advisor, prepares a program reflecting individual needs and interests. All courses are administered online.

Courses
(Select 30 credit hours)
MMAE 433   Design of Thermal Systems (3 credit hours)
MMAE 445   CAD/CAM with Numerical Control (3 credit hours)
MMAE 474   Metals Processing (3 credit hours)
MMAE 481   Introduction to Joining Processes (3 credit hours)
MMAE 540   Robotics and Mechatronics (3 credit hours)
MMAE 545   Advanced CAD/CAM (3 credit hours)
MMAE 546   Advanced Manufacturing Engineering (3 credit hours)
MMAE 547   Computer-Integrated Manufacturing (3 credit hours)
MMAE 557   Advanced Computer-Integrated Manufacturing (3 credit hours)
MMAE 560   Statistical Quality and Process Control (3 credit hours)
MMAE 563   Advanced Mechanical Metallurgy (3 credit hours)
MMAE 589   Applications in Reliability Engineering I (3 credit hours)
MMAE 590   Applications in Reliability Engineering II (3 credit hours)
MMAE 704   Introduction to Finite Element Analysis (2 credit hours)
MMAE 715   Project Management (2 credit hours)
MMAE 720   Design Assurance (2 credit hours)

Required core courses
MMAE 545   Advanced CAD/CAM (3 credit hours)
MMAE 546   Advanced Manufacturing Engineering (3 credit hours)
MMAE 547   Computer-Integrated Manufacturing (3 credit hours)
MMAE 560   Statistical Quality and Process Control (3 credit hours)
AND
One materials course:
MMAE 563   Advanced Mechanical Metallurgy (3 credit hours)
AND
One course with emphasis on numerical methods:
MMAE 704   Introduction to Finite Element Analysis (2 credit hours)

Department of Mechanical, Materials and Aerospace Engineering

Doctor of Philosophy in Mechanical and Aerospace Engineering
Doctor of Philosophy in Materials Science and Engineering

84 credit hours beyond the Bachelor of Science
Qualifying examination
16 credit hours (minimum) of courses beyond the M.S.
One full year (minimum) of thesis research
Comprehensive examination
Dissertation and oral defense

This program provides advanced, research-based education and knowledge through advanced coursework, state-of-the-art and original research, and publication of novel results in preparation for careers in academia and industrial research and development.

The department offers programs leading to the Ph.D. in Mechanical and Aerospace Engineering and the Ph.D. in Materials Science and Engineering. The doctoral degree is awarded in recognition of a high level of mastery in one of the several fields of the department including a significant original research contribution. A student working toward the Ph.D. degree has great flexibility in formulating an overall program to meet individual needs under the guidance of an advisor and the department.

In order to maintain the standards expected in this degree program, there are requirements that must be satisfied. Primarily, the Ph.D. candidate should meet the requirements for a master's degree or present evidence that he or she has reached an equivalent level of proficiency.

Further, the student must be accepted by a thesis advisor and pass a qualifying examination given by the department in order to be admitted to candidacy for the Ph.D. degree. The examination evaluates the student's back-ground in order to determine the student's potential for achieving a doctorate.

The student, in consultation with the advisor, prepares a program of study to meet individual needs and interests, which must then be approved by the advisor, the department's Graduate Studies Committee, the Department Chair, and the Graduate College. The program of study usually consists of at least one full year of advanced coursework beyond the master's degree and a minimum of one full year of thesis research.

After the student essentially completes all coursework, he or she must pass the Ph.D. comprehensive examination. Conducted by the student's Thesis Advisory Committee, this examination must be completed at least one year prior to graduation.

Concentrated research to satisfy the requirements of a doctoral dissertation is ordinarily conducted after the comprehensive examination has been passed. The dissertation must be approved by the student's Thesis Advisory Committee. Thesis research should be equivalent to at least one full year's work, corresponding to up to 36 thesis credit hours. This work is performed on campus; the department's Graduate Studies Committee and the Dean of the Graduate College must approve off-campus research. The doctoral dissertation is expected to contain a distinct and substantial original contribution to the student's field of study. After the research has been completed and a preliminary draft of the dissertation is approved, the candidate defends his or her thesis at a final oral examination, which is open to the public.

Course Requirements for Mechanical and Aerospace Engineering

MMAE 501   Engineering Analysis Ib
MMAE 502   Engineering Analysis II
MMAE 503   Advanced Engineering Analysis
MMAE 507   Introduction to Continuum Mechanics
AND
12 or more credit hours of coursework in major area of study
AND
The required core course in a second area:
Computer Aided Design and Manufacturing:
MMAE 546   Advanced Manufacturing Engineering

Dynamics and Control:
MMAE 541   Advanced Dynamics

Fluid Dynamics:
MMAE 510   Fundamentals of Fluid Mechanics

Solids and Structures:
MMAE 530   Advanced Mechanics of Solids

Thermal Sciences:
MMAE 520   Advanced Thermodynamics

AND
Elective courses as needed.

Course Requirements for Material Science and Engineering

MMAE 563   Advanced Mechanical Metallurgy
MMAE 569   Advanced Physical Metallurgy
AND
MMAE 468   Introduction to Ceramic Materials **OR**
MMAE 486   Properties of Ceramics
AND one course selected from the following:

MMAE 467   Fundamental Principles of Polymeric Materials
MMAE 578   Fiber Composite Materials
MMAE 579   Characterization of Polymers
MMAE 580   Structure and Properties of Polymers
AND
36–60 credit hours of non-core courses.

Department of Mechanical, Materials and Aerospace Engineering

Certificate Programs

Computer Integrated Design and Manufacturing

Required courses (select four)

MMAE 445   CAD/CAM with Numerical Control (3 credit hours)

MMAE 540   Robotics and Mechatronics (3 credit hours)

MMAE 545   Advanced CAD/CAM (3 credit hours)

MMAE 547   Computer Integrated Manufacturing (3 credit hours)

MMAE 557   Advanced Computer Integrated Manufacturing (3 credit hours)

Product Quality and Reliability Assurance

Required courses

MMAE 560   Statistical Quality and Process Control (3 credit hours)

MMAE 589   Applications in Reliability Engineering I (3 credit hours)

MMAE 590   Applications in Reliability Engineering II (3 credit hours)

MMAE 720   Introduction to Design Assurance (2 credit hours)

Course Descriptions

Numbers in parentheses indicate class, lab and total credit hours, respectively.

MMAE 501
Engineering Analysis Ib
Matrices, Gauss-Jordan elimination, rank of a matrix, linear vector spaces and transformations, eigenvalue problems. Functions of matrices and Cayley-Hamilton theorem. Hilbert space and Fourier series. Differential eigenvalue problems. Sturm-Liouville equation. Calculus of variations, Euler-Lagrange equations. Rayleigh-Ritz and finite element approximations. Hamilton's principle. Complex variables, functions of a complex variable, analytic functions and Cauchy-Riemann equations. Multiple-valued functions and branch cuts. Integration in the complex plane. Goursat theorem. Cauchy integral theorem. Evaluation of real integrals. Conformal mapping. Laplace equation. Applications in steady-state heat conduction and incompressible fluids. Prerequisites: MMAE 350, MATH 331, MATH 333, or MATH 461. (4-0-4)

MMAE 502
Engineering Analysis II
Generalized functions. Green's functions, integral equations. Fredholm and Volterra equations, Hilbert-Schmidt theory, singular integral equations. Integral transforms: Fourier, Laplace, Hankel and Mellin transforms. Prerequisite: MMAE 501. (3-0-3)

MMAE 503
Advanced Engineering Analysis
Ordinary differential equations in the complex domain. Elementary properties. Series solutions. Riemann's P-function. Normal and subnormal solutions. Classification of ODE by singularities. Classical polynomials and special functions of ODE. Solutions by definite integrals and integral transforms. Asymptotic series. Methods of Laplace, steepest descents, and stationary phase. Stokes phenomenon. Asymptotic solutions by WKB, Langer and Olver methods. Prerequisite: MMAE 502. (3-0-3)

MMAE 504
Engineering Analysis Ia
Matrices, linear vector spaces and transformations, eigenvalue problems. System of first-order differential equations. Functions of matrices and Cayley-Hamilton theorem. Hilbert space and Fourier series. Differential eigenvalue problems. Sturm-Liouville equation. Calculus of variations, Euler-Lagrange equations, Legendre transformation. Mini-max problems. Rayleigh-Ritz and Finite element approximations. Hamilton's principle. Prerequisite: MMAE 350, MATH 331, MATH 333 or MATH 461. (3-0-3)

MMAE 505
Numerical Methods in Engineering
Introduction to numerical methods in engineering. Polynomial interpolation. Solution of scalar nonlinear equations by interactive methods. Solution of linear systems of equations by direct methods. Discussion of error estimation and convergence criteria. Finite difference techniques for initial value problems and two-point boundary value problems.

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Introduction to finite difference techniques for partial differential equations. Prerequisite: B.S. degree in engineering and familiarity with a computer programming language. (3-0-3.)

MMAE 506
Computational Methods in Engineering Analysis

Numerical methods applied to engineering analysis. Methods for solving nonlinear equations, numerical linear algebra, approximation of functions, numerical integration, finite difference methods. Applications to mechanics and mechanical and aerospace engineering problems. Survey and use of various software libraries including IMSL. Prerequisite: MMAE 505. (3-0-3)

MMAE 507
Introduction to Continuum Mechanics

A unified treatment of those topics that are common to solid and fluid continua. General discussion of Cartesian tensors. Deformation, strain, strain invariants, rotation, compatibility conditions. Motion, velocity, deformation. Momentum, moment of momentum, energy, stress. Principles of balance of local momenta, equations of motion. Principles of frame indifference. Constitutive relations for fluids, elastic and plastic solids. Corequisite: MMAE 501. (4-0-4)

MMAE 508
Perturbation Methods

Asymptotic series, algebraic equations, evaluation of integrals using Laplace, steepest descent and stationary phase methods. Differential equations and solutions using stretched coordinates, multiple scales and WKB methods. Matched asymptotic technique and turning points. Boundary layers, oscillators and Floquet theory. Prerequisite: MMAE 502. (3-0-3)

MMAE 510
Fundamentals of Fluid Mechanics

Kinematics of fluid motion. Constitutive equations of isotropic viscous compressible fluids. Derivation of Navier-Stokes equations. Lessons from special exact solutions, self-similarity. Admissibility of idealizations and their applications; inviscid, adiabatic, irrotational, incompressible, boundary-layer, quasi one-dimensional, linearized and creeping flows. Vorticity theorems. Unsteady Bernoulli equation. Basic flow solutions. Basic features of turbulent flows. Corequisite: MMAE 501. (4-0-4)

MMAE 511
Dynamics of Compressible Fluids

Low-speed compressible flow past bodies. Linearized, subsonic, and supersonic flow past slender bodies. Similarity laws. Transonic flow. Hypersonic flow, mathematical theory of characteristics. Applications including shock and nonlinear wave interaction in unsteady one-dimensional flow and two-dimensional, planar and axisymmetric supersonic flow. Prerequisite: MMAE 510. (3-0-3)

MMAE 512
Dynamics of Viscous Fluids

Navier-Stokes equations and some simple exact solutions. Oseen-Stokes flows. Boundary-layer equations and their physical interpretations. Flows along walls and in channels. Jets and wakes. Separation and transition to turbulence. Boundary layers in unsteady flows. Thermal and compressible boundary layers. Mathematical techniques of similarity transformation, regular and singular perturbation, and finite differences. Prerequisite: MMAE 510. (4-0-4)

MMAE 513
Turbulent Flows

Stationary random functions. Correlation tensors. Wave number space. Mechanics of turbulence. Energy spectrum. Dissipation and energy cascade. Turbulence measurements. Isotropic turbulence. Turbulent transport processes. Mixing and free turbulence. Wall-constrained turbulence. Compressibility effects. Sound and pseudo-sound generated by turbulence. Familiarity with basic concepts of probability and statistics and with Cartesian tensors is assumed. Prerequisite: MMAE 510. (4-0-4)

MMAE 514
Stability of Viscous Flows

Concept of hydrodynamic stability. Governing equations. Analytical and numerical treatment of eigenvalue problems and variational methods. Inviscid stability of parallel flows and spiral flows. Thermal instability and its consequences. Stability of channel flows, layered fluid flows, jets and flows around cylinders. Other effects and their consequences; moving frames, compressibility, stratification, hydromagnetics. Nonlinear theory and energy methods. Transition to turbulence. Prerequisites: MMAE 502, MMAE 510. (4-0-4)

MMAE 515
Engineering Acoustics

Characteristics of sound waves in two and three dimensions. External and internal sound wave propagation. Transmission and reflection of sound waves through media. Sources of sound from fixed and moving bodies. Flow-induced vibrations. Sound-level measurement techniques. (3-0-3)

MMAE 516
Advanced Experimental Methods in Fluid Mechanics

Design and use of multiple sensor probes to measure multiple velocity components, reverse-flow velocities, Reynolds stress, vorticity components and intermittency. Simultaneous measurement of velocity and temperature. Theory and use of optical transducers, including laser velocimetry and particle tracking. Special measurement techniques applied to multiphase and reacting flows. Laboratory measurements in transitional and turbulent wakes, free-shear flows, jets, grid turbulence and boundary layers. Digital signal acquisition and processing. Prerequisite: MMAE 550. (2-3-3)

MMAE 517
Computational Fluid Dynamics

Classification of partial differential equations. Finite-difference methods. Numerical solution techniques, including direct, iterative and multigrid methods, for general elliptic and parabolic differential equations. Numerical algorithms for

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solution of the Navier-Stokes equations in the primitive-variables and vorticity-streamfunction formulations. Grids and grid generation. Numerical modeling of turbulent flows. Prerequisites: MMAE 510 and MMAE 505 or an undergraduate course in numerical methods. (3-0-3)

MMAE 520
Advanced Thermodynamics

Macroscopic thermodynamics: first and second laws applied to equilibrium in multicomponent systems with chemical reaction and phase change; availability analysis; evaluations of thermodynamic properties of solids, liquids; and gases for single and multicomponent systems. Applications to contemporary engineering systems. Prerequisite: MMAE 321 or equivalent. (3-0-3)

MMAE 521
Statistical Thermodynamics

Nature of statistical thermodynamics, kinetic description of dilute gases. Elementary kinetic theory of transport processes. Classical statistics of independent particles. Development of quantum mechanics. Application of quantum mechanics. Quantum statistics and thermostatic properties of ideal gases. Prerequisite: MMAE 321 or instructor's consent. (3-0-3)

MMAE 522
Air Conditioning Analysis

Heating and cooling design for energy conservation. Transient load calculations. Computer simulation. Solar heating and air conditioning methods. Two-duct systems versus one-duct systems. Advanced system analysis and design. Prerequisite: MMAE 321. (3-0-3)

MMAE 523
Fundamentals of Power Generation

Thermodynamics and design aspects of steam-turbine and gas-turbine power generation. Cycle analysis and heat- rate evaluation. Cogeneration. Advanced concepts such as MHD and wind power. Economic considerations. Prerequisite: MMAE 321 or equivalent. (3-0-3)

MMAE 524
Fundamentals of Combustion

Combustion stoichiometry. Chemical equilibrium. Adiabatic flame temperature. Reaction kinetics. Transport processes. Gas flames classification. Premixed flames. Laminar and turbulent regimes. Flame propagation. Deflagrations and detonations. Diffusion flames. Spray combustion. The fractal geometry of flames. Ignition theory. Pollutant formation. Engine combustion. Solid phase combustion. Combustion diagnostics. Prerequisite: MMAE 321, MMAE 322 or instructor's consent. (3-0-3)

MMAE 525
Fundamentals of Heat Transfer

Modes and fundamental laws of heat transfer. The heat equations and their initial and boundary conditions. Conduction problems solved by separation of variables. Numerical methods in conduction. Forced and natural convection in channels and over exterior surfaces. Similarity and dimensionless parameters. Heat and mass analogy. Effects of turbulence. Boiling and condensation. Radiation processes and properties. Blackbody and gray surfaces radiation. Shape factors. Radiation shields. Prerequisite: MMAE 322 or instructor's consent. (3-0-3)

MMAE 526
Heat Transfer: Conduction

Fundamental laws of heat conduction. Heat equations and their initial and boundary conditions. Steady, unsteady and periodic states in one or multidimensional problems. Composite materials. Methods of Green's functions, eigenfunction expansions, finite differences, finite element methods. Prerequisites: MMAE 502, MMAE 525. (3-0-3)

MMAE 527
Heat Transfer: Convection and Radiation

Convective heat transfer analyses of external and internal flows. Forced and free convection. Dimensional analysis. Phase change. Heat and mass analogy. Reynolds analogy. Turbulence effects. Heat exchangers, regenerators. Basic laws of radiation heat transfer. Thermal radiation and quantum mechanics pyrometry. Infrared measuring techniques. Prerequisite: MMAE 525. (3-0-3)

MMAE528
Liquid-Vapor Phase-Change Phenomena

This course focuses on basic elements of condensation and vaporization processes. Specifically, this course covers the thermodynamic and mechanical aspects of interfacial phenomena and phase transitions, boiling and condensation near immersed bodies, and internal flow convective boiling and condensation. Prerequisite: MMAE320, MMAE310 and MMAE322. (3-0-3)

MMAE 529
Theory of Plasticity

Phenomenological nature of metals, yield criteria for 3-D states of stress, geometric representation of the yield surface. Levy-Mises and Prandtl-Reuss equations, associated and nonassociated flow rules, Drucker's stability postulate and its consequences, consistency condition for nonhardening materials, strain hardening postulates. Elastic-plastic boundary value problems. Computational techniques for treatment of small and finite plastic deformations. Prerequisite: MMAE 530. (3-0-3). Same as CAE 588. (3-0-3)

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MMAE 530
Advanced Mechanics of Solids
Analysis of stress and strain. Stress-strain relations. Two-dimensional problems in elasticity. Axisymmetrically loaded thick-walled cylinders and rotating disks. Plates and axisymmetrical shells. Energy methods. Torsion. Beams on elastic foundations. Unsymmetric bending of straight beams. Prerequisites: MMAE 303 or MMAE 304. Corequisite: MMAE 504 or MMAE 501. (3-0-3)

MMAE 531
Theory of Elasticity
Notions of stress and strain, field equations of linearized elasticity. Plane problems in rectangular and polar coordinates. Problems without a characteristic length. Plane problems in linear elastic fracture mechanics. Complex variable techniques, energy theorems, approximate numerical techniques. Prerequisite: MMAE 530. (4-0-4)

MMAE 532
Finite Element Methods II
Continuation of MMAE 451/CAE 442. Covers the theory and practice of advanced finite element procedures. Topics include implicit and explicit time integration, stability of integration algorithms, unsteady heat conduction, treatment of plates and shells, small-strain plasticity, and treatment geometric nonlinearity. Practical engineering problems in solid mechanics and heat transfer are solved using MATLAB and commercial finite element software. Special emphasis is placed on proper time step and convergence tolerance selection, mesh design, and results interpretation. Prerequisite: MMAE 451 or CAE 442 or MMAE 51/CAE 442. (3-0-3)

MMAE 533
Fatigue and Fracture Mechanics
Analysis of the general state of stress and strain in solids; dynamic fracture tests (FAD, CAT). Linear elastic fracture mechanics (LEFM), Griffith-Irwin analysis, ASTM KIC, KIPCI, KIA, KID. Plane stress, plane strain; yielding fracture mechanics (COD, JIC). Fatigue crack initiation.

Goodman diagrams and fatigue crack propagation. Notch sensitivity and stress concentrations. Low-cycle fatigue, corrosion and thermal fatigue. Prerequisite: MMAE 271, MMAE 304 or MMAE 303. (3-0-3)

MMAE 534
Mechanics of Composite Materials
Basic concepts and definitions, constituent materials, micro-mechanics, macromechanics. Elastic behavior and strength of unidirectional lamina. Elastic behavior of multidirectional laminates, lamination theory. Stress analysis and strength of multidirectional laminates, failure theories. Prerequisite: MMAE 303 or 304 (2-0-2)

MMAE 535
Design and Analysis of Brittle Structures
Analysis algorithm based on statistical fracture theory. Introduction to both conventional and extreme value statistics, combined stress theory, load redistribution models, and specimen testing and design. Design philosophies including structural reliability theory, destructive proof testing, and prestressing and segmenting. Applications to static design, thermal shock, and fragmentation of structures such as ceramic nose cones, leading edges and machine tools. Prerequisite: MMAE 303 or MMAE 304. (3-0-3)

MMAE 536
Experimental Solid Mechanics
Review of applied elasticity. Stress, strain and stress-strain relations. Basic equations and boundary value problems in plane elasticity. Methods of strain measurement and related instrumentation. Electrical resistance strain gauges, strain gauge circuits and recording instruments. Analysis of strain gauge data. Brittle coatings. Photoelasticity; photoelastic coatings; moire methods; interferometric methods. Applications of these methods in the laboratory. Prerequisite: MMAE 271, MMAE 303 or MMAE 304. (3-2-4)

MMAE 537
Finite Element Applications
A review of FEM with respect to application types (fluid, solid and thermal). Training in the use of FEM on industrial and research problems. Introduction to several kinds of mesh generation. Discussions on the major causes of error. Consideration of modeling techniques including symmetry considerations, boundary conditions and constraint equations. Prerequisite: MMAE 451 or CAE 442. (2-0-2)

MMAE 538
Computational Techniques in Finite Element Methods
Survey of numerical methods as applied to FEM software. Database management, equation solvers, eigenvalue routines and schemes for direct integration (both implicit/explicit), all as employed in the development of a finite element program. Topics also covered include band and front minimizer, static and dynamic substructuring via superelements, and sensitivity studies. Same as CAE 534. Prerequisite: MMAE 451 or CAE 442. (3-0-3)

MMAE 539
Nonlinear Finite Element Analysis
FEM as applied to nonlinear problems. Contact problems, the mechanics of large deformation, full and updated Lagrange formulations, review of plasticity, solution algorithms. Eulerian approaches. Same as CAE 535. Prerequisite: MMAE 507. (3-0-3)

MMAE 540
Robotics and Mechatronics
Classification of robots, kinematics and inverse kinematics of manipulators, differential kinematics, trajectory planning, modeling of systems, integrative actuators, sensors, controllers and interfacing. Prerequisites: MMAE 305, PHYS 300. (3-0-3)

MMAE 541
Advanced Dynamics
Kinematics of rigid bodies. Rotating reference frames and coordinate transformations; Inertia dyadic. Newton-Euler equations of motion.

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Gyroscopic motion. Conservative forces and potential functions. Generalized coordinates and generalized forces. Lagrange's equations. Holonomic and non-holonomic constraints. Lagrange multipliers. Kane's equations. Elements of orbital and spacecraft dynamics. Prerequisite: MMAE 305. Corequisite: MMAE 504 or 501. (3-0-3)

MMAE 542
Advanced Mechanical Vibrations

Multidegree of freedom discrete systems, continuous systems, approximate methods, finite element method, vibration control, random vibration, and nonlinear vibration. Prerequisite: MMAE 406. (3-0-3)

MMAE 543
Analog and Digital Control Systems

Review of classical control. Discrete-time systems. Linear difference equations. Z-transform. Design of digital controllers using transform methods. State-space representations of continuous and discrete-time systems. State-feedback. Controllability and observability. Pole placement. Optimal control. Linear-Quadratic Regulator (LQR). Probability and stochastic processes. Optimal estimation. Kalman Filter. Prerequisite: MMAE 443. Corequisite: MMAE 504 or MMAE 501 (3-0-3)

MMAE 544
Optimization Techniques in Computer-Aided Design

Optimization theory and practice with examples. Finite-dimensional unconstrained and constrained optimization, Kuhn-Tucker theory, linear and quadratic programming, penalty methods, direct methods, approximation techniques, duality. Formulation and computer solution of design optimization problems in structures, manufacturing and thermofluid systems. Prerequisite: MMAE 505. (3-0-3)

MMAE 545
Advanced CAD/CAM

Interactive computer graphics in mechanical engineering design and manufacturing. Mathematics of three-dimensional object and curved surface representations. Surface versus solid modeling methods. Numerical control of machine tools and factory automation. Applications using commercial CAD/CAM in design projects. Prerequisite: MMAE 445 or instructor's consent. (3-0-3)

MMAE 546
Advanced Manufacturing Engineering

Analytical, experimental and computer simulation techniques for the study of manufacturing processes (forming, machining, casting, joining and assembly). Effects of variables on the quality of manufactured products. Advances in processing of engineered materials. Manufacturing cells and flexible manufacturing systems. Prerequisite: MMAE 485 or instructor's consent. (3-0-3)

MMAE 547
Computer-Integrated Manufacturing

The use of computer systems in planning and controlling the manufacturing process including product design, production planning, production control, production processes, quality control, production equipment and plant facilities. (3-0-3)

MMAE 548
Principles of Minimum-Weight Design

Minimum weight designs of basic structural elements are developed for different behavior criteria including stiffness, elastic and plastic strength, and stability. A number of optimization techniques are used to explore various structural concepts, such as prestressing, statistical screening and energized systems. Prerequisite: MMAE 303. Corequisite: MMAE 530. (3-0-3)

MMAE 549
Tribology

Surface topography and integrity. Sliding and rolling friction. Temperature in sliding contact. Types, mechanisms, and theories of wear. Antifriction and wear-resistant materials. Boundary, hydrodynamic and elastohydrodynamic lubrication. High pressure and wear-resistant additives. Solid lubricants. Examples of tribology applied to engineering design. Prerequisite: Instructor's consent. (3-0-3)

MMAE 550
Experimental Methods in Mechanical Engineering

Design and implementation of computer-based measurement systems. Analog and digital signal conditioning. Text and graphic-based programming for data acquisition and control. Digital processing of deterministic and stochastic data. Digital image acquisition and processing. Modern techniques for measurements of flow, temperature, position, strain, force, etc. Hands-on experience in laboratory sessions. Prerequisite: Familiarity with Fortran or C. (3-3-4)

MMAE 551
Advanced Robotics and Mechatronics

Equations of motion of manipulators by Newton-Euler and Lagrange formulations; independent joint control, multivariable control, feedback linearization, computer interfacing, trajectory control, compliant motion control. Prerequisite: MMAE 540 or equivalent. (3-0-3)

MMAE 552
Practical Machine Design

This course includes an introduction to Precision Engineering, Synthesis of Mechanics, and Case Studies in Engineering Design. This group of topics introduces the theory and practical techniques of machine design. Methods for achieving precision and for linkage design are used in nearly all mechanical industries. The series of cases provide study of actual engineering practice, and include applications of gearing, bearings, shifts and linkage analysis with consideration of economics and patents. (3-0-3)

MMAE 557
Advanced Computer-Integrated Manufacturing

Advanced topics in computer-integrated manufacturing, including control systems, group technology, cellular manufacturing, flexible man-

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ufacturing systems, automated inspection, lean production, just-in-time production, and agile manufacturing systems. Prerequisite: MMAE 547. (3-0-3)

MMAE 560
Statistical Quality and Process Control

Basic theory, methods and techniques of on-line, feedback quality control systems for variable and attribute characteristics. Methods for improving the parameters of the production, diagnosis, and adjustment processes so that quality loss is minimized. Same as CHE 560. (3-0-3)

MMAE 561
Solidification

Properties of liquids, undercooling, solidification of single- and polyphase alloys, zone processes, controlled and directional solidification reactions. Prerequisite: MMAE 361. (2-0-2)

MMAE 562
Design of Modern Alloys

Phase rule, multicomponent equilibrium diagrams, determination of phase equilibria, parameters of alloy development, prediction of structure and properties. Prerequisite: MMAE 361. (2-0-2)

MMAE 563
Advanced Mechanical Metallurgy

Analysis of the general state of stress and strain in solids. Analysis of elasticity, plasticity and fracture, with a major emphasis on the relationship between properties and structure. Isotropic and anisotropic yield criteria. Testing and forming techniques related to creep and superplasticity. Deformation mechanism maps. Fracture mechanics topics related to testing and prediction of service performance. Static loading to onset of rapid fracture, environmentally assisted cracking fatigue, and corrosion fatigue. Prerequisite: MMAE 271. (3-0-3)

MMAE 564
Dislocations and Strengthening Mechanisms

Basic characteristics of dislocations in crystalline materials. Dislocations and slip phenomena. Application of dislocation theory to strengthening mechanisms. Strain hardening. Solid solution and particle strengthening. Dislocations and grain boundaries. Grain size strengthening. Creep. Fatigue. Prerequisite: MMAE 271 or instructor's consent. (3-0-3)

MMAE 565
Preferred Orientations

Measurement and analysis of preferred orientations (textures). Theory and control of texture development in metal processing. Influence on the properties and commercial use of metals. Prerequisite: MMAE 271. (2-0-2)

MMAE 566
Problems in High-Temperature Materials

Temperature-dependent mechanical properties. Creep mechanisms. Basic concepts in designing high-temperature materials. Metallurgy of basic alloy systems. Surface stability. High-temperature oxidation. Hot corrosion. Coatings and protection. Elements of process metallurgy. Prerequisite: MMAE 564 or instructor's consent. (3-0-3)

MMAE 567
Fracture Mechanisms

Basic mechanisms of fracture and embrittlement of metals. Crack initiation and propagation by cleavage, microvoid coalescence, and fatigue mechanisms. Hydrogen embrittlement, stress corrosion cracking and liquid metal embrittlement. Temper brittleness and related topics. Prerequisites: MMAE 361 and MMAE 271. (3-0-3)

MMAE 568
Diffusion

Theory, techniques and interpretation of diffusion studies in metals. Prerequisite: MMAE 361. (2-0-2)

MMAE 569
Advanced Physical Metallurgy

Thermodynamics and kinetics of phase transformations, theory of nucleation and growth, metastability, phase diagrams. Prerequisite: MMAE 464. (3-0-3)

MMAE 570
Computational Methods in Materials Processing

Advanced theories and computational methods used in understanding and modeling of various materials processing that involve deformation, solidification, microstructural changes, etc. This course will discuss the fundamental theories and mathematical models that describe the relevant physical phenomena in the computational framework of the finite element method. It will consist of three parts: (1) Lectures on fundamental theories and models, (2) computational and numerical methods, and (3) computer laboratories. Prerequisites: MMAE 362, MMAE 451. (3-0-3)

MMAE 571
Microstructural Characterization of Materials

Advanced optical microscopy. Scanning and transmission electron microscopies. x-ray microanalysis. Surface characterization. Quantitative microscopy. Elements of applied statistics. Prerequisite: instructor's consent. (2-3-3)

MMAE 572
Gas-Metal Reactions in the Surface Treatment of Steels

Theory of solid and gas carburizing, nitriding, and carbonitriding. Generation of exothermic, endothermic and special gas atmospheres; control of atmosphere carburizing potential by dew point and infrared detectors. Prerequisite: MMAE 361. (2-0-2)

MMAE 573
Transmission Electron Microscopy

Design, construction and operation of transmission electron microscope, including image formation and principles of defect analysis in materials science applications. Theory and use of state-of-the-art microcharacterization techniques for morphological, crystallographic, and elemental analysis at high spatial resolutions at 10 nanometers in metallurgical and ceramic studies will also be covered. Prerequisite: Instructor's consent. (2-3-3)

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MMAE 574
Ferrous Transformations
Allotropic modifications in iron and the solid solution effects of the important alloying elements on iron. Physical metallurgy of pearlite, bainite and martensite reactions. Physical and mechanical property changes during eutectoid decomposition and tempering. Prerequisite: MMAE 361. (3-0-3)

MMAE 575
Ferrous Products: Metallurgy and Manufacture
Relationships between the engineering properties of steels and the fundamental aspects of steelmaking and shaping technologies. Topics will include the behavior of high purity iron; effects of interstitial and substitutional alloying additions; metallurgical principles of strength, ductility and toughness; steelmaking and solidification; post-solidification processing; and micro-structure and crystallographic anisotropy. Prerequisite: MMAE 464. (3-0-3)

MMAE 576
Materials and Process Selection
Context of selection; decision analysis; demand, materials and processing profiles; design criteria; selection schemes; value and performance oriented selection; case studies. (3-0-3)

MMAE 577
Lasers in Manufacturing
Lasers and components of laser systems. Applications of lasers in manufacturing processes, including thermal treatment, drilling, cutting, turning, milling, welding and prototyping. (3-0-3)

MMAE 579
Characterization of Polymers
Review of principles and practical applications of techniques for characterization of polymeric materials. Includes discussion of microscopy, diffraction and scattering methods, spectroscopy, thermal analysis, mechanical property measurements, trace analysis methods and rheological techniques. Prerequisite: MMAE 467 or instructor's consent. (3-0-3)

MMAE 580
Structure and Properties of Polymers
Molecular structure of amorphous, crystalline, and network polymers. Theories of the glassy state. Transition and melt temperatures. Model prediction of viscoelastic properties. Time-temperature superposition principle. Theory of rubber elasticity. Prerequisite: MMAE 467. (3-0-3)

MMAE 581
Theory of Mechanical Behavior of Polymers
Molecular theories for glass transitions and viscoelastic properties, strength of rubbery and glassy polymers. Deformation of crystalline polymers. Yield phenomena in glassy polymers. Photo-elastic properties of polymers. Prerequisite: MMAE 580. (2-0-2)

MMAE 582
Ferrous Technology
Production of ferrous materials in the steel mill, including treatment of the iron blast furnace and steel making in basic oxygen and electric-arc furnace. Processing of the materials in the plant and thermodynamic reaction considerations. Emerging processes will also be discussed. (3-0-3)

MMAE 584
Forging and Forming
Mechanical and metallurgical basis for successful production of forgings and stampings. Prerequisite: MMAE 271 or instructor's consent. (3-0-3)

MMAE 589
Applications in Reliability Engineering I
This first part of a two-course sequence focuses on the primary building blocks that enable an engineer to effectively communicate and contribute as a part of a reliability engineering effort. Students develop an understanding of the long term and intermediate goals of a reliability program and acquire the necessary knowledge and tools to meet these goals. The concepts of both probabilistic and deterministic design are presented, along with the necessary supporting understanding that enables engineers to make design trade-offs that achieve a positive impact on the design process. Strengthening their ability to contribute in a cross functional environment, students gain insight that helps them understand the reliability engineering implications associated with a given design objective, and the customer's expectations associated with the individual product or product platforms that integrate the design. These expectations are transformed into metrics against which the design can be measured. A group project focuses on selecting a system, developing a flexible reliability model, and applying assessment techniques that suggest options for improving the design of the system. (3-0-3)

MMAE 590
Applications in Reliability Engineering II
This is the second part of a two-course sequence emphasizing the importance of positively impacting reliability during the design phase and the implications of not making reliability an integrated engineering function. Much of the subject matter is designed to allow the students to understand the risks associated with a design and provide the insight to reduce these risks to an acceptable level. The student gains an understanding of the methods available to measure reliability metrics and develops an appreciation for the impact manufacturing can have on product performance if careful attention is not paid to the influencing factors early in the development process. The discipline of software reliability is introduced, as well as the influence that maintainability has on performance reliability. The sequence culminates in an exhaustive review of the lesson plans in a way that empowers practicing or future engineers to implement their acquired knowledge in a variety of functional environments, organizations and industries. The group project for this class is a continuation of the previous course, with an emphasis on applying the tools and techniques introduced during this second of two courses. Prerequisite: MMAE 589. (3-0-3)

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MMAE 591
Research and Thesis
for M.S. Degree

MMAE 593
MMAE Seminar
Reports on current research. Full-time graduate students in the department are required to register and attend. (1-0-0)

MMAE 594
Project for Professional
Master Students
Design projects for the Master of Mechanical and Aerospace Engineering, Master of Materials Science and Engineering, and Master of Manufacturing Engineering degrees. (Variable credit.)

MMAE 597
Special Topics
Advanced topics in the fields of mechanics, mechanical and aerospace, materials science, and manufacturing engineering in which there is special student and staff interest. (Variable credit.)

MMAE 691
Research and Thesis
for Ph.D. Degree

MMAE 704
Introduction
to Finite-Element Analysis
This course provides a comprehensive overview of the theory and practice of the finite element method by combining lectures with selected laboratory experiences. Lectures cover the fundamentals of linear finite element analysis, with special emphasis on problems in solid mechanics and heat transfer. Topics include the direct stiffness method, the Galerkin method, isoparametric finite elements, numerical integration, development of finite element equations, equation solvers, bandwidth of linear algebraic equations and other computational issues. Lab sessions provide experience in solving practical engineering problems using commercial finite element software. Special emphasis is given to mesh design and results interpretation using commercially available pre-and post-processing software. Note: This course is offered as an intersession short course. (2-0-2)

MMAE 705
Computer-Aided Design
with Pro/ENGINEER
This course provides an introduction to computer-aided design and an associated finite element analysis technique. A series of exercises and instruction in Pro/ENGINEER will be completed. The operation of Mecanica (the associated FEM package) will also be introduced. Previous experience with CAD and FEA will definitely speed learning, but is not essential. Note: This course is offered as an intersession course. (2-0-2)

MMAE 709
Overview of Reliability Engineering
This course covers the role of reliability in robust product design. It dwells upon typical failure mode investigation and develops strategies to design them out of the product. Topics addressed include reliability concepts, systems reliability, modeling techniques, and system availability predications. Case studies are presented to illustrate the cost-benefits due to pro-active reliability input to systems design, manufacturing, and testing. (2-0-2)

MMAE 710
Dynamic and Nonlinear Finite
Element Analysis
This is a four-day course that provides a comprehensive understanding of the theory and practice of advanced finite element procedures. The course combines lectures on dynamic and nonlinear finite element analysis with selected computer labs. The lectures cover implicit and explicit time integration techniques, stability of integration algorithms, treatment of material and geometric nonlinearity, and solution techniques for nonlinear finite element equations. The computer labs train students to solve practical engineering problems in solid mechanics and heat transfer using ABAQUS and Hypermesh. Special emphasis is placed on proper time step and convergence tolerance selection, mesh design, and results interpretation. A full set of course notes will be provided to class participants as well as a CD-ROM containing course notes, written exercises, computer labs, and all worked out examples. Note: This

class is offered as an intersession course. (2-0-2)

MMAE713
Engineering Economic Analysis
Introduction to the concepts of Engineering Economic Analysis, also known as micro-economics. Topics include equivalence, the time value of money, selecting between alternatives, rate of return analysis, compound interest, inflation, depreciation, and estimating economic life of an asset.

MMAE715
Project Management
This course covers the basic theory and practice of project management from a practical viewpoint. Topics include project management concepts, resources, duration vs. effort, project planning and initiation, progress tracking methods, CPM and PERT, reporting methods, re-planning, team project concepts, and managing multiple projects. Microsoft Project software will be used extensively.

MMAE720
Design Assurance
This course covers a range of analytical and procedural methods which support product and process development. Also referred to as Six Sigma, this approach ensures a more effective product by defining design requirements based on a comprehensive examination of the circumstances of the application. The methodology includes the use of such techniques as time line analysis, cause and effect analysis, failure mode analysis and Taguchi's robust design approach. Additionally, the importance of developmental testing is emphasized.

MMAE723
Discrete Event Simulation
Introduction to purposes, tools and concepts of Discrete Event Simulation with particular emphasis on simulation of production systems for the manufacturing and services sectors. Focus will be on theory and application rather than specific software packages, although one program will be used as an example. (2-0-2)

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Director:
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Director, Information Technology Program:
Bill Enright

Director, Manufacturing /Industrial Technology Program:
Keith McKee

Director, Business Development:
Scott Pfeiffer

Director, Professional Learning and Business Relations:
Ruth Sweetser

Director, Information Technology:
Ray Trygstad

The Center for Professional Development (CPD) draws on IIT's extensive experience in adult education to offer technology-oriented training and education for working professionals. Courses are taught by IIT professors and industry professionals with significant working, teaching and research experience in their fields. CPD offers education and training in a wide variety of formats including degree, non-degree, certificate, credit and non-credit programs; corporate training; short courses; and seminars ranging from a few hours to several days in length. Completion of all CPD non-credit courses will result in the assignment of Continuing Education Units (CEU) fully accredited by the International Association for Continuing Education and Training (IACET).

Degrees Offered

Master of Information Technology and Management

Master of Industrial Technology and Operations

Master of Information Technology and Management

This 30-credit-hour course-only master's degree program is designed for working professionals who have a four year degree from an accredited college or university.

Students can find more information and program description in the "Information Technology and Management" section on page 218 or visit www.cpd.iit.edu/itm.

Master of Industrial Technology and Operations

This is a 30 credit-hour, course-only master's degree program designed for those who are already employed in manufacturing and have a four-year degree from an accredited college or university. For more information and

program description, please see the section "Manufacturing / Industrial Programs" on page 231 or visit www.mtm.iit.edu.

Academic Certificate Program Offered

Computer and Network Security Technologies Certificate

Professional Learning Programs Offered

Information Technology Certificate Programs
Manufacturing/Industrial Technology Certificate Programs

Professional Engineer (PE) Engineering Intern (EI) Review
Short Course (one to five days) in all disciplines

Professional Learning Programs

Professional Learning Programs are hands-on training classes designed for professionals who are either looking to upgrade their existing skills or make a career change into another field. All classes are held in state-of-the-art classrooms and computer labs and are taught by IIT faculty members or by industry professionals who enhance the learning process with real-world knowledge and experience.

Particular areas of focus include information technology, manufacturing and industrial technology and management, and engineering, but all other disciplines within

the university are represented as well. Courses are available as ten to seventeen week certificate programs, as corporate training and as short courses and seminars ranging from a few hours to several days in length. Instructor-mediated online courses are also available. All courses are designed to meet professional continuing education requirements and carry Continuing Education Unit (CEU) credit.

Detailed information regarding the course offerings of IIT's Professional Learning Programs is available at www.cpd.iit.edu or by calling 630.682.6035

Institute of Psychology

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312.567.3500
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www.iit.edu/colleges/psych

Director:
M. Ellen Mitchell

Assistant Director:
Scott B. Morris

Director, Clinical Program:
Tamara Sher

Director, Industrial/Organizational Programs:
Roya Ayman

Director, Rehabilitation Counseling Program:
Chow Lam

The Institute of Psychology offers graduate programs in Clinical, Industrial/Organizational (I/O) and Rehabilitation Psychology. The institute's goal is to provide students with a scientist-practitioner model of training that integrates theory, research, and practice. Each program requires specific research, practicum, internship and curricular activities, which are linked to the specific goals of the individual training program.

Degrees Offered

Master of Science in Personnel
    and Human Resource Development
Master of Science in Psychology
Master of Science in Rehabilitation Counseling

Doctor of Philosophy in Psychology
    Doctoral specialty training in: Clinical,
        Industrial/Organizational, Rehabilitation
Postdoctoral Retraining in Clinical Psychology

Combined Degree Programs

Bachelor of Science in Psychology/Master of Science
    in Personnel and Human Resources Development

Bachelor of Science in Psychology/Master of Science
    in Rehabilitation Counseling

Certificate Programs

Compensation Management
Psychiatric Rehabilitation

Rehabilitation Engineering Technology

Research Center

Psychology faculty and students collaborate on applied research projects through the Center for Research and Service.

Research Facilities

Facilities include laboratories for human behavioral assessment studies, psychophysiological research, infant and maternal attachment research, and testing and interviewing laboratories with one-way mirror viewing. Special computer and video equipment is part of the research facilities. There are graduate student offices, a testing library and a student lounge. The University Center for Disability Resources is housed within the Institute of Psychology. Many journals and databases are available through IIT's libraries.

Institute of Psychology

Research Areas

Clinical psychology faculty interests include health psychology, behavioral medicine, attachment, child social and emotional development, educational assessment, couples treatment, family therapy, social support, and mood disorders. Some clinical students work with Rehabilitation faculty in areas such as adjustment to disability, stages of change, stigma and prevention, psychiatric rehabilitation, and cross-cultural issues. Industrial/Organizational faculty interests include leadership, diversity, organizational climate, performance appraisal, test development, selection bias, and item-response theory. Rehabilitation faculty pursue research in the areas of adjustment to disability, vocational rehabilitation, factors affecting job placement, rehabilitation engineering technology, and psychiatric rehabilitation.

Faculty

Roya Ayman, Professor and Director, Industrial/Organizational Program. B.A., M.A., Ph.D., University of Utah. Leadership, diversity, organizational climate, and work-family interface

Patricia Bach, Assistant Professor and Practicum Coordinator, Clinical Program. B.A., B.S., University of Michigan; Ph.D., University of Nevada. Psychosocial treatment for psychosis; the role of verbal behavior in psychopathology; acceptance and commitment therapy

Patrick Corrigan, Professor, Rehabilitation Program. B.S., Creighton University; M. A., Roosevelt University; Psy.D., Illinois School of Professional Psychology. The stigma of disabilities, the disabilities and rehabilitation of people with serious mental illness

Glen Geist, Professor Emeritus. B.A., Allegheny College; M.S., Ph.D., State University of New York, Buffalo. Factors affecting job placement, rehabilitation counselor education

Ruthanna Gordon, Assistant Professor. B.A., Hampshire College; M.A., Ph.D., State University of New York, Stony Brook. Decision making, judgment, and memory (specializing in source/reality monitoring)

Joyce Hopkins, Associate Professor, Clinical Program. B.A., McGill University; M.A., Tufts University; Ph.D., University of Pittsburgh. Infant/maternal attachment, high-risk infants and toddlers, maternal psychopathology, and infant development

Margaret Huyck, Professor and Undergraduate Advisor. A.B., Vassar College; M.A., Ph.D., University of Chicago. Gerontology, adult development

Chow Lam, Distinguished Professor, Director, Rehabilitation Program. B.S., M.S.ed., University of Wisconsin, Whitewater; Ph.D., University of Wisconsin, Madison . Stages of change, cross-cultural issues in rehabilitation

Frank Lane, Assistant Professor, Rehabilitation Program. B.A., St. Leo College; M.H.S., University of Florida. Applied ethics, attitude measurement, how attitudes prevent people with disabilities from full participation

Jonathon Larson, Clinical Assistant Professor, Rehabilitation Program. B.A., Western Illinois University; M.S., Southern Illinois University; Ed.D., Roosevelt University. Staff burnout, psychiatric rehabilitation, supported employment, stigma, mental health leadership

M. Ellen Mitchell, Associate Professor, Director of the Institute, Clinical Program. B.A., Hamilton/Kirkland College; Ph.D., University of Tennessee. Social support, family and marital therapy

Scott Morris, Associate Professor, Industrial/Organizational Program. B.A., University of Northern Iowa; M.S., Ph.D., University of Akron. Selection (gender) bias

Robert Schleser, Professor, Clinical Program. B.A., Rutgers University; M.S., Ph.D., Memphis State University. Sport and performance psychology, developmental issues, educational evaluation

Tamara Goldman Sher, Associate Professor, Director, Clinical Program. B.A., University of Michigan; M.A., Ph.D., University of North Carolina. Health psychology, couples therapy, and couples and health

Annette Towler, Associate Professor, Industrial/Organizational Program. B.Sc., University of London; Ph.D. Rice University. Training and development, leadership, stigmatization at work

Allen Wolach, Professor Emeritus. B.A., University of Illinois; M.A. Roosevelt University; Ph.D., University of New Mexico. Statistical packages, learning models

Michael Young, Associate Professor, Clinical Program. A.B., University of Chicago; M.A., Ph.D., Adelphi. Seasonal affective disorder, cognitive models of depression, statistical modeling of psychopathology

Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0
GRE score minimum:
For tests taken prior to Oct. 1, 2002, M.S./Ph.D.: 1200
    (combined)
For tests taken on or after Oct. 1, 2002, M.S.: 900
    (quantitative + verbal) 2.5 (analytical writing)
For tests taken on or after Oct. 1, 2002, Ph.D.: 1000
    (quantitative + verbal) 3.0 (analytical writing)
Minimum TOEFL score: 550/213*

The faculty of the Institute of Psychology place primary emphasis on the GRE scores in the verbal and quantitative sections. The master's program in Rehabilitation Counseling does not require the GRE. Meeting the minimum GPA and test score requirements does not guarantee admission. Test scores and GPA are just two of several important factors considered. At least 18 credit hours of undergraduate study in psychology, with at least one course each in experimental psychology and statistics, are required.

Applicants for master's degree programs should have a bachelor's degree from an accredited institution and meet the minimum standards listed above. The exception is the master's in Rehabilitation Counseling; undergraduate general psychology courses are the only required prerequisites for that program. Prerequisite to admission to doctoral programs are a bachelor's or master's degree from an accredited institution, superior academic records in both undergraduate and graduate programs, and favorable recommendations. GRE results are required for all psychology doctoral programs. Applications for admission are evaluated by separate committees for each program (Clinical, Industrial/Organizational, Rehabilitation). Therefore, a prospective student must designate a specialty area on the appropriate form.

* Paper-based test score/computer-based test score.

Program Descriptions

The Clinical Psychology Ph.D. program, accredited by the American Psychological Association, offers training from the cognitive-behavioral and social learning theoretical frameworks. Based on the Boulder scientist-practitioner model, the program emphasizes an integration of clinical practice and applied clinical research. Working with a faculty mentor, students begin research work their first year. Students in the rehabilitation specialization track take rehabilitation courses as electives and do research with Rehabilitation faculty. Clinical practicum experiences take place at general and specialized clinical sites throughout the Chicago area. All students complete an APA-accredited internship. The program prepares students to be license-eligible in the state of Illinois. Graduates typically function as practitioners and researchers in medical centers and multi-disciplinary clinical settings.

The Industrial and Organizational Psychology program emphasizes students' exposure to the scientists' and practitioners' viewpoints of the field. Students undertake a balanced education in personnel and organizational topics, disciplines and research. The program strengthens students' quantitative skills for research and consulting. All students are expected to complete two internships. These positions are within various organizations where students are responsible for human resource management and development functions. Students in the Personnel and Human Resource Development master's

degree program receive the knowledge and skills necessary for professions in human resources, as well as management consulting positions. Ph.D. students will acquire a strong theoretical and methodological background in various areas of I/O psychology and are required to complete a minimum of two research projects. Many students in the past have presented and published their work. The Ph.D. curriculum prepares students to choose from several career paths in consulting, corporate human resources, or research and teaching.

The Rehabilitation program prepares master's degree students to perform a vital role as counselors in the vocational, educational, and personal adjustment of persons with physical, mental, and emotional disabilities. The program also provides advanced training for persons presently employed in agencies and facilities offering services to persons with disabilities. It prepares counselors for employment in state, federal, and private rehabilitation agencies; hospitals; correctional institutions; public schools; rehabilitation centers; and other organizations serving persons with physical, psychiatric, mental, social or emotional disabilities. The Ph.D. program prepares individuals for careers in university teaching, research and clinical practice in Rehabilitation Psychology. A minor is required for the rehabilitation counseling education track.

Institute of Psychology

Master of Science in Personnel and Human Resources Development

43 credit hours

The M.S. in Personnel and Human Resources Development is designed for individuals who wish to work as applied professionals in areas such as management consulting, human resource management, industrial relations and consumer behavior.

Core course requirements

PSYC 511	Psychometric Theory
PSYC 529	Personnel Selection and Evaluation
PSYC 545	Graduate Statistics I
PSYC 546	Graduate Statistics II
PSYC 555	Training
PSYC 556	Organizational Psychology
PSYC 558	Internship
PSYC 559	Internship

These core courses provide a broad understanding of human relations in the workplace through theory and practice. Electives in industrial/organizational psychology, vocational rehabilitation, public administration, law and business allow for specialization. Designed as a two-year full-time program with a minimum of 43 credit hours required, it also can be undertaken on a part-time basis. A research thesis or project is not required. Completing each I/O and statistics course with a minimum of a "B" constitutes the comprehensive requirement.

Minimum requirements for admission include a bachelor's degree from an accredited institution, a minimum undergraduate GPA of 3.2/4.0, GRE results, and favorable recommendations. There is no foreign language requirement. Further information can be obtained from the institute upon request.

Master of Science in Psychology

32-36 credit hours
Thesis and oral defense

The M.S. in Psychology is almost exclusively a preliminary degree for students working toward a Ph.D. The aim is to evaluate and prepare students for work beyond the M.S. All candidates for the M.S. in Psychology must complete the following requirements:

PSYC 545	Graduate Statistics I
PSYC 546	Graduate Statistics II
PSYC 591	Research and Thesis for the M.S. Degree

All students pursuing the M.S. in Psychology degree must complete the following four core courses within two years after the sequence is started:

PSYC 501	Physiological Foundations of Behavior
PSYC 502	Social Bases of Behavior
PSYC 503	Learning, Cognition, and Motivation
PSYC 504	Individual and Cultural Differences

This sequence constitutes the comprehensive requirement for the degree. Students must complete it with a minimum of a "B" average and no more than one "C" in these four core courses. There is no foreign language requirement. The remaining courses are planned by the student and adviser according to the requirements of the program area in which the student wishes to specialize. No more than 12 credit hours may be taken below the 500 level. More detailed information concerning requirements for specialization in the areas of experimental or industrial/organizational psychology is available from the institute upon request.

Each student must prepare a thesis proposal before beginning M.S. thesis research. The thesis proposal is prepared in collaboration with a faculty research advisor. Upon completion of the thesis, the student must satisfactorily complete an oral examination, which is limited to a defense of the thesis. For students in the Clinical Psychology program, the oral examination committee must include the advisor and one additional Clinical Psychology faculty member. For students in the Industrial and Organizational Psychology program, the oral examination committee must include the advisor and two additional psychology faculty members, at least one of whom must be from the I/O program.

Master of Science in Rehabilitation Counseling

60 credit hours
Project

The Rehabilitation Counseling education program, fully accredited by the Council on Rehabilitation Education, is designed to educate the student to function as a rehabilitation counselor for persons with physical or mental disabilities who need psychosocial and vocational readjustment. The goal of rehabilitation is to help such persons realize their optimum level of vocational adjustment and independent living through the provision or coordination of evaluation, physical restoration, counseling, training, placement and follow-up services. The demand for rehabilitation counselors has exceeded the supply in recent years, in public, private, nonprofit and for-profit sectors.

A core of required graduate courses provides the basic knowledge and skills necessary to the field of rehabilitation. These include rehabilitation principles and practices, vocational counseling, job placement, medical and psychosocial aspects of disability, vocational evaluation and research methods.

Concurrently, field work of progressively increasing complexity takes place at a variety of rehabilitation facilities in the Chicago area. These include the state department of vocational rehabilitation, community rehabilitation facilities, rehabilitation centers, mental health centers, medical hospitals, and other facilities for persons with mental and physical disabilities. Within the program, two specialization tracks are available for interested students. The psychiatric rehabilitation track prepares students to work with persons with mental illness. The assistive technology track prepares students to use assistive technology and devices to help persons with disabilities in independent living and work accommodations.

The two-year 60-credit-hour program allows ample time for electives. A student entering with appropriate undergraduate courses and at least one year of work experience as a rehabilitation counselor may complete the degree in a minimum of 48 credit hours. Graduation requires successful completion of a research project. The comprehensive requirement is satisfied when the student completes the following courses:

PSYC 410	Vocational Rehabilitation
PSYC 411	Medical Aspects of Disabling Conditions
PSYC 412	Multicultural and Psychosocial Aspects of Disability
PSYC 513	Assessment in Rehabilitation Counseling
PSYC 562	Job Placement
PSYC 563	Human Growth and Career Development
PSYC 564	Rehabilitation Research Seminar
PSYC 594	Practicum in Rehabilitation Counseling
AND	
PSYC 578	Rehabilitation Internship **OR**
PSYC 579	Rehabilitation Internship

Full-time students admitted to the program have frequently received traineeships of tuition and stipend funded by the Rehabilitation Services Administration. Traineeships are awarded on the basis of economic need but, as the precise number varies from year to year, they cannot be guaranteed to any student at the time of acceptance.

For persons providing direct rehabilitation service in community facilities and agencies, and who want the M.S. in Rehabilitation Counseling degree or need it to maintain employment, there is a 48 credit hour part-time program. Covering three years, students take one Saturday course and one evening course for six semesters and one Saturday course for each of three summers. The required fieldwork experiences are usually worked out with the students' place of employment. This is a cohort program, with a new class beginning every three years.

Institute of Psychology

Doctor of Philosophy

96 credit hours
Comprehensive exam
Dissertation and oral defense
Internship (for Clinical specialization)

A minimum of 96 credit hours beyond the bachelor's degree is required for the Ph.D. Individual specialties (e.g. Clinical) may require completion of additional courses. There is no foreign language requirement. Details concerning specific program requirements are available from the institute upon request.

All candidates for the Ph.D. in Psychology must complete the following requirements:

PSYC 545	Graduate Statistics I
PSYC 546	Graduate Statistics II
PSYC 691	Research and Thesis for the Ph.D. degree

And at least two of the following: (Students must check with their academic advisor to ascertain which of the following courses best pertains to their specific program emphasis)

PSYC 540	Research Methods
PSYC 551	Design and Implementation of Experiments
PSYC 554	Survey of Multivariate Statistic
PSYC 511	Psychometric Theory

All students pursuing the Ph.D. in psychology must complete the following four core courses within two years after the sequence is started:

PSYC 501	Physiological Foundations of Behavior
PSYC 502	Social Bases of Behavior
PSYC 503	Learning, Cognition and Motivation
PSYC 504	Individual and Cultural

Students must complete the sequence with a minimum of a "B" average and no more than one "C" in these four courses. In addition, History and Systems of Psychology (PSYC 406), or completion of an equivalent course that must be shown on the student's transcript, is required for all students pursuing the Ph.D. in Psychology. Ph.D. comprehensive examinations are held once each semester for the I/O program. Clinical students must schedule their comprehensive exam in consultation with their faculty advisor. These must be passed before students can register for dissertation credit hours.

All students are expected to show competency in methodology and research design, as well as in the specific content of their program areas. Before beginning thesis research, a student must present a thesis proposal for approval by a committee of the faculty. The final requirement of the Ph.D. program is an oral examination restricted to defense of the thesis and conducted by a committee nominated by the Institute and appointed by the dean of graduate studies.

The Ph.D. program with specialization in Clinical Psychology is accredited by the American Psychological Association. Completion typically requires five years of study beyond the bachelor's degree, including a one-year full-time internship. Students with prior graduate work may receive advanced credit. The program follows the scientist-practitioner model and emphasizes an integration of clinical practice and applied clinical research. Working with a faculty mentor, students begin research work their first year. Students complete 2-3 years of 15-20 hour/week practicum training that includes a wide variety of assessment and treatment experiences with a broad range of clients, including minority and under-served populations. Training sites include medical centers, community mental health centers and clinics throughout the Chicago metropolitan area. Clinical supervision is provided both onsite and at IIT. All students complete an APA-accredited internship. The program prepares students to be license-eligible in the state of Illinois. Graduates typically function as practitioners and researchers in medical centers and multi-disciplinary clinical settings.

Students may elect to further specialize within the rehabilitation track. It consists of practica in a rehabilitation or behavioral medicine setting. In addition, students complete 15 hours of rehabilitation coursework and a master's project and dissertation related to rehabilitation or behavioral medicine. The development of a specialization within the rehabilitation track occurs in addition to the standard program of study in Clinical Psychology.

A Clinical Respecialization Certificate Program also is offered for individuals with a Ph.D. in another area of psychology. The postdoctoral respecialization program provides the same core clinical training as the doctoral program. Completion typically takes three years, including one-year full-time internship. In recognition of the diverse previous experiences of participants, the program is tailored to the individual's specific training needs.

The Ph.D. program with specialization in Industrial and Organizational psychology includes coursework in both personnel and organizational psychology. Two semesters of internship in an organizational setting are usually required. Students in this program frequently are advised to supplement departmental offerings with selected courses in management, sociology, and law.

The Ph.D. program with specialization in Rehabilitation Counselor Education includes advanced seminars in adult career development and vocational behavior, professional and ethical issues, and psychosocial bases of disability and behavior, as well as practice in research, teaching and supervision. Students can supplement their studies with electives focusing on psychiatric rehabilita-tion, rehabilitation administration and organizational psychology or clinical psychology.

The Industrial/Organizational and Rehabilitation programs usually require three years of study beyond the master's degree. Further information on all programs is available from the Institute.

Special Fellowships

Full-time students in the M.S. in Rehabilitation Counseling program are eligible for consideration for U.S. Government Rehabilitation Services Administration traineeship grants when available, which may cover up to full tuition plus a monthly stipend. To a limited number of students, the Institute also awards teaching and research assistantships, which cover partial tuition as well as provide a stipend. The amount of the stipend and tuition scholarships depends upon the terms of the appointment. The Institute requires that students on assistantships apply for federal work study support.

Bachelor of Science in Psychology/Master of Science in Personnel and Human Resources Development

For IIT undergraduate psychology majors it is possible to earn a master's degree in Personnel and Human Resources Development in 1.5 years instead of the normal 2 years. The regular master's program in Personnel and Human Resources Development requires 43 credit hours post bachelors usually completed over the course of 2 years (see program description on p. 260). However, IIT psychology majors who meet the criteria for regular admission to the Masters program can consider completing their Masters degree more quickly by smart use of their electives. In the senior year, qualified students can take graduate courses to meet their undergraduate elective requirements. For a class to be accepted towards the PHRD masters the student needs to obtain a grade of B or better. By taking psychology courses that also apply to the Personnel and Human Resources Development Program, students can reduce the graduate degree requirements by 13 credit hours. Interested students should submit a formal application to the PHRD program in the fall of their sophomore or junior year and work closely with the Director of the Industrial/Organizational (I/O) program and their undergraduate academic advisor throughout to ensure proper course sequencing.

The following courses are required for the M.S. degree in Personnel and Human Resources Development. They can be taken as part of required or elective courses for the B.S. degree in Psychology. If taken as an undergraduate, these courses do not have to be repeated for the graduate program. Students should also work closely with their undergraduate academic advisor to best plan a program leading to the combined degrees in the shortest possible time.

In the senior year, and in consultation with the Director of I/O Program, students may take the following courses:

PSYC 502	Social Bases of Behavior
PSYC 529	Personnel Selection*
PSYC 545	Graduate Statistics I*
PSYC 546	Graduate Statistics II*
PSYC 556	Organizational Psychology*
MBA 510	Financial and Managerial Accounting
MBA 560	Marketing

Courses noted * above need to be taken in the senior year in order to accelerate completion of the Masters degree.

In the summer after completion of the B.S. students will be eligible to complete their first required graduate internship. This needs to be coordinated during the senior year and prior to summer with Director of the I/O Program.

Institute of Psychology

Bachelor of Science in Psychology/Master of Science in Rehabilitation Counseling

For IIT undergraduate psychology majors it is possible to earn a master's degree in Rehabilitation Counseling in 1.5 years instead of the normal 2 years. The regular master's program in Rehabilitation Counseling requires 60 credit hours post bachelors usually completed over the course of 2 years (see program description on p. 261). However, IIT psychology majors who meet the criteria for regular admission to the Masters program can consider completing their Masters degree more quickly by smart use of their electives. In the senior year, qualified students can take graduate courses to meet their undergraduate elective requirements. For a class to be accepted towards the Rehabilitation Counseling masters the student needs to obtain a grade of B or better. By taking psychology courses that also apply to the Rehabilitation Counseling program, students can reduce the graduate degree requirements by 15 credit hours, or one full-time semester. Interested students should submit a formal application to the Rehabilitation Counseling Program in the fall of their sophomore or junior year and work closely with the Director of the Rehabilitation program and their undergraduate academic advisor throughout to ensure proper course sequencing.

The following courses are required for the M.S. degree in Rehabilitation Counseling. They can be taken as part of required or elective courses for the B.S. degree in Psychology. If taken as an undergraduate, these courses do not have to be repeated for the graduate program. Students should also work closely with their undergraduate academic advisor to best plan a program leading to the combined degrees in the shortest possible time.

In the senior year, and in consultation with the Director of Rehabilitation Program, students may take the following courses:

PSYC 410	Vocational Rehabilitation
PSYC 411	Medical Aspects of Disabling Conditions
PSYC 412	Multicultural and Psychosocial Aspects of Disability
PSYC 513	Assessment in Rehabilitation Counsseling
PSYC 523	Introduction to Theories of Psychotherapy
PSYC 557	Pre-Practicum in Rehabilitation Counseling
PSYC 562	Job Placement
PSYC 563	Human Growth and Career Development
PSYC 583	Rehabilitation Engineering Technology I
PSYC 590	Introduction to Psychiatric Rehabilitation

Certificate Programs

Compensation Management

Required Courses

ACC 510	Introductory Accounting (Stuart School of Business)
PSYC 710	Compensation and Benefits Application
PSYC 716	Base Pay Management
PSYC 717	Variable Pay Programs
PSYC 719	Fundamentals of Employee Benefits Programs

And one of the following

PSYC 556	Organizational Psychology
PSYC 529	Personnel Selection and Evaluation

Psychiatric Rehabilitation

Required courses

PSYC 548	Vocational Issues in Psychiatric Rehabilitation
PSYC 561	Applied Group Counseling
PSYC 590	Psychiatric Rehabilitation

Rehabilitation Engineering Technology

Required courses

PSYC 583	Rehabilitation Engineering Technology I
PSYC 584	Rehabilitation Engineering Technology II
PSYC 585	Rehabilitation Engineering Technology III

Course Descriptions

Numbers in parentheses indicate class, lab and credit hours, respectively.

PSYC 501
Physiological Foundation of Behavior
A critical review of the anatomical and neurophysiological bases of behavior as related to theory and practice in psychology. (3-0-3)

PSYC 502
Social Bases of Behavior
Critical overview of theory and research in social cognition, interpersonal relations, group dynamics and organizational psychology. Implications of principles for issues and problems in real-world social systems are developed. (3-0-3)

PSYC 503
Learning, Cognition and Motivation
Empirical and theoretical issues relating to learning, cognitive psychology, perceptual learning, drive and emotion will be surveyed. Emphasis will be placed on differing theoretical interpretations of a given set of data. (3-0-3)

PSYC 504
Individual and Cultural Differences
Review of the basic models used to explore and explain how and why people differ from each other. The course will explore the influence of culture and individual characteristics such as gender, ability and personality, as well as how these influences change over a person's lifetime. (3-0-3).

PSYC 506
Basic Clinical Skills I
First semester seminar and supervised training in basic clinical skills, including interviewing, development of therapeutic relationship, selection of appropriate goals, and assessment of therapy progress and outcome. Prerequisite: Active standing in the clinical program; must have approved clinical placement. (3-0-3)

PSYC 507
Basic Clinical Skills II
Second semester seminar and supervised training in basic clinical skills, including interviewing, development of a therapeutic relationship, managing the process of therapy and assessing therapy progress. Prerequisites: PSYC 506; active standing in the clinical program; must have approved clinical placement. (3-0-3)

PSYC 510
Clinical Assessment I
Seminar and supervised training in intellectual and cognitive assessment for adults and children. Research, psychometric characteristics, conceptual foundations, clinical applicability, administration, scoring and interpretation of major assessment instruments. Prerequisite: Active standing in the clinical program. (3-0-3)

PSYC 511
Psychometric Theory
Basic understanding of principles and theories of psychological measurement emphasizing (1) theories and methods for estimation of reliability and validity, (2) techniques for the measurement of psychological variables, and (3) methods for construction of psychological and educational measuring instruments. Prerequisites: PSYC 409, PSYC 545, PSYC 546. (3-0-3)

PSYC 512
Clinical Assessment II
Seminar and supervised training in objective and projective assessment of adults and children. Research, psychometric characteristics, conceptual foundations, clinical applicability, administration, scoring and interpretation of major assessment instruments. Prerequisite: PSYC 510 or instructor's consent. (3-0-3)

PSYC 513
Assessment in Rehabilitation Counseling
An orientation to the process and practice of assessing adults with disabling conditions for rehabilitation plan development and vocational decision-making. Introduction to test selection, administration, and interpretation through synthesis, integration, and evaluation of vocational assessment data used in rehabilitation counseling. (3-0-3)

PSYC 514
Vocational Evaluation II: Report Development and Communication
The process of developing vocational evaluation and staffing reports. Gathering, analyzing, integrating, synthesizing and interpreting evaluation information. Development of feasible recommendations utilizing related sources of labor market/occupational information. Prerequisite: PSYC 513. (3-0-3)

PSYC 515
Vocational Evaluation Lab
Practical skills in vocational evaluation including application of work samples and situational assessment at a vocational evaluation site in the community. Prerequisites: PSYC 513, PSYC 514. (3-0-3)

PSYC 516
Clinical Assessment III
Seminar and supervised training on cognitive and behavioral assessment and treatment. Research, psychometric characteristics, conceptual foundations of major assessment methods. Prerequisites: PSYC 526, may be concurrent. (3-0-3)

PSYC 517
Performance Appraisal Seminar
The objectives of the seminar are to (1) provide a broad understanding of the multiple facets of performance appraisal, (2) understand research and advances in the field, and (3) understand the challenges and pitfalls of successfully implementing a performance appraisal system in an organization. Prerequisites: PSYC 529, PSYC 556. (3-0-3)

PSYC 519
Ethical and Professional Issues in Clinical Psychology

A review of the development of clinical psychology as an academic discipline and a profession. The role of the clinical psychologist as a scientist/practitioner. The role of ethics, theory and methodology in clinical research and practice. Prerequisite: Instructor's consent. (3-0-3)

PSYC 520
Adult Behavioral Medicine

Introduction to theoretical, clinical and research issues in adult behavioral medicine. Covers general perspectives of a biobehavioral approach, factors affecting adult health and illness, diagnostic and treatment approaches, and issues in research and application. (3-0-3)

PSYC 523
Introduction to Theories of Psychotherapy

Introduction to various approaches to therapeutic intervention. The conceptual bases, history, methods, empirical foundations and applicability of important schools of therapeutic intervention will be considered. Prerequisite: PSYC 303 or equivalent. (3-0-3)

PSYC 524
Child Behavior Therapy

Reviews current conceptualizations, assessment and treatment of childhood disorders from a behavioral-system perspective. Examines the impact of the family, school and other relevant systems on the development and treatment of child behavior problems. (3-0-3)

PSYC 525
Child Psychopathology

Comprehensive understanding of child and adolescent psychopathology covering all DSM-IV disorders in infancy, childhood and adolescence. The epidemiology and etiology of each disorder from a developmental perspective is reviewed. (3-0-3)

PSYC 526
Psychopathology

Critical examination of clinical and experimental research in psychopathology and diagnostic classification systems. Prerequisite: PSYC 303 or equivalent. (3-0-3)

PSYC 529
Personnel Selection and Evaluation

Principles and techniques of employee selection and placement. Analysis of test data which will maximize the effectiveness of such techniques. Prerequisites: PSYC 409, PSYC 545, PSYC 546. (3-0-3)

PSYC 530
Contemporary Issues in Industrial-Organizational Psychology

Survey of major theoretical formulations and current approaches to intervention techniques in the field of industrial-organizational psychology. Prerequisites: PSYC 529, PSYC 556. (3-0-3)

PSYC 531
Organizational Attitudes and Behaviors Seminar

The course is an in depth study of factors that affect organizational behavior and attitudes (motivational theories). The various key attitudes and behaviors in organizations are defined and research relating to them is discussed (e.g., job satisfaction, organizational commitment, job involvement, turnover, absenteeism, and organizational citizenship). We also identify the stressors in today's employees' lives and discuss some ways to manage them (e.g. job stress, work-family conflict, minority and immigrant workers). Prerequisite: PSYC 556. (3-0-3)

PSYC 533
Clinical Practicum

Clinical assessment, therapy and/or consultation in a community-based mental health setting or medical facility for an average of 15 hours per week, per semester. Students obtain supervised experience in the provision of psychological services and related professional activities. Prerequisite: Must be in approved clinical placement site. (Credit: Variable, one to three hours)

PSYC 534
Attachment Theory Throughout the Lifespan

Provides an in-depth understanding of attachment theory and research, as well as clinical applications throughout the lifespan. Prerequisite: Consent of instructor. (3-0-3)

PSYC 535
Seminar in Personnel Selection

A critical review of advanced techniques in personnel selection. Includes such topics as validity generalization, utility analysis and applications of latent trait theory. Prerequisites: PSYC 511.

PSYC 536
Affective Disorders

Examination of current theory and research regarding affective disorders. Covers cognitive, behavioral, biological and cultural models. The relationship of affective symptomatology and diagnoses to other types of psychopathology are considered. Prerequisite: PSYC 526 or consent of instructor. (3-0-3)

PSYC 540
Research Methods

This course prepares students for designing and interpreting empirical research. The collection of meaningful data, appropriate use of data analytic techniques, and the interpretation of data results are presented. Prerequisites: PSYC 545 and PSYC 546 or instructor's consent (3-0-3)

PSYC 545
Graduate Statistics I

Introduction to inferential statistics and statistical analysis of psychological data. Emphasis on hypothesis testing procedures and computer applications. Prerequisite: Basic course in elementary statistics. (3-0-3)

PSYC 546
Graduate Statistics II

Statistical procedures used in the prediction and explanation of psychological data, including multiple regression and the analysis of variance. Emphasis on computer applications. Prerequisite: PSYC 545. (3-0-3)

PSYC 548
Vocational Psychiatric Rehabilitation

An in depth review of models available to help people with severe mental illness obtain and maintain employment. Topics relating to vocational evaluation, work adjustment, placement, supported work models, and follow-up will be covered. (3-0-3)

PSYC 549
Practicumin Rehabilitation Counseling
Seminar and supervised experience in rehabilitation counseling. Working two days in a rehabilitation facility and carrying a small client caseload geared toward the development of individual counseling skills. Prerequisites: PSYC 410, PSYC 523, PSYC 557. (Credit: Variable.)

PSYC 550
Couples Research and Therapy
Advanced seminar introduces students to empirically based interventions for couples. Presents clinically relevant and empirically derived material to better understand the importance of both technique and theory when intervening at a couples level. (3-0-3)

PSYC 551
Design and Implementation of Experiments
Selection of appropriate designs, relevant control groups for experimental studies, researching relevant literature for experimental topics and applying appropriate statistical analyses. Prerequisites: PSYC 545, PSYC 546. (3-0-3)

PSYC 552
Legal Issues in Human Resource Management
Seminar on the legal context of human resource management, focusing on equal employment opportunity laws. Will discuss how to design employee selection, evaluation and compensation systems that comply with U.S. federal laws and regulations. Prerequisite: PSYC 529. (3-0-3)

PSYC 553
Family and Couples Therapy
Surveys the major theoretical perspectives for understanding and intervening with family and marital problems. Prerequisites: PSYC 506, PSYC 523, PSYC 526. (3-0-3)

PSYC 554
Survey of Multivariate Statistics
Introduction to the major multivariate statistical procedures used in psychology; factor analysis, discriminant analysis, multivariate analysis of variance and canonical correlation. Prerequisites: PSYC 545, PSYC 546. (3-0-3)

PSYC 555
Seminar in Industrial Training
Survey of various types of training and development programs used in industry. Also included are related major issues, specific techniques, assessment of training needs and evaluation of training programs. Prerequisites: PSYC 529, PSYC 556. (3-0-3)

PSYC 556
Organizational Psychology
Theory and research concerning human behavior in formal organizations, communication nets, dynamics of managerial jobs; current ideas concerning organizations. (3-0-3)

PSYC 557
Pre-Practicum in Rehabilitation Counseling
Seminar and observation at community rehabilitation facilities. Study of interviewing techniques, orientation to rehabilitation programs and field activities at rehabilitation agencies. (3-0-3)

PSYC 558, 559
Industrial Psychology Internship I, II
Supervised experience in psychological practices in an industrial setting. (Credit: Variable)

PSYC 561
Applied Counseling Techniques
Methods and techniques of various procedures in the counseling process. Advantages, limitations and unique applications of various approaches with specific client populations. Prerequisite: PSYC 523 or concurrent registration in PSYC 523. (3-0-3)

PSYC 562
Job Placement
Techniques of job development, job analysis, job placement, job-seeking skills and follow-up. Includes affirmative action, manpower, and legislative programs involving job placement of special groups. Prerequisite: PSYC 563 or concurrent registration. (3-0-3)

PSYC 563
Human Growth and Career Development
Presentation and discussion of human growth and career development theories across life span with special emphasis on persons with disabilities. Specific content includes Erickson's psychosocial development, Super's life span theory, Holland's theory of types, Trait-factor Theory, Krumboltz's social learning approach, Tiedeman's spiritual perspective in career decision making, and family and system influences on vocational choice. (3-0-3)

PSYC 564
Rehabilitation Research Seminar
The primary objective of this course is to help students become familiar with rehabilitation research, acquire the basic knowledge and skills for designing and conducting applied research, and develop a preliminary research proposal for their research project. A secondary purpose is to teach students to critically evaluate rehabilitation research. Specifically, this course covers an overview of various research designs, data analysis techniques, and the use of SPSS for statistical analysis. Prerequisite: PSYC 204 (3-0-3)

PSYC 566
Addictive Behaviors
A review of theoretical models of addiction from sociological, biological, and psychological perspectives. Critical examination of research methodology and clinical approaches. Emphasis on alcohol and drug abuse. Also covers substance abuse in special populations and other addictive behaviors. (3-0-3)

PSYC 571
Seminar in Quantitative Psychology
Presentation and discussion of advanced topics in quantitative psychology. Specific content will vary from year to year. Topics such as factor analysis, multidimensional scaling, etc., will be discussed. May be taken more than once. Prerequisite: Instructor's consent. (3-0-3)

Institute of Psychology

PSYC 573
Psychosocial Bases of Disability and Behavior
Presentation and discussion of psychological and social issues of disability and human behavior. Somatopsychology, field integrative theories and psychosocial aspects of disabilities. Prerequisite: Instructor's consent. (3-0-3)

PSYC 575
Adult Career Development and Vocational Behavior
Presentation and discussion of impact of disabilities on adult career development. Vocational development theories, occupational information and analysis, career counseling and research methodology. Prerequisite: Instructor's consent. (3-0-3)

PSYC 577
Professional and Ethical Issues in Rehabilitation Counseling Psychology
Presentation and discussion of issues related to professional and ethical practice in rehabilitation counseling psychology. History and philosophy of rehabilitation, professional and ethical standards, concerns in rehabilitation assessment, counseling, placement and independent living. Prerequisite: Instructor's consent. (3-0-3)

PSYC 578, 579
Rehabilitation Internship I, II
Supervised experience in rehabilitation counseling. Prerequisite: PSYC 549. (Credit: Variable)

PSYC 580
Seminar in Leadership
Reviews models and theories of leadership that cover group dynamics, power, influence, and conflict management as well as issues of diversity and gender. The focus is on research and practical issues in understanding leadership and its effectiveness. (3-0-3)

PSYC 581
Neuropsychological Assessment
Seminar and supervised training in neuropsychological assessment for adults. A review of neuroanatomy followed with a review of the conceptual foundations of brain-behavior relationships. Major assessment instruments will be covered.

Prerequisites: PSYC 501, PSYC 510. (3-0-3)

PSYC 582
Applied Psychophysiology and Biofeedback
Reviews applications of physiological measures to practical problems. Clinical applications of biofeedback are discussed and demonstrated. Special emphasis on electromyographic techniques. Prerequisite: PSYC 501. (3-0-3)

PSYC 583
Rehabilitation Engineering Technology I: Survey of Interdisciplinary Applications of RET
An overview of Assistive Technology (AT) used by people with disabilities. Includes contact with local AT sites, consumers and practicing professionals. Reviews specific AT applications for communication, mobility and control; national and local AT resources; and economics of AT development, marketing and service delivery. Design, engineering, and architectural issues relevant to people with disabilities are introduced. Prerequisite: PSYC 201. (3-0-3)

PSYC 584
Rehabilitation Engineering Technology II: Access to Independence through Assistive Technology
Seminar designed for deeper exploration of assistive technology issues introduced in PSYC 583. Special focus on accessibility issues, technology outreach and awareness training; additional topics are chosen to reflect the specific interests of students in the class. Buildings are surveyed using ADAAG criteria for accessibility. Prerequisite: PSYC 583. (3-0-3)

PSYC 585
Rehabilitation Engineering Technology III: Seminar in Applications of Assistive Technology
Seminar designed to accompany and enhance practical RET experiences, such as concurrent internship, employment or approved projects involving RET/AT applications. Case presentations of technology for independent living, issues of quality of

outcome, alternatives/appropriateness of technology solutions, ethics, emotional aspects of technology acquisition, independence/dependency, and barriers to acquiring and deployment of AT are discussed. Prerequisite: PSYC 584. (3-0-3)

PSYC 586
Concepts of Supervision
Explores formulations of the supervisory relationship and critical issues in the supervision of clinicians. Prerequisites: PSYC 506 and 533 or PSYC 578 and PSYC 579. (3-0-3)

PSYC 588
Graduate Psychology Seminar
Reports and discussion of current problems and issues in psychology. (3-0-3)

PSYC 589
Rehabilitation Internship III
Supervised experience in rehabilitation counseling. Prerequisite: PSYC 549. (Credit: Variable)

PSYC 590
Psychiatric Rehabilitation
Class covers a wide range of topics including a review of the disease and disability models of mental illness, skills training components in treatment, incentive strategies for participants, transfer of learned skills to other situations, and cognitive rehabilitation strategies. (3-0-3)

PSYC 591
Research and Thesis for the M.S. Degree
(Credit: Variable)

PSYC 594
Special Projects
(Credit: Variable)

PSYC 597
Graduate Special Problems
(Credit: Variable)

PSYC 599
Clinical Internship
Participation in full-time internship accredited by the American Psychological Association, or in exceptional cases, approved by the Clinical Psychology Program faculty. Prerequisite: Ph.D. Comprehensive Exam. (1-0-1)

PSYC 691
Research and Thesis
for the Ph.D. Degree

PSYC 710
Compensation
and Benefit Application
Learn to design and modify a variety of compensation programs. Covers compensation basics, job analysis, job evaluation, compensation structure, incentive planning and more. (1.5–0–1.5)

PSYC 711
Multilevel Data Analysis
Review of statistical methods for analysis of data at multiple levels of aggregation, such as individual and group level phenomena. The course covers conceptual issues, statistical models, and data analysis using computer software. Prerequisite: PSYC 546 or equivalent. (1.5-0-1.5)

PSYC 712
Bayley Scales
of Infant Development
Provides clinical skills required to administer, score, and interpret the Bayley Scales of Infant Development, 2nd Edition. Prerequisite: Consent of instructor. (1-0-1)

PSYC 714
Assessment Centers
Develops the knowledge and skills needed for the design and implementation of assessment centers and other individual assessment methods. Prerequisite: PSYC 529. (1.5-0-1.5)

PSYC 715
Organizational Assessment
and Planning
This short course focuses on various processes and tools used in organizations to assess effectiveness, establishing priorities, and creating plans of action for change. Topics include the strategic planning process and the development and use of assessment tools such as organizational surveys and focus groups. Prerequisites: PSYC 556 and basic knowledge of statistics. (1.5-0-1.5)

PSYC 716
Base Pay Management
This course provides an in-depth discussion of the principles, design, implementation and evaluation of an employee base-pay program. Topics include concepts for determining market position using salary surveys, the design of base pay structures, principles of merit pay, and the ongoing management of base pay programs. Prerequisite: PSYC 710. (1.5-0-1.5)

PSYC 717
Variable Pay Programs
This course provides an in-depth review of variable pay programs with organizations, including incentives, recognition programs and team-based pay. Organization-wide, organizational unit, and individual programs will be discussed in terms of plan design, implementation and evaluation. Prerequisites: PSYC 710, PSYC 716. (1.5-0-1.5)

PSYC 719
Fundamentals of Employee
Benefits Programs
This course will address all aspects of employee benefits programs including government regulations, health and welfare plans, retirement plans and pay for time not worked. Case studies will be used to model real-life situations encountered by Human Resources professionals. (1.5-0-1.5)

PSYC 782
Interdisciplinary Applications of
Assistive Technology for
Counselors
Intensive one-week overview of Assistive Technology with a focus on vocational applications. Includes visitations to working assistive technology sites, and lectures by consumers and specialists (including several of national prominence) in various areas of AT. (1.5-0-1.5)

PSYC 783
Foundations of Vocational
Applications of AT
Internet based distance class designed to follow PSYC 782 and further develop the student's knowledge of AT and the skill in applying AT to solve practical problems for persons with disabilities. Applies knowledge AT service delivery presented in PSYC 782 to issues in the student's local region. Identifies AT needs of persons with disabilities and weaknesses, strengths, and gaps in local region's AT service delivery, with emphasis on vocational applications. Prerequisite: PSYC 782. (1.5-0-1.5)

Undergraduate Courses
Available to Graduate Students

PSYC 406
History and Systems of Psychology

PSYC 409
Psychological Testing

PSYC 410
Vocational Rehabilitation

PSYC 411
Medical Aspects
of Disabling Conditions

PSYC 412
Multicultural and Psycholsocial
Aspects of Disability

PSYC 414
Physiological Psychology

PSYC 420
Single-Subject Design
and Applied Behavior Analysis

PSYC 426
Cognitive Processes

PSYC 431
Measurement of Attitudes

PSYC 435
Early Development

PSYC 436
Adult Development

PSYC 449
Practicum in Rehabilitation Services

PSYC 452
Personality Theory

PSYC 456
Engineering Psychology

Graduate Program in Public Administration (Department of Social Sciences)

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Ullica Segerstrale

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Karl Nollenberger

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Director of Program Development:
Richard Bonaccorsi

Academic Head:
Scott Peters

The Graduate Program in Public Administration (GPPA) is a unit of IIT's Department of Social Sciences, which encompasses the disciplines of political science and sociology, with special emphases in the fields of urban government and community affairs, policy analysis, organization and management of work, public finance, public safety, and nonprofit management.

IIT has offered educational programs in public administration since the 1940s and has awarded the Master of Public Administration (M.P.A.) degree, the most widely recognized professional credential, since the mid-1960s. Building on the foundations laid by former departmental faculty members Herbert A. Simon (a Nobel Laureate), Victor Thompson and Donald Smithburg, the current program continues to present a practical focus on the characteristics and responsibilities of the effective governmental manager. Nearly all public administration students have substantial work experience in public or nonprofit agencies. Courses meet during the evening hours at IIT's Downtown Campus, conveniently located in the West Loop near transportation and many governmental offices, to accommodate the needs of the mid-career public service professionals that constitute most of the program's student body.

Degrees Offered

Master of Public Administration (M.P.A.)
Masters of Public Administration with specialization in Nonprofit Management

Masters of Public Administration with specialization in Public Safety and Crisis Management
Master of Public Administration with specialization in Public Works

Dual- and Joint-Degree Programs

With Department of Social Sciences:
Bachelor of Science in Political Science/
    Master of Public Administration

With Chicago-Kent College of Law:
Juris Doctor/Master of Public Administration

With Stuart School of Business:
Master of Business Administration/
    Master of Public Administration

Certificate Programs

Nonprofit Studies and Management
Public Safety and Crisis Management

Research Facilities

Students and faculty have access to the libraries of both the Downtown Campus, with its extensive collections in law and management, and the Galvin Library on IIT's Main Campus. The Downtown Campus also has excellent computer laboratories.

Research Areas

Faculty and student research is concentrated principally in the areas of public management, public policy formulation, urban government, intergovernmental relations, planning and land use, community and regional development, criminal justice, civil society and administrative ethics.

Faculty

Richard Bonaccorsi, Director of Program Development and Senior Lecturer. B.A., DePauw University; M.I.M., American Graduate School of International Management (Thunderbird); Executive Ph.D. of Management, Case Western Reserve. Strategic planning, international management, international marketing, leadership.

Donald Bradkovic, Adjunct Professor. M.A., University of Chicago. Public personnel administration.

Kelly Brest van Kempen, Adjunct Professor. M.A., University of Utah, J.D., Illinois Institute of Technology Chicago-Kent College of Law. Legal Writing, managerial communications, English as a second language (ESL).

Roland Calia, Adjunct Professor. M.A., Claremont Graduate School, Ph.D., University of Chicago. Public Finance, governmental budgeting and financial management.

Paul H. DeForest, Associate Professor. B.S., Ph.D., Georgetown University. Administrative politics, regulatory policy.

William Disselhorst, Adjunct Professor. MPA, Illinois Institute of Technology. Police administration.

William J. Grimshaw, Professor. B.A., University of Chicago; M.A., Ph.D., University of Illinois, Urbana-Champaign. Urban politics and administration.

Rick Kuner, Adjunct Professor. M.S., Massachusetts Institute of Technology. Planning analysis.

Richard Lipinski, Adjunct Professor M.A. and Ph.D., University of Chicago. Policy Analysis.

Michael Marcus, Adjunct Professor. M.S.W., University of Maryland. Public and non-profit organization and management.

William Markle, Adjunct Professor. Ph.D., University of Illinois, Chicago. Public works/Infrastructure management

Harriet McCullough, Adjunct Professor. M.A., DePaul University. Governmental ethics.

Christena E. Nippert-Eng, Associate Professor. B.A., State University of New York, Cortland; M.A., Temple University; Ph.D., State University of New York, Stony Brook. Organization and management.

Karl Nollenberger, Academic Director and Senior Lecturer. B.B.A., University of Iowa; M.P.A., University of Colorado-Denver; Ph.D. in Public Administration, UIC-Chicago. Public administration, financial management, budgeting, human resource management, urban management, local government.

Terrance Norton, Adjunct Professor. J.D., DePaul University College of Law. Governmental Ethics.

Gregory Peters, Adjunct Professor. M.P.A., Syracuse University. Public Finance and Budgeting.

Scott Peters, Academic Head and Senior Lecturer. B.A., Macalester College; J.D., Washington University; Ph.D., University of Illinois, Chicago. Public management, urban planning and policy, comparative political economy and administration.

Charles Pounian, Adjunct Professor. Ph.D., Illinois Institute of Technology. Public personnel administration.

Ullica Segerstrale, Professor and Chair of the Department. Fil. kand., Pol. kand., University of Helsinki (Finland); M.A., University of Pennsylvania; Ph.D., Harvard University. Science and technology studies.

Ray Trygstad, Assistant Director for Information Technology. IIT Rice Campus, M.S., University of Denver, Information systems security/cyber crime.

Admission Requirements

Cumulative undergraduate GPA: 3.0/4.0
GRE: not required
TOEFL minimum: 575/233/90*
Meeting the minimum GPA and test score requirements does not guarantee admission. Test scores and GPA are just two of several important factors considered.

* Paper-based test score/computer-based test score/internet-based test score.

Graduate Program in Public Administration

Master of Public Administration

32 credit hours
Preliminary

The Master of Public Administration program, which is designed for the working professional, combines rigorous instruction with a practical orientation toward public and nonprofit management and policy analysis. Students encounter this balance between the academic and the practical in the teaching faculty, course materials and classroom exercises. The program emphasizes both administrative knowledge and managerial skills related to the formulation of policy, the acquisition of human and financial resources, application of sound methods of organization and management, and the development and execution of effective implementation strategies. The curriculum allows students a significant amount of flexibility in selecting courses that meet their personal educational and professional objectives, while also assuring them of a sound foundation in all key areas of the discipline.

The M.P.A. degree requires a minimum of 32 credit hours of graduate work. No more than six credit hours may be taken in IIT courses numbered between 400 and 499. A maximum of nine credits of graduate-level coursework may be transferred from another accredited university if these have not been used toward a degree and upon approval of the student's advisor and Academic Director. The normal program of study requires completion of the following core courses:

PA 501	Introduction to Public Administration
PA 502	Complex Organizations
PA 503	Public Administrative Law
PA 522	Public Personnel Administration
PA 532	Principles and Practices of Public Finance
PA 542	Strategic Planning
PA 509	Practicum in Policy Analysis

In addition, the program requires completion of PA 510 Managerial Communications for the students who do not place out of that course pursuant to department procedures.

Students must complete a minimum of 32 semester hours. Elective courses may be selected from courses in public administration or such other fields as architecture, business, city and regional planning, civil engineering, computer science, design, environmental engineering, humanities, psychology, social sciences or law. These courses are to be chosen with the help of his/her advisor to help further the student's career objectives.

Prior to enrolling for their second semester, full-time students are required to successfully complete a preliminary exam in public administration theory and organization theory. Part-time students must take the preliminary exam before enrolling for their fifth course. Students are urged to begin their program with courses in public administration theory and organization theory in preparation for this exam. A thesis is not required for this degree but rather a capstone project is part of the PA 509 Practicum in Policy Analysis course.

Masters of Public Administration with Nonprofit Management Specialization

In 2005, the GPPA initiated a Nonprofit Studies and Management specialization. Students from non-profit organizations and students interested in the non-profit sector take the regular M.P.A. core curriculum and up to four to five electives from the non-profit courses offered in the program. This program is designed for the working professional combining rigorous instruction with practical orientation toward nonprofit management and policy analysis.

Masters of Public Administration with Public Safety/ Crisis Management Specialization

In 2005, the GPPA initiated a Public Safety and Crisis Management specialization. Students take the regular M.P.A. core curriculum and up to four to five electives from the public safety and crisis management courses offered in the program. This program is designed for the working professional combining rigorous instruction with practical orientation toward public safety management and policy analysis.

Master of Public Administration with Public Works Specialization

In 1982, the GPPA initiated a public works specialization in conjunction with IIT's Department of Civil and Architectural Engineering, the Chicago Metropolitan Chapter of the American Public Works Association (APWA), and the Education Foundation of the APWA. Students from public works agencies, especially those with engineering and technical backgrounds, take the regular M.P.A. core curriculum and PA 551 (Public Infrastructure Management) and may also take appropriate engineering courses for elective credit. In addition, the M.P.A. program cooperates with the Department of Civil and Architectural Engineering in their offering of a Master of Public Works (M.P.W.) degree.

Graduate Program in Public Administration

B.S./M.P.A.

The requirements for the B.S. in Political Science/M.P.A. degree may be completed in five years of full-time study. Qualified students interested in careers in the public sector are encouraged to begin their preparation at the undergraduate level and follow a course of study that will allow them to move directly into the M.P.A. program. For detailed information, prospective students should contact the chair of the social sciences department.

J.D./M.P.A.

A J.D./M.P.A. program, offered in conjunction with IIT's Chicago-Kent College of Law, allows students to receive both a Juris Doctor degree and a Master of Public Administration degree in a reduced time period, depending on undergraduate preparation. This program is particularly valuable for administrators whose work is guided and circumscribed by a web of legislation, rules and judicial decisions, including persons interested in city management, labor and personnel work, police administration, and public policy analysis. Students must be admitted to both programs separately. For detailed information, prospective students should contact the coordinator of the J.D./M.P.A. program, Professor Scott Peters.

M.B.A./M.P.A.

Many managers wish to increase their understanding of and ability to operate effectively in both the public and private sectors. This desire flows from the extensive interaction between the two sectors in such areas as procurement, contracting, consulting and economic development, as well as opportunities for career mobility. The dual-degree M.B.A./M.P.A. program reduces course requirements by as many as six courses from the requirements for the two degrees taken separately. For detailed information, prospective students should contact the assistant director of the public administration program and the Stuart School of Business.

Certificate Programs

The GPPA offers two graduate certificate programs. These programs provide students with a post-baccalaureate knowledge of an area of specialization with public administration. Students in these programs register as certificate students. Certificate programs require a set of four courses. Students who are admitted to a master's degree program may apply coursework previously taken in a certificate program toward the requirements for the master's degree.

Nonprofit Studies and Management

This program is designed for those interested in increasing their knowledge and skills in the nonprofit sector but do not currently have the time to pursue an MPA with a specialization in Nonprofit Studies and Management. The student will take at least 3 of the 6 courses described above and below:
• PA 565 – The Nonprofit Sector;
• PA 535 – Resource Development in the Nonprofit Sector;
• PA 534 – Financial Management of Nonprofit Organizations;
• PA 543 – Public Policy, Nonprofits and Philanthropy;
• PA 566 – Nonprofits and the Public Sector;
• PA 505 – The Law and the Nonprofit Sector.
And take 1 MPA course:
• Recommended is PA502, Complex Organizations;
• With permission from the MPA program director the student may take another course of the student's choosing.

Public Safety and Crisis Management

This program is designed for those interested in increasing their knowledge and skills in the public safety field but do not currently have the time to pursue an MPA with a specialization in Public Safety Management. The student will take 3 of the courses described below:
• PA 553 - Public Safety Administration;
• PA 539 - Local Government Management;
• PA 537 - Homeland Security/Crisis Management
• PA 538 – Information Systems Security/Cyber-crime.
And 1 MPA course:
• Recommended is PA 502, Complex Organizations;
• With permission from the MPA program director the student may take another course of the student's choosing.

Graduate Program in Public Administration

Course Descriptions

Numbers in parentheses indicate lecture, laboratory and credit hours, respectively.

PA 501
Introduction to Public Administration

Analyzes what public managers actually do in relation to elected officials, agency personnel, client groups, the press and the public, including attention to the value conflicts they confront and must resolve. Considers both classical and contemporary views and emerging issues. Introduces the student to the systematic analysis of government operations. (3-0-3)

PA 502
Complex Organizations

Analyzes how large public and non-profit administrative agencies are organized, led and managed. Examines relationships between the chief executive, line management operations and support staff. Considers relations between organization and its environment, the importance of interorganizational networks, and the role of power in organizational life. (3-0-3)

PA 503
Administration Law

Considers the role of statutes, case law and administrative law in the establishment, operation and control of public agencies. Examines how legislation and administrative procedures direct and constrain the exercise of discretion by public managers and how they ensure accountability and the fair treatment of the public. Prerequisite: PA 501. (3-0-3)

PA 504
Social Psychology in Practice

Surveys important insights from social psychology, which are then applied to everyday life and professional practice in different fields, such as management, science, medicine, politics, education, and business. Topics covered include social judgment, interpersonal processes, cultural misunderstand-

ings, group phenomena, persuasion, and leadership. In addition, the course examines the role of nonverbal signals in professional interaction and the effect of settings and spatial factors on human behavior. Part of the coursework is in the form of teamwork and team self-analysis. In addition to exams, there will be a group presentation as well as group and individual exercises, some in class. (3-0-3)

PA 505
The Law and the Nonprofit Sector

Exams local, state, and Federal law as it pertains to the nonprofit sector. This includes such things as the IRS, lobbying, human resources, property, and contracts. (3-0-3)

PA 508
Seminar in Public Management

Students attend lectures and make site visits to state and local agencies and governments, learning about special problems encountered by leadership for each agency and the solutions that the agencies have devised. Course offers students an opportunity to interact with a group of agency directors, public officials and staff about their experience, and solutions to common management problems. Students compare experience of local leaders with theoretical public administration material. Prerequisite: PA 501 and permission of Program Director. (3-0-3)

PA 509
Practicum in Policy Analysis

A student project course that concludes the required core course sequence. Focuses on the analysis of a complex, real-world administrative or policy problem. Requires analyses of legal, financial, personnel, organizational and political aspects of this problem, followed by the preparation of a thorough written and oral report, including recommendations for action. Prerequisite: All other core courses. (3-0-3)

PA 510
Managerial Communications

Provides hands-on training and practice in the effective styles of writing and related communications skills needed by all public managers, including memoranda, letters and formal reports. Emphasis is placed on learning and practicing effective writing and communication related to real-world administrative and managerial situations relevant to the student's particular current or chosen professional position. (3-0-3)

PA 513
Public Policy Analysis and Evaluation

Explores techniques of policy analysis and program evaluation having practical application in such fields as transportation, education, housing, criminal justice and environmental quality. Includes those research and analytical methods most frequently applied in governmental decision-making. Prerequisite: PA 501. (3-0-3)

PA 514
Government Management and Information Systems

A practical introduction to database management programs. Demonstrates the use of a variety of other office automation software tools (including graphics, desktop publishing, telecommunications /file transfer, bibliographic text retrieval, computer-aided instruction, and expert systems). Considers issues relating to effective computer management, including computer ethics, security, needs assessment and training. Prior working knowledge of personal computer operating systems, word processing, and spreadsheet programs is needed. Prerequisite: PA 501. (3-0-3)

PA 515
Organizational Communications

This course is intended specifically for the Chinese students in the cohort MPA program. The course will focus on written and oral communications on topics pertinent to public administrators. The purpose of this

course is to support those international students whose English skills need strengthening to help them get the maximum benefit from their graduate MPA programs of study. (3-0-3)

PA 522
Public Personnel Administration

Reviews development of merit-based civil service, examining implications of political accountability, and patronage and professional responsibility. Considers personnel recruitment, examination and promotion procedures in light of collective bargaining, affirmative action, and employee productivity and performance evaluation. Prerequisite: PA 501. (3-0-3)

PA 532
Principles and Practices of Public Finance

A general review of public finance management. This course is designed to provide students with an understanding of the public finance environment and an opportunity to explore practical challenges in managing governmental resources. Includes basic accounting, analytical tools, budgeting, purchasing, and cash management. Examines the integrated role of the various finance functions. Prerequisite: PA 501. (3-0-3)

PA 533
Advanced Financial Management

An advanced course focusing on the application of techniques used by financial managers to evaluate government financial condition and performance. Students will conduct case studies in which they apply tools such as performance measurement, budget analysis, priority-setting and financial indicator analysis to evaluate core public financial documents including budgets, capital improvement plans and audited financial statements. Prerequisite: PA 532. (3-0-3)

PA 534 Financial Management of Nonprofit Organizations:

Nonprofits are businesses organized on many of the same principles as for-profits, but there are differences including financial reporting to boards of directors, donation accounting, reporting to government funding sources, tax reporting, and even investment strategies (for example program related investing). This course will equip a nonprofit manager to responsibly guide the complex financial life of a modern nonprofit. (3-0-3)

PA 535
Resource Development in the Nonprofit Sector

Provides insight and learning into fundraising, marketing, and strategic planning in the nonprofit sector. This course offers an in-depth look into finding and securing the resources necessary to the success of nonprofit organizations. (3-0-3)

PA 537
Homeland Security/Crisis Management

This course is taught by experts from various disciplines and provides a basic overview of homeland security including a brief history of terrorism. Specifically, the course is intended to provide the audience issues related to homeland security, awareness on the types of treats (damage to buildings, processing plants, public facilities, etc.) and the type of risks involved. Other relevant aspects include types of weapons used by modern terrorists; how one goes about estimating risk and threat to a facility; how buildings and people respond when subjected to blast and fires; the role of search and rescue operations; weapon effects; building security; facility analysis to identify vulnerable areas given a threat; procedures for minimizing vulnerability; effective fire safety; contingency plans, etc. At the conclusion of this course the student will know how to estimate the risk and threat to a given facility, prepare a basic security audit; develop a basic contingency plan, develop a passive/active security system for a given facility and develop post event search and rescue operations. (3-0-3)

PA 538
Information Systems Security/Cyber-crime

Provides an introduction to information systems security, an in depth review of topics in cyber-crime issues in the public safety field and identifies methods of preventing cyber-crime in organizations. It includes issues involved with policy and legal issues of enforcement of cyber-crime laws, as well as tools used for network security. (3-0-3)

PA 539
Local Government Management

Examines the governmental structure in which public safety administrators work and studies the interrelationship of public safety administrators with the rest of the organization. The leadership and management roles of public safety officials, finances and budgeting in local government, and ethics in the profession will be examined. (3-0-3)

PA 542
Strategic Planning

Designed to present practical, cost-effective techniques that can be used to make better decisions regarding the allocation of scarce resources. Includes problem identification, goal development, data needs and collection, generation of alternative solutions, projecting impacts, goals-oriented evaluation and strategies for implementation. Prerequisite: PA 501. (3-0-3)

PA 543
Public Policy, Nonprofits, and Philanthropy

Examines the long history of charitable giving across the globe, with special emphasis on the United States. In particular this course will focus on the philosophical roots of philanthropy, organized giving, and the role philanthropy has played in the development of modern public policy, as it pertains to health and human services. (3-0-3)

Graduate Program in Public Administration

PA 551
Public Infrastructure Management
Considers the status and operation of public infrastructure facilities in the United States generally and in the Chicago metropolitan area, with particular attention to the responsibilities and roles of the public works manager. Explores the relationships between the engineering, administrative and political aspects of public works management. Focuses on critical infrastructure issues through case studies. (3-0-3)

PA 552
Human Services Policy and Administration
Examines the major issue associated with the administration and operation of social welfare and health services in the United States by governments and nonprofit organizations. Designed for students who work in such agencies and for those who have regular contact with them or their clientele. Structure, funding, staffing and other operating characteristics are examined. (3-0-3)

PA 553
Public Safety Administration
Deals with contemporary public safety and security management in communities for public safety professionals, public administrators and law enforcement officials who deal with public safety issues, existing in post-9/11 American society. Examines the relationship between police/public safety policy, operations and administration. Addresses various current problems and issues through case studies. Focuses mainly on the City of Chicago and surrounding metropolitan area. (3-0-3)

PA 555
Introduction to Urban and Regional Planning
Governmental and private sector activities that influence the maintenance and development of the built environment. Students learn both quantitative and qualitative analysis and are introduced to planning systems incorporating fiscal analysis, social analysis, transportation analysis, demographic and economic analysis. They will also learn about various processes providing participation and citizen input to the development of plans for the built environment. Regulatory tools covered include zoning, comprehensive plans, neighborhood planning and subdivision regulation. (3-0-3)

PA 556
Tools of Government
In the United States, an increasing proportion of the goods and services traditionally provided by governmental employees in the context of a governmental bureaucracy are now provided by outside contractors, or through indirect means such as social, economic regulation, tax policy, loan guarantees, vouchers, and manipulation of incentives for the private sector. This course is intended to provide students with an understanding of various tools used by governments throughout the West as the traditional rule based bureaucracy is replaced by other types of institutions and other means to provide goods and services traditionally provided by government. (3-0-3)

PA 557
Urban and Regional Development
Covers materials on infrastructure management, and the interrelationship of infrastructure management to urban and regional development. The course acquaints students with the increasing role of the private sector in infrastructure maintenance, development, and management. Students learn various analytic techniques useful for officials responsible for urban and regional development (including development of new infrastructure) and for the continuing maintenance and management of existing infrastructure. Students learn analytic techniques relating to management and planning. (3-0-3)

PA 558
Energy and Environmental Policy
Places energy and environmental policy in domestic and global contexts. Traces the economic and political implications of dependence on fossil fuels and the attempt to develop alternate energy sources and promote conservation. Assesses the environmental effects of resource consumption and the effort to control these effects by increased efficiency and regulation of pollution. Explores such problems such as nuclear waste, acid rain, global warming, and deforestation. Examines national and international attempts at economic, political, and technological solutions. (3-0-3)

PA 559
Issues in Globalization
Globalization has become a powerful buzzword in social science and in popular discourse. This course utilizes a sociological perspective to examine the economic, socio-political, and cultural aspects of globalization within the context of contemporary debates about the phenomenon. (3-0-3)

PA 560 Political Economy
An introduction to political economy exploring the relationship between economy and government or political system. Role of the state, role of the market, impact of the economic ideologies on political and economic systems will be examined. Structure of political and economic interests and the mediating effects of institutions on political and economic outcomes will be examined. Normative issues connected to ideal political and economic institutions and appropriate political and economic institutions and outcomes will be examined. (3-0-3)

PA 561
The Political Process and Administration
Addresses the relation between democratic institutions and processes of American politics and the administrative agencies of government. Examines obligations of citizenship, influence of private interests on public purposes, and effects of demographic, economic and technological change on self-government. (3-0-3)

PA 562
Urban and Metropolitan Government
Analyzes the decision-making process in urban and metropolitan governments. Emphasizes the role of elected and appointed officials, business, organized labor, community organizations and the electorate. Also focuses on the major problems of city-suburban relations. (3-0-3)

PA 565
The Nonprofit Sector
Considers the role played by the non-profit sector in the larger American society and economy. Topics include major organizational forms, financial management, human resource policies, leadership, board-executive relations, and private-public connections. (3-0-3)

PA 566
Nonprofits and the Public Sector
Provides an overview of the complex and important relationship between government and non-profits. This course includes a review of the history, funding schemes, the differences between grant and contract funding, recent trends, and much more. (3-0-3)

PA 567
Regulatory Policy and Politics
Examines the changing role of government regulation of private and public activities from a political and administrative perspective. Explores the reasons for growth and reform of economic and social regulation. Investigates the regulatory process, including standards for rule-making and the involvement of organized groups and the courts. (3-0-3)

PA 568
Seminar on International Business and Government
The course provides public sector managers a foundation for understanding key marketing and strategy topics from a private sector managers' perspective, so that public sector managers gain perspective into the private sector decision-making process in a globalizing environment. The course traces and compares the evolution of industrial systems in different countries, and the role of public policy in emerging industrial clusters in an international context. The underlying forces driving the development and internationalization of business systems will be explored, and the implications for corporate and public policy makers will be emphasized. (3-0-3)

PA 577
Topics in Public Management
A reading and seminar course on a contemporary topic in public administration or policy. Subject matter will change in successive offerings of the course. May be taken more than once. (Credit: Variable)

PA 579
Ethics & Professional Responsibility in Public Service
Focuses on the ethical problems and issues faced by individuals in public service organizations. Examines questions related to corruption, abuse of power, financial impropriety, ethics codes and standards in government and professional fields, whistle-blowing, and many other topics related to front-page concerns and individual problems of conscience and judgment. Traces the growth of concern about the standards of ethical behavior in government in the U.S. (3-0-3)

PA 590
Internship in Public Administration
Supervised practical experience in public administration. May be taken only by students lacking extensive work experience in governmental administration. Prerequisites: PA 501 and departmental permission. (Credit: Variable)

PA 592
Directed Readings in Public Administration
Consists of independent reading and analysis centered on particular problems and supervised by a member of the public administration faculty. Prerequisite: Instructor's consent. (Credit: Variable)

PA 597
Special Problems
Subject matter will vary with the interests and background of the students and the instructor. May be taken more than once. (Credit: Maximum of six hours)

PA 600
Continuation of Residence.
(0-0-1)

Stuart School of Business

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Master of Business Administration:
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Environmental Management:
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Finance & Financial Markets:
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John Bilson

Marketing Communication:
Sanford Bredine

Ph.D. in Management Science:
M. Zia Hassan

Business at IIT

Established in 1969 at IIT with a gift from Chicago financier Harold Leonard Stuart, the school offers a wide range of intellectually challenging business and management programs taught from a practical perspective, with an emphasis on analytic skills and the relation between business and technology. AACS-accredited programs include the M.B.A., Ph.D., and four industry-responsive master's programs.

In addition to their scholarly and teaching activities, faculty members are consultants to major national and international corporations. Their expertise has been called upon by local and federal government agencies, including the Environmental Protection Agency, National Institute of Standards and Technology, Metropolitan Sanitary District, Department of Housing and Urban Development, and Department of Energy. Most IIT Stuart students are working professionals from Chicago's business and finance communities. International stu-

dents are 41 percent of the student population, contributing global perspectives to classes and extra curricular activities. Student resources include an Office of Career Services, which is available to current students and alumni; computer resources, including more than 200 student workstations; an interactive computer teaching lab featuring the latest industry software; and the Stuart Business Library.

The Stuart School of Business follows an academic calendar of four quarters, beginning in August, November, February and May. Because a majority of Stuart students work full time, most classes meet once a week in the evenings. Courses are also offered in the daytime and on weekends. All programs offer classes at our Downtown Campus. Part-time and other M.B.A. programs are also offered at IIT's Daniel F. and Ada L. Rice Campus in Wheaton, 35 miles southwest of Chicago.

Degrees Offered

Master of Mathematical Finance *(collaborative program with the Department of Applied Mathematics)*
Master of Business Administration
Master of Science in Environmental Management

Master of Science in Finance
Master of Science in Financial Markets
Master of Science in Marketing Communication
Doctor of Philosophy in Management Science

Stuart School of Business

Dual-Degree Programs

M.B.A./M.S. in Environmental Management
M.B.A./M.S. in Finance
M.B.A./M.S. in Financial Markets
M.B.A./M.S. in Marketing Communication

With the Institute of Design
M.Des/M.B.A.

**With the IIT Graduate Program
in Public Administration:**
M.B.A./Master of Public Administration

With the IIT Chicago-Kent College of Law:
J.D./M.B.A.
J.D./M.S. in Environmental Management
J.D./M.S. in Financial Markets

Graduate Certificate Programs

**Graduate Management
Certificates**
Entrepreneurship
Financial Management
Information Management
International Business
Management Science
Marketing
Operations, Quality, and Technology
 Management
Strategic Management of
 Organizations

Graduate Certificates
E-Business
Environmental Management
Healthcare Management
Healthcare Marketing
 Communication

Financial Markets Certificates
Alternative Investments
Electronic Trading
Financial Markets
Financial Programming
Portfolio Management

Research Facilities

The Downtown Campus Libraries are an open-stack collection of more than 525,000 volumes, including the holdings of the Stuart Business Library, the Chicago-Kent Law Library, and the Library of International Relations, which contains international materials in history, economics, political science and law. IIT Stuart's downtown facility is equipped with four computer labs, offering more than 200 student workstations linked to the Internet and networked with IIT libraries (including the Downtown Campus Libraries). The computer lab provides access to a wide range of business software and resources. The Quantitative Research Lab provides an interactive learning environment, featuring simulated trading, investment analysis and financial industry databases.

The **Center for Financial Markets** provides a unique focus on four interrelated spheres of knowledge needed by any professional who works for a financial intermediary or other capital market institution: financial markets, trading, financial engineering, and information technol-

ogy. The Center supports Stuart School's M.S. in Financial Markets program and offers related certificate programs online and on-site; promotes scholarship and linkages to Chicago's financial industry, assists faculty and students to contribute actively to projects in electronic trading, risk management, and new derivative products development. Michael Gorham, director, can be reached at 312.906.6520 or gorham@stuart.iit.edu.

The **Chicago Center for Sustainable Enterprise** has as its mission "to identify, develop, communicate, and help implement practical and equitable business strategies that advance the ecological sustainability of the Chicago area while fostering current and future economic viability." The Center brings together many disciplines at IIT in a collaborative relationship with business corporations, other academic institutions, government agencies, and members of the NGO community. George Nassos, director, can be reached at 312.906.6543 or gnassos@stuart.iit.edu.

Stuart School of Business

Faculty

Martin L. Bariff, Associate Professor. B.A., M.A.S., Ph.D., University of Illinois, Urbana-Champaign. Impact of information technology on business strategy, organizational structure, management controls and human decision-making.

John Bilson, Professor of Finance. B.Econ, Monash University, Australia; M.Econ, Monash University, Australia; Ph.D., University of Chicago.

Keith Black, Assistant Professor. B.A., Whittier College; M.S., Carnegie Mellon University, A.B.D. Illinois Institute of Technology.

Sanford A. Bredine, Senior Lecturer, B.A., Trinity College, M.B.A., University of Chicago. Marketing and marketing communications.

Deborah Cernauskas, Visiting Assistant Professor. B.S., Northern Illinois University; N.S., Northern Illinois University Graduate School; M.B.A., Illinois Benedictine College; Ph.D., Illinois Institute of Technology.

Eliezer Geisler, Professor. Ph.D., Northwestern University. Organizational behavior, health care technology management, management of information and telecommunication technology, strategic management.

Joel Goldhar, Professor. B.Ch.E., Rensselaer Polytechnic Institute; M.B.A., Harvard University; D.B.A., George Washington University. Computer-integrated manufacturing, the impact of technology on business strategy.

Michael Gorham, Assistant Professor. B.A., University of Notre Dame; M.S., University of Wisconsin; M.S., University of Florida; Ph.D., University of Wisconsin

Charles T. Hamilton, Clinical Associate Professor. B.S., M.A.S., Ph.D., University of Illinois, Urbana-Champaign. Accounting education, the behavioral factors that influence audit judgment.

M. Zia Hassan, Professor. B.Sc., University of Punjab (Pakistan); M.S., Ph.D., Illinois Institute of Technology. Effective organizations, strategic and quality issues in organizations.

Kamyar Jabbari, Senior Lecturer. B.S., Towson State University; M.B.A., University of Chicago. Project financing, international banking and independent power production.

Harvey Kahalas, Professor of Organizational Management, Dean. B.S., Boston University; M.B.A., University of Michigan; Ph.D., University of Massachusetts. Economic development, organizational competetiveness.

Michael Kelly, Assistant Professor. B.Sc. (Hons), Sydney University; Ph.D. in Applied Mathematics (Queing Theory), University of NSW, Australia.

Nasrin R. Khalili, Assistant Professor and Academic Director, Environmental Management. B.Sc., M.S.P.H., Tehran University (Iran); Ph.D., Illinois Institute of Technology. Atmospheric chemistry, environmental impact analysis, environmental system analysis, and waste engineering.

Thomas W. Knowles, Professor. B.S., Purdue University; M.B.A., Ph.D., University of Chicago. Mathematical and computer modeling.

Michael K. Ong, Professor and Director of Finance and Financial Markets. B.S. Physics, University of the Philippines, M.A. Physics, M.S. Applied Mathematics, Ph.D. Applied Mathematics, State University of New York at Stony Brook. Risk management- market risk, credit risk, operational risk and regulatory issues. International finance and capital markets. Financial risk modeling.

Paul R. Prabhaker, Associate Professor, Associate Dean and Academic Director, Marketing Communication Program. B.Tech., M.B.A., Indian Institute of Technology (India); M.S., Ph.D., University of Rochester. Advertising-price interaction, Technology/Marketing interface.

Nick T. Thomopoulos, Research Professor. B.S., M.A., University of Illinois, Urbana-Champaign; Ph.D., Illinois Institute of Technology. Forecasting, inventory, assembly line systems.

Khairy A. Tourk, Professor. B.S., University of Alexandria (Egypt); M.A., Vanderbilt University; Ph.D., University of California, Berkeley. Evolution of the Asian enterprise, economics of the newly industrializing Asia.

Benjamin Van Vliet, Lecturer. B.A., Calvin College; M.Sc., Illinois Institute of Technology.

Russell Wojcik, Lecturer. B.S., SUN College at Oneonta; M.S., Clarkson College of Technology.

Admission Requirements

Admission to the Stuart School of Business is based on a profile combination of undergraduate GPA, GMAT test scores (some M.S. programs accept GRE scores in place of GMAT scores), and work experience. Applicants to all master's programs, including the M.B.A., must have, or are expected to have completed prior to enrollment, a four year undergraduate degree from an accredited institution. Applications are accepted throughout the year, and part-time students may enter most programs at the beginning of any quarter. Applicants must submit essays, letters of recommendation, official transcripts, a recent GMAT score report, and a summary of work experience. Applicants from non-English-speaking countries must also submit TOEFL (Test of English as a Foreign Language) scores of at least 600 (250 computer), unless they received an undergraduate or graduate degree from an accredited U.S. institution. Applicants who score less than 600 must enroll in "English for International Students" during their first quarter.

Completion of a diagnostic mathematics exam is required for all incoming students in the M.S. in Financial Markets and related certificate programs. Based on the performance on this exam, additional prerequisite courses may be required.

Applicants to the Ph.D. program in management science must have completed a master's degree and with a graduate level business core, or a Master's in Finance or equivalent degree. For applicants who have a master's degree but have not completed the business core, some prerequisite courses will be required.

Master of Business Administration (M.B.A.)

To meet your interests and needs, IIT Stuart offers a choice of four M.B.A. programs: the Full-Time M.B.A. program, the Flexible M.B.A. program, the Accelerated M.B.A. program, and the Fast-Track M.B.A. program.

Full-Time M.B.A. Program
The 20-course curriculum requires completion of eight core courses, four concentration electives from one of 10 areas of concentration, seven open electives, and a required capstone course in Business Policy. Students may also complete a specialization, consisting of six courses. A 16-course General Management version of this program, which does not require the four concentration electives, is also offered. Courses are offered in the daytime and evenings at the Downtown Chicago campus.

Flexible M.B.A. Program
This part-time program is designed to accommodate the needs of working professionals. Classes meet one evening each week at the Downtown Chicago campus. Students complete 20 courses including: eight core courses, four concentration electives, seven open electives, and a capstone course in Business Policy. Students may also complete a specialization, consisting of six courses. A 16-course General Management version of this program, which does not require the four concentration electives, is also offered.

Accelerated M.B.A. Program
A one-year full-time M.B.A. for recent graduates of U.S. colleges and universities, the program requires completion of 16 courses, including eight core courses, seven elective courses, and a capstone course in Business Policy.

Fast-Track M.B.A. Program
This two-year part-time program for mid-career professionals is offered only at IIT's Rice Campus in Wheaton. The cohort program consists of 16 courses (two courses per quarter in a sequenced order over eight quarters). Courses are offered either on Saturdays or on weeknights.

Stuart School of Business

Master of Business Administration Curriculum

Core courses

MBA 510	Financial and Managerial Accounting
MBA 520	Organizational Behavior
MBA 530	Managerial Economics
MBA 540	Statistical Methods
MBA 550	Managerial Finance
MBA 560	Marketing Management
MBA 570	Operations Management
MBA 580	International Business

Capstone course

MBA 590	Business Policy

M.B.A. Concentration Courses

Entrepreneurship

ENT 510	Global Future Practices in Entrepreneurial Management
ENT 520	Forming New Ventures and the Value-Creation Process
ENT 530	Strategic Marketing Management of New Ventures
ENT 540	Financing New Ventures and Venture Capital

Financial Management

FIN 520	Corporate Finance
FIN 521	Investment and Portfolio Management

Two of the following:

FIN 524	Cases in Financial Engineering and Policy
FIN 525	Financial Risk Management
IB 525	International Finance

Any designated course from the M.S.F. and M.S.F.M. programs

Financial Markets

FM 503 Introduction to Investments

Two of the following:

FM 500 Global Financial Markets

FM 502 Global Market Economies

FM 505 Futures and Futures Markets

Healthcare Management

HM 500	Management of Health Care
HM 510	Health Care Systems and Technology
HM 520	Health Informatics
HM 530	Organization, Policy and Strategic Management of Health Systems

Information Technology Management

IM 510 Strategic Management of Information Technology

IM 512 Management of Enterprise Data

Two of the following:

IM 514 Data Mining

IM 516 Marketing in the Networked Economy

IM 518 Supply Chain Management

International Business

IB 515	International Trade
IB 560	The Global Enterprise in the Competitive Environment

Two of the following:

ECON 513	Macroeconomics in the Global Economy
IB 525	International Finance
MKT 548	International Marketing

Management Science

MSC 535	Models for Decision Making
MSC 545	Spreadsheet Modeling
MSC 571	Advanced Data Analysis
OM 530	Inventory, Logistics & Supply Chain Management

Marketing

MKT 541	Marketing Research
MKT 544	Strategic Marketing

Two of the following:

MKT 545	Industrial Marketing
MKT 548	International Marketing
IM 516	Marketing in the Networked Economy

Any designated course from the M.S. Marketing Communications Program

Marketing Communication

MC514 The Marketing Communication Plan

MC520 Understanding the Target Audience

Two of the following:

MC 502 Brand Management

MC 516 Marketing and Advertising Research

MC 524 Creative Strategies

MC 546 Communication Strategy in the Digital Environment

MC 552 Marketing Strategy in the Digital Environment

Any other MCOM course based on advisor's recommendation.

Operations, Quality, and Technology Management

OM 522	Management of Manufacturing and Service Enterprises
OM 510	Operating Systems Design & Management

Two of the following:

OM 530	Inventory, Logistics, and Supply Chain Management
QLM 512	Quality Management
TM 510	Strategic Management of Technology and Innovation
MSC 535	Models for Decision Making

Stuart School of Business

Strategic Management of Organizations

MGT 555	Industry Structure and Competitive Strategy
MGT 553	Organization Leadership and Management of Change

Two of the following:

MGT 585	Integrated Functional Management
MGT 576	Individual Effectiveness
TM 510	Strategic Management of Technology and Innovation
MGT 545	Business Information and Management Control
ACCT 501	Financial Statement Analysis
ACCT 506	Cost Management
ECON 513	Macroeconomics in the Global Economy
MGT 551	Organization Design and Theory
MGT 557	Management and Development of Human Resources

MGT 556	Legal, Ethical, and Political Issue in Business
IB 560	The Global Enterprise in the Competitive Environment
MGT 565	Project Management

Sustainable Enterprise

EM 507 Industrial Ecology
EM 590 Business Strategy: The Sustainable Enterprise

Two of the following:

EM 515 Decision Tools for Environmental Management
EM 520 Contemporary Issues and Global Sustainability
EM 530 Energy, Environment and Economics

Specializations consisting of six courses, are available in selected areas.

Master of Science in Environmental Management

14 courses

The Master of Science in Environmental Management—among the best of such programs in the nation—integrates law, science and business to answer the increasing demand for a uniquely trained management professional who understands the many complex dimensions of environmental issues today, with an emphasis on sustainability.

To provide the program's interdisciplinary perspective, Stuart combines aspects of IIT's renowned Department of Chemical and Environmental Engineering and Chicago-Kent College of Law's pioneering program in environmental and energy law. The program prepares students for executive and management environmental positions in corporations, government agencies, consulting firms and not-for-profit organizations. The program is supported by the Stuart School's recently founded Center for Sustainable Enterprise. The mission of this resource center is to identify, develop, communicate and help implement practical and equitable business strategies to advance the ecological sustainability of the Chicago area while fostering current and future economic viability.

The master's curriculum consists of 14 courses: eight required core courses, four elective courses (at least three of which must be business electives), and two required capstone courses. Two prerequisite courses are required of students who have not taken college-level chemistry and calculus or their equivalents. Students who already have either an M.B.A. or an undergraduate business degree may substitute other recommended graduate management courses for all or some of the business electives.

Prerequisite Courses

EM 500	Fundamentals of Environmental Science
EM 503	Applied Mathematics for Environmental Managers

Required Core Courses

EM 501	Environmental Law and Regulation I
EM 502	Environmental Law and Regulation II
EM 506	Environmental Risk Assessment & Management
EM 507	Industrial Ecology
EM 508	Air and Water Pollution Control
EM 509	Solid and Hazardous Waste Management
EM 511	Industrial Health and Safety
EM 515	Decision Tools for Environmental Management

Required Capstone Courses

EM 512	Environmental Monitoring and Compliance
EM 590	Business Strategy: The Sustainable Enterprise

Elective Courses

Business Electives

MBA 510	Financial & Managerial Accounting
MBA 520	Organizational Behavior
MBA 530	Managerial Economics
MBA 550	Managerial Finance
MBA 560	Marketing
MBA 570	Operations Management
MBA 580	International Business

Technical Electives

EM 520	Contemporary Issues & Global Sustainability
EM 530	Energy, Environment & Economics
EM 597	Independent Study

Stuart School of Business

Master of Science in Finance

The IIT Stuart Master of Science in Finance Program features a leading-edge curriculum. Specific courses necessary to complete the MS Finance degree requirements must be taken from the following list of twenty-one courses:

Economics Sequence
MSF 511   Financial Economics I
MSF 512   Financial Economics II
MSF 513   Financial Theory

Financial Modeling Sequence
MSF 521   Financial Modeling I
MSF 522   Financial Modeling II
MSF 523   Financial Modeling III

Corporate Finance Sequence
ACCT 501   Financial Statement Analysis
MSF 532   Corporate Finance
MSF 533   Marketing of Financial Products

Investments Sequence
MSF 541   Valuation and Portfolio Management
MSF 542   Structured Fixed Income Portfolios
MSF 543   Quantitative Investment Strategies

Risk Management Sequence
MSF 551   Futures, Options and OTC Derivatives
MSF 552   Market Risk Management
MSF 553   Enterprise Risk Management

Financial Econometrics Sequence
MSF 561   Financial Time Series Analysis
MSF 562   Econometric Analysis
MSF 563   Bayesian Inference in Econometrics

Computational Finance Sequence
MSF 571   Computational Finance I
MSF 572   Computational Finance II
MSF 573   Computational Finance III

Core Requirement
In order to obtain a general foundation in business and applied finance, students must take the following six core courses: MSF 511, MSF 521, ACCT 501, MSF 541, MSF 551, and MSF 562. These courses are shown in bold in the list above.

Specialization Requirement
In order to achieve in-depth understanding of specific areas of business and applied finance, students are required to complete at least two sequences from the seven sequences listed above.

Concentration Requirement
To gain a competitive advantage in the market place, students are strongly encouraged to pursue at least one concentration. Students graduating with a concentration will be duly recognized in the degrees they earned, for example, "Master's of Science in Finance" will appear only on their Diploma, while "Master's of Science in Finance with Concentration in XX" will appear on their official transcript.

In order to graduate with a concentration, students must complete one of the following prescribed curricula:

Concentration	Curriculum	Number of Courses
Risk Management		
	Core Requirement	6 courses
	Risk Management Sequence	2 courses
	Financial Modeling Sequence	2 courses
	Investments Sequence	2 courses
	Open Electives	2 courses
		14 courses
Corporate Finance		
	Core Requirement	6 courses
	Corporate Finance Sequence	2 courses
	Economics Sequence	2 courses
	Risk Management Sequence	2 courses
	Open Electives	2 courses
		14 courses
Quantitative Finance		
	Core Requirement	6 courses
	Financial Modeling Sequence	2 courses
	Computational Finance Sequence	3 courses
	Risk Management Sequence	2 courses
	Programming Track in M.S. Financial Markets	3 courses*
		16 courses

*The Programming Track in the M.S. Financial Markets curriculum consists of three required courses, namely, FM 492, FM 530 and FM 538, of which only FM 538 counts toward the degree program.

Important Note: Both FM 492 and FM 530 are additional requirements for graduation with a Quantitative Finance concentration. Students with a bachelors or masters degree in a technology related field may be relieved of these prerequisites, provided they show proof of taking accredited courses in Visual Basic C++ programming or commensurate professional experience.

Course Substitutions
To the extent that students have completed commensurate coursework or professional experience, substitutions to the required curriculum may be permitted, with the approval of the academic advisor.

Free Electives
Up to two electives may be taken from outside the courses prescribed above. These electives may be taken from other offerings of the Stuart School of Business, the Chicago-Kent College of Law, or the Main Campus graduate programs, provided that: (1) they are consistent with the M.S. Finance program's objectives; and (2) they have been approved, prior to the student's registration, by the Program Director of the M.S. Finance program.

A "prerequisite course" that is not part of the Finance Program curriculum will not be counted toward a student's program of study. For example, a "prerequisite course" may either be a formal prerequisite, such as MBA 510 which is a formal prerequisite for ACCT 501, or an informal prerequisite such as a basic math course which is an informal prerequisite for MSF 511.

Master of Science in Financial Markets

Introduced in 1992, the Master of Science in Financial Markets (FM) is the nation's oldest and most prestigious graduate degree program focusing exclusively on modern capital markets. Designed at the request of and in collaboration with industry leaders, the program provides an intellectual framework for understanding how financial markets are structured, regulated and interconnected in the U.S. and around the world. Some courses in the program are offered online as iCourses.

In order to earn the M.S. Financial Markets degree from the Stuart School of Business, a student must complete at a minimum, a fourteen-course program of study. Specific courses necessary to complete the M.S. Financial Markets degree requirements must be taken from the following list of courses:

Prerequisite Sequence

FM 490	Math for Financial Markets
FM 491	Statistics for Financial Markets
MBA 510	Financial and Managerial Accounting

Core Sequence

FM 502	Global Market Economics
FM 503	Introduction to Investments
FM 505	Futures and Futures Markets
FM 506	Options and Options Theory
FM 507	Quantitative Methods in Financial Markets
FM 508	Statistical Methods in Financial Markets

Investments Sequence

FM 520	Equity Valuation
FM 521	Global Investment Strategy
FM 522	Portfolio Management and Mutual Funds
FM 523	Financial Statement and Security Analysis

Alternative Investments Sequence

FM 524	Hedge Funds
FM 525	Real Estate Investment Analysis
FM 592	Enterprise Formation and Finance

Trading Sequence

FM 543	Market Analysis
FM 545	Advanced Options Trading Strategy
FM 544	Equity Trading Strategies
FM 546	Fixed Income Trading Strategies

Derivatives Sequence

FM 532	Equity & Equity Derivatives Modeling
FM 533	Term Structure & Interest Rate Derivatives Modeling
FM 545	Advanced and Options Trading Strategies

Programming Track

FM 492	Introduction to C/C++ Programming for Financial Markets
FM 530	Visual Basic & Databases for Financial Markets
FM 538	Advanced OOP for Financial Markets

Course Substitutions

To the extent that students have completed commensurate coursework or professional experience, substitutions to the required curriculum may be permitted, with the approval of the academic advisor.

Core Requirement

In order to obtain a general foundation in financial markets, students are required to take the following six courses in the Core Sequence: FM 502, FM 503, FM 505, FM 506, FM 507, FM 508. These courses are listed above in bold.

Specialization Requirement

In order to achieve in-depth understanding of specific areas of financial markets, students are required to complete at least two sequences from the five sequences listed above.

Stuart School of Business

Concentration Requirement

To gain a competitive advantage in the market place, students are strongly encouraged to pursue at least one concentration. Students graduating with a concentration will be duly recognized in the degrees they earned, for example, "Master of Science in Financial Markets" will appear only on their Diploma, while "Master's of Science in Finance with Concentration in XX" will appear on their official transcript.

In order to graduate with a concentration, students must complete one of the following prescribed curricula:

Concentration	Curriculum	Number of Courses
Financial Markets		
	Core Sequence	6 courses
	Trading Sequence	3 courses
	Derivatives Sequence	3 courses
	Open Electives	2 courses
		14 courses
Investments		
	Core Sequence	6 courses
	Investments Sequence	4 courses
	Alternative Investments Sequence	3 courses
	Open Electives	1 course
		14 courses
Financial Engineering		
	Core Sequence	6 courses
	Programming Track	3 courses*
	Derivatives Sequence	3 courses
	Choose from (MSF 522, 523, 552, 553)	
	or Financial Econometrics Sequence	
	or Computational Finance Sequence	
	of the M.S. Finance Program)	4 courses
		16 courses

Important Note: Both FM 492 and FM 530 are additional requirements for graduation with a Financial Engineering concentration. Students with a bachelor's or master's degree in a technology related field may be relieved of these prerequisites, provided they show proof of taking accredited courses in Visual Basic and C++ programming or commensurate professional experience.

Free Electives
Up to two electives may be taken from outside the courses prescribed above. These electives may be taken from other offerings of the IIT Stuart School of Business, the Chicago-Kent College of Law, or the Main Campus graduate programs, provided that: (1) they are consistent with the M.S. Financial Markets program's objectives; and (2) they have been approved, prior to the student's registration, by the Associate Director of the M.S. Financial Markets program.

A prerequisite or 400 level course that is not part of the Financial Markets curriculum will not be counted towards a student"s graduate program of study. For example, a "prerequisite course" may either be a formal prerequisite, such as MBA 510 which is a formal prerequisite for FM 523, or an informal prerequisite such as a basic math course which is an informal prerequisite for FM 507 or FM 508.

* Programming Track consists of three required courses, namely, FM 492, FM 530 and FM 538, of which only FM 538 counts toward the degree program.

Master of Mathematical Finance (MMF)

(Collaborative Program with the Department of Applied Mathematics)

21.6 quarter credits
18 semester credits

The objective of the MMF program is to provide individuals interested in pursuing careers in financial risk management with advanced education in theoretical, computational and business aspects of relevant quantitative methodologies. This is a collaborative program between the Stuart School of Business (SSB) and the

Applied Mathematics Department (AM) and as such, it will give the students the chance to benefit from the strength of both units.

For specific course requirements, see the description on page 55.

Course Substitutions
To the extent that students have completed commensurate coursework or professional experience, substitutions to the required curriculum may be permitted, with the approval of the academic advisor.

Stuart School of Business

Master of Science in Marketing Communication

The marketing communication program offers the student three distinct curriculum paths: (1) marketing communication graduate degree with a concentration in communication management; (2) marketing communication graduate degree with a concentration in electronic marketing; (3) marketing communication graduate degree with a concentration in health care.

Each path is grounded in a group of common core courses. The student completes these courses and chooses the preferred concentration. IIT Stuart's marketing communication program teaches a strategy-driven approach that integrates advertising, public relations, database marketing, promotion and other marketing tools using the latest technology and quantitative research methods. The program provides recent college graduates and professionals working in the field with the background needed to plan, manage, implement and assess marketing communication programs at advertising agencies, public relations firms, communication departments in corporations, government and not-for-profits, convention industry firms, design companies and small total marketing businesses.

The M.S. curriculum consists of 14 courses, structured to emphasize the function of objectives and strategy in the marketing communication process. If students demonstrate a mastery of such areas as media planning, promotion or direct marketing, advanced placement is available. Students may then choose from relevant electives in other Stuart or IIT courses or an independent study course. Consent of the program director is required. Students may begin in any quarter and may take up to six years to complete a degree.

Master of Science in Marketing Communication Curriculum

Required core courses

MC 510	Marketing Foundations
MC 514	The Marketing Communication Plan
MC 516	Marketing and Advertising Research
MC 520	Understanding the Target Audience
MC 522	Media Strategy and Implementation
MC 524	Creative Strategies
MC 526	The Database as Marketing Tool
MC 530	Direct Marketing

Communication Management Concentration Courses

MC 532	Sales Promotion Techniques
MC 534	Fundamentals of Public Relations
MC 536	Practicum
MC 552	Marketing Strategy in Digital Environment

Electronic Marketing Concentration Courses

MC 546	Communication Strategies in Digital Environment
MC 551	Business Strategy in Networked Economy
MC 552	Marketing Strategy in Digital Environment
MC 554	Customer Relationship Management

Healthcare Marketing Concentration Courses

MC 521	The Healthcare Consumer
MC 511	Healthcare Marketing Strategies
MC 577	The Healthcare Marketplace

Free Electives (any two)

MC 502	Brand Management
MC 504	Account Planning
MC 512	Organization Dynamics
MC 528	Writing & Presentation Skills
MC 532	Sales Promotion Techniques
MC 534	Fundamentals of Public Relations
MC 536	Practicum
MC 538	International Marketing Communication
MC 546	Communication Strategies in Digital Environment
MC 551	Business Strategy in Networked Economy
MC 552	Marketing Strategy in Digital Environment
MC 554	Customer Relationship Management
MC 563	Web Page Design

Stuart School of Business

Doctor of Philosophy in Management Science

17 courses:
    Six required core courses
    (21.6 quarter credit hours)
    Eight elective courses in area of interest
    (28.8 quarter credit hours)
    Three adviser-approved open electives
    (10.8 quarter credit hours)
Optional practicum in teaching and curriculum
    (one quarter credit hour)
Qualifying exam upon completion of core coursework
Comprehensive exam upon completion of all coursework
Research (32.4 quarter credit hours)
Submission of dissertation
Oral defense of dissertation

The Ph.D. in Management Science Program at IIT prepares students and working professionals for careers in university teaching and research and for executive and management positions in business, government and consulting firms. Approximately half of the program's graduates have chosen academic careers.

The program is selective and small with a high degree of interaction between faculty and students and a mentor relationship with a faculty adviser. The Ph.D. Area Committee carefully matches the interest of the student with the expertise of the faculty member. The program offers two concentrations: Operations and Finance.

Operations Concentration

At the IIT Stuart School of Business, operations is taught as the design and implementation of systems that improve the efficiency and effectiveness of organizations. Candidates in the program learn to understand how the optimization of resources—people, technology, finance and information—can be effectively integrated for competitive advantage. Management today realizes the value of operations in any organization, whether it produces products or provides services.

Areas of research in operations pursued by faculty and students include design of quality systems, strategic quality management, forecasting, materials management, scheduling, optimization, capacity planning, manufacturing strategy, and strategic management of manufacturing firms.

Finance Concentration

The Ph.D. with a finance concentration is offered only as part of the Master of Science in Finance/Ph.D. Dual Degree Program, unless the applicant has earned a finance degree that is equivalent to the program at IIT

Stuart, as determined by the program director. Students in this dual degree program may earn both an M.S. in Finance and a Ph.D. in Management Science.

Stuart School of Business

Ph.D. Program of Study

IIT requires that at least three quarters of study be completed on a full-time basis. The quarters need not be consecutive but must occur within the six years prior to the awarding of the degree. Research may be done off campus if suitable arrangements for supervision can be made. Upon a student's admission to the program, the dean of the Stuart School appoints the student an adviser. The adviser helps the student to formulate an overall plan of study, including coursework, reading, independent study, and a plan of research, which must be approved by the dean of the Stuart School.

Upon completion of core coursework, a written qualifying examination is required. The qualifying examination is diagnostic in purpose, and the school determines its form and scope. After completion of all coursework, a written comprehensive examination is required. This examination is a rigorous review of the level of competency achieved as a result of the entire program of graduate study (except for the dissertation) as approved by an advisory committee and specified in the program of study. There may also be an oral component to the comprehen-

sive examination. Qualifying or comprehensive examinations may be taken only twice.

When a student is ready to begin research, he or she is appointed a mutually acceptable research adviser by the dean of the Stuart School. A research project must be an original investigation of high quality, and the results must be submitted in the form of a dissertation and of a related publishable paper. After submitting a completed dissertation, the student will appear before an oral thesis defense committee composed of at least four full-time faculty members, one of whom will be a representative from outside the student's field. There must be a period of at least 12 months between the date of the comprehensive examination and the final defense.

Students may take up to six years to complete the degree. After six years, students may petition for an extension, but they must reapply to the program and may be required to retake a comprehensive examination. A cumulative GPA of 3.0/4.0 in an approved program of study is required for the Ph.D. program.

Doctor of Philosophy in Management Science Curriculum

Required core courses

ECON 570	Microeconomic Theory
MSC 538	Simulation
MSC 549	Advanced Spreadsheet Modeling
MSC 560	Optimization Techniques I
MSC 570	Probability and Statistics
MSC 571	Data Analysis

Elective courses (select eight)

MSC 534	Queueing
MSC 550	Topics in Quality Management
MSC 554	Scheduling Theory
MSC 562	Optimization Techniques II
MSC 564	Optimization Techniques III
MSC 573	Time-Series Analysis
MSC 595	Research Seminar
MSC 596	Special Topics Seminar
MSF 511	Financial Economics I
MSF 512	Financial Economics II
MSF F13	Financial Theory
MSF 521	Financial Modeling I
MSF 522	Financial Modeling II
MSF 523	Financial Modeling III

MSF 532	Corporate Finance
MSF 533	Marketing of Financial Products
MSF 541	Valuation and Portfolio Management
MSF 542	Structured Fixed-Income Portfolios
MSF 543	Quantitative Investment Strategies
MSF 551	Futures, Options and OTC Derivatives
MSF 552	Market Risk Management
MSF 553	Enterprise Risk Management
MSF 561	Financial Time-Series Analysis
MSF 562	Econometric Analysis
MSF 563	Bayesian Inference in Econometrics
MSF 571	Computational Finance I
MSF 572	Computational Finance II
MSF 573	Computational Finance III
MSF 596	Research Seminar in Finance

Open electives

Three adviser-approved electives should be selected from the remaining elective courses or from other curricula at IIT.

Practicum (optional)

MSC 576	Teaching and Curriculum Skills

Stuart School of Business

Dual-Degree Programs

Several dual-degree programs are offered, including three in which enrollees are eligible to earn a law degree from IIT Chicago-Kent College of Law. To help plan a program of study, students will be assigned advisers from both programs in which they are studying. Simultaneous enrollment is required for varying periods of time, depending on programs. Students should consult advisers from both programs for further information. Candidates for a dual-degree program must apply to and be accepted by each program separately. Current LSAT scores are required for admission to Chicago-Kent College of Law. Current GMAT scores are required by the Stuart School of Business, but current LSAT scores may be substituted in some programs. Interested students should contact program advisers from either program for other specific requirements.

M.B.A./M.S. in Environmental Management

The M.B.A./M.S. in Environmental Management is designed to prepare professionals for management-level positions in corporations, government agencies and consulting firms. Students typically select one of the 10 M.B.A. concentrations to advance their specific professional goals in the environmental field.

For example, a student who wishes to focus on global concerns could combine the environmental management degree with an M.B.A. concentration in international business. An M.B.A. with an operations management concentration would be especially useful to students interested in the effects of the production of goods on the environment. A combination of 16 M.B.A. courses plus 12 M.S. in Environmental Management courses, for a total of 28 courses, makes up the dual curriculum. Both degrees are usually earned in three years of full-time study or in five years of part-time study. Dual enrollment can reduce degree requirements by as many as four courses.

M.B.A./M.S. in Financial Markets

The M.B.A./M.S. in Financial Markets program is designed for students and working professionals who wish to pursue a career in the financial markets at the managerial or executive level. Both degrees are usually earned in three years of full-time study or in five years of part-time study. A combination of 16 M.B.A. courses plus 12 M.S. in Financial Markets courses, for a total of 28 courses, makes up the dual curriculum. Students may select any M.B.A. concentration, except finance. Dual enrollment can reduce degree requirements by as many as four courses.

M.B.A./M.S. in Finance

The M.B.A./M.S. in Finance program is designed for students and working professionals who wish to pursue a career in finance at the managerial or executive level. Both degrees are usually earned in three years of full-time study or in five years of part-time study. A combination of 16 M.B.A. courses plus 12 M.S. in Finance courses, for a total of 28 courses, makes up the dual curriculum. Students may select any M.B.A. concentration, except finance. Dual enrollment can reduce degree requirements by as many as four courses.

M.B.A./M.S. in Marketing Communication

The M.B.A./M.S. in Marketing Communication program is designed to prepare students and working professionals who wish to pursue a career in marketing at the managerial or executive level at advertising agencies, public relations firms, and marketing firms or in the functional area of marketing at corporations. A combination of 16 M.B.A. courses plus 12 M.S. in Marketing Communication courses, for a total of 28 courses, makes up the dual curriculum. Both degrees are usually earned in three years of full-time study or in five years of part-time study. Dual enrollment can reduce degree requirements by as many as four courses.

Stuart School of Business

M.Des./M.B.A.

Offered in conjunction with the IIT Institute of Design, the Master of Design / Master of Business Administration (MDes/MBA) dual degree program combines graduate professional education in both design and business. The first program of its kind in the world, IIT's MDes/MBA marks an important milestone in the co-evolution of design, management, and innovation. The dual degree will require students to take 14 MBA courses and 47 credit hours of design courses.

M.B.A./Master of Public Administration

The Master of Public Administration program, designed for the working professional, emphasizes the formulation of policy, the acquisition of human and financial resources, and the application of sound methods of management in public and nonprofit organizations. The M.B.A./M.P.A. is ideal for students who intend to work in an environment that combines aspects of both public- and private-sector management and for those who expect to move between business and government positions during their career. Both degrees are usually earned in three years of full-time study or in five years of part-time study. A combination of 16 core courses (nine M.B.A. and seven M.P.A.) and nine electives (five M.B.A., two M.P.A. and two chosen from either program), for a total of 25 courses, makes up the dual curriculum. Dual enrollment can reduce degree requirements by as many as six courses.

J.D./M.B.A.

The J.D./M.B.A. program is offered in conjunction with Chicago-Kent College of Law. The management expertise and business skills that participants acquire in the M.B.A. program can be important skills in the legal profession. A solid understanding of the business world can be invaluable in many areas of law, especially for corporate attorneys or legal/management consultants. An M.B.A. degree prepares lawyers for management responsibility in their firm. Both degrees are usually earned in four years of full-time study or five-and-a-half years of part-time study. Dual enrollment can reduce degree requirements by as many as 10 courses (five law and five M.B.A.).

J.D./M.S. in Environmental Management

The Environmental Management (EM) Program integrates managerial and technical skills into Chicago-Kent's renowned Environmental and Energy Studies Program. This dual program is particularly well integrated because the two schools worked closely together to design the Environmental Management Program and faculty are drawn from both schools. Both degrees are usually earned in four years of full-time study or in 5.5 years of part-time study. Dual enrollment can reduce degree requirements by as many as nine courses (five EM and four law).

J.D./M.S. in Financial Markets

Offered in conjunction with the Chicago-Kent College of Law, this dual degree program is designed for students who wish to specialize in securities and commodities law for a law firm, brokerage firm, commodity exchange or trading company. Students gain a unique perspective on the economics of financial products and markets that are used to advise clients, to propose regulation, or to litigate.

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Course Descriptions

Numbers in parentheses represent class, lab and total credit hours, respectively.

ACCT 501
Financial Statement Analysis

After reviewing the content of the major financial statements, the course examines ratios, inventories, long-lived assets, income taxes, debt, leases, and pensions, among other topics. U.S. practices are compared to practices in other major countries. This course is intended for those who will examine financial statements of outside organizations. Prerequisite: MBA 510 or consent of instructor. (3.6, 0, 3.6)

ACCT 506
Cost Management

This course builds upon the management accounting foundation presented in MBA 510. Competitive strategy is linked with the following managerial topics: activity based costing, the theory of constraints, strategic decision-making, management and operational control, cost estimation, budgeting, and cost allocation. This course is intended for those who will use accounting information within their own organization. Prerequisite: MBA 510 or consent of instructor. (3.6, 0, 3.6)

ECON 513
Macroeconomics in the Global Economy

A survey of macroeconomics for business planning. Topics include an analysis of the forces determining the level of national income and employment, the relationship between the government and the private sector, theories of consumption and investment, the tools of monetary and fiscal policies, and the effect of the international open economy on the U.S. economy. Prerequisite: MBA 530 or consent of instructor. (3.6, 0, 3.6)

ECON 570
Microeconomic Theory

A systematic exposition of basic mathematical methods as they are related to microeconomic analysis. Topics include economic models, comparative statics, optimization, supply and demand, the economics of production market structure, and resource allocation. (3.6, 0, 3.6)

EM 500
Fundamentals of Environmental Science

An introduction to the basic scientific knowledge needed to understand the nature of environmental problems and to quantify them. The course reviews the current state of technology of environmental control in its application to water, air and land pollution. Topics include an examination of human-induced environmental problems (population growth, industrialization, energy consumption) and the role of technology in dealing with these; quantifying environmental problems using principles of physics, chemistry, microbiology, epidemiology and environmental ecology; and the technological control of environmental problems water supply, water pollution, air pollution, solid and hazardous waste. Local and global examples of environmental problems and solutions are discussed. (3.6, 0, 3.6)

EM 501
Environmental Law and Regulation I

This course will introduce students to the major federal and state statutes and regulatory programs that govern pollution from industrial, commercial, and public sources. The course will emphasize the organization of the government regulatory agencies, the techniques of environmental regulation, the interplay of federal and state environmental regulation, environmental enforcement, and environmental litigation. The National Environmental Policy Act (NEPA), the Clean Water Act, Safe Drinking Water Act, and the Endangered Species Act will be the main statutes used to illustrate the workings of the pollution control statutes. The role of environmental law in the international arena will also be discussed. (3.6, 0, 3.6)

EM 502
Environmental Law & Regulations II

This course is a continuation of EM 501. It will emphasize the organization of government regulatory agencies, the techniques of environmental regulation, the interplay of federal and state environmental regulation, environmental enforcement, and environmental compliance. The Clean Air Act, Solid Waste Disposal Act (and Resource Conservation and Recovery Act, RCRA), Toxic Substances Control Act (TSCA), Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) will be the main statutes used to illustrate the workings of pollution control statutes. (3.6, 0, 3.6)

EM 503
Applied Mathematics for Environmental Managers

This course is an overview of the fundamentals of calculus and statistics with applications in solving environmental problems. The course begins with a general discussion of linear and non-linear equations, logarithms and exponents and moves into differential and integral calculus with emphasis on applications. Other modules include linear programming, probability and statistics. (3.6, 0, 3.6)

EM 506
Environmental Risk Assessment and Management

This course presents a multidisciplinary approach for identifying, evaluating, and managing risks from environmental contaminants and technological hazards. The use of risk assessment and risk management as tools for setting scientifically sound, risk-based priorities is evaluated. In addition, a conceptual framework for environmental health risk management is examined as an integrated strategy for addressing multiple sources of risk. (3.6, 0, 3.6)

EM 507
Industrial Ecology
Industrial ecology is the study of the material and energy flows that stem from industrial and consumer activities and the regulatory, political, economic, technical, and social issues that intertwine these activities. By examining these relationships, industrial ecologists strive to bring environmental concerns into harmony with economic development. (3.6, 0, 3.6)

EM 508
Air and Water Pollution Control
This course provides a comprehensive review of the most current and advanced control technologies used for management of air, water, and wastewater pollutants. Prerequisites: EM 500 and EM 503 or consent of instructor. (3.6, 0, 3.6)

EM 509
Solid and Hazardous Waste Management
This course offers a comprehensive review of current and advanced physical, chemical, and biological methods of solid and hazardous waste management and disposal. Prerequisites: EM 500 and EM 503 or consent of instructor. (3.6, 0, 3.6)

EM 511
Industrial Health and Safety
This course is designed to fulfill educational needs for enhancing safety and health, a basic necessity in the industrial workplace. The requirements of the Occupational Safety and Health Administration (OSHA), increased employer liability, and worker awareness of implications of an unsafe and unhealthy work environment, will be discussed. The major elements of hazard evaluation and control, workplace hazard control, worker-machine interaction, occupational injury and diseases, and process alterations are examples of topics covered in this course. (3.6, 0, 3.6)

EM 512
Environmental Monitoring and Compliance
This course is designed to familiarize students with the environmental manager's duties in permitting, reporting, record-keeping, and sampling. It emphasizes a systematic approach to identifying a source's obligations with respect to each regulated media and activity and developing appropriate responses. Obligations under United States environmental laws and their relationship to state and local laws are considered as a model for analysis and response. The role of environmental manager is examined through extensive use of experienced environmental managers as guest lecturers, coupled with a laboratory visit, lectures by the teacher, course materials, research assignments on the computer, and a final project where the course lessons are applied. (3.6, 0, 3.6)

EM 515
Decision Tools Environmental Management
This course will deal directly with innovative methods and technologies to institutionalize systems that allow managers to use their assets—human, financial, physical, and natural—in an optimum manner. Students will apply what they learn to assess problems and propose solutions to manage assets related to business operations, environmental management, and community development. Approximately half of the course will involve hands-on training using mapping technologies and other analytical tools. Work will includes individual study as well as team project assignments. (3.6, 0, 3.6)

EM 520
Contemporary Issues and Global Sustainability
The increasing complexity of environmental problems warrants an integrated multidisciplinary approach to developing management strategies for local, regional, and global sustainability. This course provides an analysis of significant environmental issues currently facing multinational corporations and

government agencies. Representative topics include macrosustainable development, pollution prevention, urban sprawl and brownfields, resource efficiency, and global climate change. (3.6, 0, 3.6)

EM 530
Energy, Environment and Economics
This course deals with the linkage of energy, environmental and economic issues. The impact of energy supply and end-use on human well-being and the ecosystem is covered. It also includes a comprehensive approach to the resolution of resource, technical, economic, strategic, environmental, socio- and geopolitical problems of the energy industries. In addition, pathways to a sustainable global energy system are presented. (3.6, 0, 3.6)

EM 590
Business Strategy: The Sustainable Enterprise
Integrates environmental management issues with use of strategic planning tools for assessing and responding to competitive and social forces. The course looks at the challenge of corporations competing in the global economy of the new millennium in such a way that will allow the planet to support them indefinitely. Emphasis is on the company's ability to build and sustain a competitive advantage utilizing traditional management concepts as well as new sustainability practices. Topics include a review of the systems approach, The Natural Step, the "servicizing" concept, base of the pyramid strategy, and various case studies showing how an enterprise can meet its sustainable goals consistent with its financial and market goals. (3.6, 0, 3.6)

ENT 510
Global Future Practices in Entrepreneurial Management
This course is designed to provide a broad perspective of the end-to-end processes that constitute the architecture of successful entrepreneur-founded and managed business. Students will study the history of the business sector in North

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America and the contributions of entrepreneurs to the economy. In addition, students will recognize the emergence of "strategy" as the intellectual driving force that networks all activities of the firm into a coordinated, interactive, efficient, and effective force with a high probability of dominating the firm's chosen markets. This course also integrates the narrower perspectives of the core courses and provides a framework for selecting elective courses in areas that relate specifically to each student's career goals.

ENT 520
Forming New Ventures and the Value-Creation Process

This course explores the core of the formation of new ventures: the systematic, structured, iterative process of identification of opportunities to enter markets, dictate market structure, establish a sustainable competitive advantage, and dominate markets. At the beginning, this course focuses on new product development, and then progresses to the concepts of value migration, value creation, and value bundles. These concepts are examined from both a strategic and financial perspective. (Prerequisite: ENT 510.)

ENT 530
Strategic Marketing Management of New Ventures

This course provides students the opportunity to apply their knowledge and skills to the role of a CEO or as a member of a firm's executive management team in the role of a senior decision maker. This is a pure management course that requires the effective and efficient application of all cross-functional and interdisciplinary knowledge and skills associated with the senior management function. The course uses an Internet-based, game theoretical computer simulation as its principle pedagogical tool. The scope and scale of the simulation covers the dynamics and functions of real world markets and firm activities. Traditional strategic analysis, game theory, and the concepts (not the math) underlying real options theory are used to analyze simulation outcomes. Management teams are

self-organizing. Teams consist of one to four students. (No prerequisites)

ENT 540
Financing New Ventures and Venture Capital

This is an experiential course that provides students with a basic understanding of the financial market sub-system that are the source of private equity financing for new ventures. The course focuses on the interactions among early stage commercialization processes, early stage entrepreneurship, early stage firm formation, and the private equity markets. All of the ideas, heuristics, concepts, principles, and theories discussed in ENT 540 are studied from a 'systems' perspective that places more emphasis on the interactions between system components than a detailed understanding of the individual components. The course is grounded in concepts developed at Babson College, Stanford Graduate School of Business. Management teams are self-organizing. Teams consist of one to four students based upon student preferences. (No prerequisites)

FIN 520
Corporate Finance

This course builds on the introduction to managerial finance presented in MBA 550. Topics include estimating cash flows, capital budgeting under uncertainty, raising debt and equity capital, financial restructuring, and financial risk management. Prerequisite: MBA 550. (3.6, 0, 3.6)

FIN 521
Investment and Portfolio Management

This course is concerned with security valuation and portfolio management. Topics include security pricing, measurement of risk and return, mean-variance portfolio analysis, the capital asset pricing model, factor models, and arbitrage pricing models. Asset classes and portfolio strategies commonly used by global portfolio managers are also studied. Prerequisite: MBA 550 or consent of instructor. (3.6, 0, 3.6)

FIN 524
Cases in Financial Engineering and Policy

This course surveys the reasons why corporations use financial products. The course prepares students to work either on the sell-side in banks and financial institutions or on the buy-side at corporations and investment funds. Prerequisites: FIN 520, FIN 521. (3.6, 0, 3.6)

FIN 525
Financial Risk Management

This course focuses on recent developments in the management of exposure to market risk, credit risk, operational risk, etc. Also, an introduction to the products used for risk management, including forwards, options, swaps, caps, collars and floors. (3.6, 0, 3.6)

FM 490
Math for Financial Markets

This course reviews pre-calculus and calculus. Topics include algebra, logarithms, analytic geometry, functions, matrices, differentiation, integration, and partial derivatives. Students do problems in class to reinforce theory and examples. Quizzes, homework and a written final exam. (3.6-0-3.6)

FM 491
Statistics for Financial Markets

An introduction to basic concepts of probability and statistics, including data presentation, probability theory, discrete random variables, expected value, variance, correlation, the normal distribution, estimation, confidence intervals, hypothesis testing, and simple linear regression. (3.6-0-3.6)

FM 492
Intro. to C/C++ Programming for Financial Markets

This course presents the ANSI C++ programming language. Students will study program design, including functions, arrays and strings, pointers, dynamic memory management, data structures and the Standard Template Library. Object-oriented design will be discussed, including the design and use of classes, overloading, inheritance and polymorphism. The focus will be to understand OOP concepts as they are applied to financial markets.

FM 500
Global Financial Markets

This course will enable the student to understand the basics of financial markets and how they function in the global arena. The student will learn how the equities market, the bond market, the money market, the foreign exchange market and the derivatives markets are set up and operate. We will focus on the instruments, the players, the jargon, the details of the trade, and the institutional framework for each market. We cover both OTC and exchange-traded markets, and explore the dramatic transformation of these markets. The student will learn how each of these markets operates in the US, but will also learn how practices differ in Europe, Asia and Latin America.

FM 502
Global Market Economics

This course provides the foundation necessary to analyze the impact of economic developments on financial markets and trading strategies. Topics include fiscal and monetary policy; interest rates; central banks; commercial banks; international trade and currency markets; economics statistics including inflation, GDP and unemployment; supply and demand analysis; Keynesian and classical economics; business cycles; business structures and decision making; and economic forecasting. Students write an economic analysis of a current market issue. (3.6-0-3.6)

FM 503
Introduction to Investments

This course focuses on the theoretical basis of finance. The fundamentals of interest rates, present value, and portfolio theory are explored. Included will be a discussion of the ways in which basic cash market instruments and derivative products affect investment return. The topics include intertemporal choice, utility bond theory, the capital asset pricing model, and the dividend discount model. The mathematics of bond pricing and the components of return are discussed. The theories of the yield curve are reviewed. Highlights include the separation theorem and the Modigliani-Miller propositions. (Prerequisites: FM 507 and FM 508.)

FM 505
Futures and Futures Markets

This course provides a comprehensive study of futures and futures markets from a variety of perspectives - theoretical, operational, evolutionary, domestic and global. Students who successfully complete this course will have an understanding of the theory of futures contract pricing, a working knowledge of how these instruments are used for pricing and risk management, and a familiarity with the breadth and diversity of the global futures markets (i.e., the products traded on them, their economic role, the issues faced by market participants and possible developments in the years ahead). Following a discussion of theoretical and operational issues in the first three classes, the remaining classes focus on uses of futures contracts in the principal product groups (i.e.; agricultural/metals/energy, short-term interest rates, long-term interest rates, stock indices and foreign currency.) (Prerequisite: FM 507.)

FM 506
Options and Options Theory

This class presents both a practical and theoretical approach to options markets. Included is an in-depth examination of the most important option pricing models and the factors that determine option prices. Also studied is the role of options in controlling risks, the relationship between an option and its underlying instrument, and the relationship of options to futures and warrants. This course explains the different roles played by investors/ hedgers, speculators and market makers, the different strategies each employs, and the different view each has of risk. The course surveys the international markets for trading options, both on and off exchanges. Prerequisites: FM 507, FM 508. (3.6-0-3.6)

FM 507
Quantitative Methods in Financial Markets

This course explains and puts to use the different mathematical and statistical techniques for understanding the financial markets. The focus of the course is on the quantitative tools necessary to understand investment theory, portfolio analysis, and the modeling of options. The course concentrates on some specific areas in probability and statistics and differential and integral calculus that are important for asset pricing and risk management. Prerequisite: FM 490 if required.

FM 508
Statistical Methods in Financial Markets

This course, a survey of statistical methods and concepts, prepares students for quantitative courses in the FM program. The course focuses on statistical inference and forecasting methodologies, including regression and time series analysis. The course makes extensive use of Excel in solving statistical problems as well as an introduction to using @Risk for Monte Carlo simulation. Prerequisite: FM 491 if required. (3.6-0-3.6)

FM 520
Equity Valuation

This course covers the various models available for equity valuation. It includes discussions of the dividend discount model, Porter analysis, DuPont decomposition of ROE, sustainable growth rates, earnings quality and accounting fraud, and relative valuation measures such as price/earnings and price/sales. The major deliverable for this course is a comprehensive analysis of a public company, modeled after the well-known Merck case study. Also required is a complete analysis of a convertible bond. (Prerequisite: FM 503 and FM 523.)

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FM 521
Global Investment Strategy
This course provides an integrated framework describing the investment process in global markets. We start with explanations of what moves the foreign exchange markets and the forecasting techniques to predict currency moves. Discussions include the benefits of international diversification, and studies in global equity markets, emerging markets stocks and bonds, and the global bond markets. The conclusion of the course includes building global portfolios including equities, fixed income instruments, alternative and emerging investments, and currency hedges. Prerequisites: FM 503, FM 508. (3.6-0-3.6)

FM 522
Portfolio Management and Mutual Funds
This course will allow the student the opportunity to add the practical business knowledge of portfolio management to their previous theoretical background. Topics include: mutual fund and hedge fund history, structure and objectives; portfolio management policies for individual and institutional investors; asset allocation, portfolio construction; optimization, reversion and trading, equity and fixed income portfolio management strategies; risk measurement, hedging and the use of derivatives in funds; performance measurement and attribution; industry analysis and sector funds. Prerequisites: FM 503, FM 508. (3.6-0-3.6)

FM 523
Financial Statements and Security Analysis
This course develops financial analysis skills from the view of an outsider using a corporation's publicly available financial statements. Techniques such as common-size statements, ratio analysis, decomposition, and use of the comprehensive DuPont and Z-score models are used as a basis to teach analytical thought processes necessary to make projections for a company based on its financial statements. Nontraditional ratio analysis for an industry, adjustment of financial statements to

reflect accounting choices, and forecasting future operating results by business segment are also covered. The student will also learn and work with alternative valuation models, including the dividend discount model and the growth model to value a company. Finally the student will learn about unique industry issues as the case study approach covers three companies in different industries. The use of spreadsheets as an analytical tool will be strongly emphasized, including use of a graphing template to compare a company's ratios to industry ratios. Prerequisite: MBA 510 or consent of instructor. (3.6-0-3.6)

FM 524
Hedge Funds
This course explores hedge funds and how they differ from regulated mutual funds. Topics covered include hedge fund business models and legal structures, performance and fee calculations, and risk management techniques. Further, students practice alternative trading strategies such as distressed investing, event-driven trading, convertible, fixed income, and merger arbitrage, and relative value, equity hedged, and market neutral strategies. Prerequisite: FM 503 or MSF 541. (3.6, 0, 3.6)

FM 525
Real Estate Investment Analysis
This course will introduce students to real estate ownership and financing. The importance of legal issues will be discussed, including zoning, types of ownership, taxes, and development regulations. The course may include several case studies to enhance students' skills in evaluating the economics of proposed real estate development projects. As a part of these studies, students will analyze compound interest, mortgage loans, amortization, and internal rates of return to support their investment decisions. Finally, students will understand the importance of capital markets and institutional investment in real estate, including mortgage-backed securities, conduit, loans, and Real Estate Investment Trusts (REITs). Prerequisite: FM 503. (3.6, 0, 3.6)

FM 530
Visual Basic and Databases for Financial Markets
This course is designed to provide students with a comprehensive knowledge of the VB.NET programming environment that includes object oriented design using the .NET Framework. It will also cover relational database design, SQL, XML and the Unified Modeling Language. These tools will be used to create financial models using real time and historical market data. Students will develop financial applications using advanced Visual Basic tools. (Prerequisite: FM 506.)

FM 532
Equity & Equity Derivatives Modeling
This course focuses on the fundamental and statistical techniques for modeling equity securities, equity options, and equity index futures and options. Students deepen skills in the analysis of price behavior, the valuation of options and the links between financial markets and fundamental economic factor. The course features extensive, hands-on use of Visual Basic and databases. Prerequisites: FM 506. (3.6-0-3.6)

FM 533
Term Structure and Interest Rate Derivatives Modeling
This course focuses on techniques for modeling fixed income instruments and interest rate-sensitive derivative products. Students deepen skills in the analysis of option embedded bonds using OAS models, mean reversion, path dependent securities using multinomial models, swaps principal component analysis and mortgage backed securities. This course also covers term structure theory and several spot rate models. This course is built around a series of laboratory studies. (Prerequisite: FM 506 and FM 508)

FM 536
Financial Time Series Analysis
This course develops a portfolio of techniques for the analysis of financial time series. Students will receive a brief overview of topics associated with technical analysis, including filters, moving averages and channels.

They will then study ARIMA modeling and forecasting and analysis of non-linear time series models. Finally, the course will conduct an indepth review of volatility estimation and forecasting models including the GARCH family and stochastic volatility models. (Prerequisites: FM 503, 507 and 508.)

FM 538
Advanced OOP for Financial Markets

After reviewing C++ programming techniques and object oriented design, students will learn to use Visual C++.NET to build advanced financial applications and automated trading systems. Topics include multithreading, sockets, APIs, synchronization and the Unified Modeling Language. Substantial amounts of homework will be assigned and students will be expected to design and develop an original term project combining, into a C++ application, topics in quantitative finance and trading strategy presented in other courses. (Prerequisites: FM 530 and FM 492 or equivalent.)

FM 543
Market Analysis

Technical analysis is based on the assumption that markets are neither efficient nor random and that valuable information can be found in the study of price movements and changes in volume and open interest. This course will study different charting techniques (candlestick, point and figure, close-to-close, etc.) as well as interpretive methodologies, such as moving averages, market indicators, oscillators, and patterns. If history does repeat itself, it is important to recognize when it is happening. (Prerequisites: FM 505 and FM 506.)

FM 544
Equity Trading Strategies

This course will provide students with an opportunity to learn the latest Equity Trading Strategies used by large banks, brokerages and hedge funds. The instructor will present strategies on equity option trading, pairs trading, program and basket trading, risk arbitrage trading, structured product trading, and dispersion trading (time permitting). Equity trading theory and practical examples will be discussed. Students will be required to structure and adapt equity trading positions based on a range of actual and theoretical market conditions. In addition, students will collaborate with each other and the course instructor to analyze and evaluate the implementation of the above-mentioned strategies. (Prerequisites: FM 503, FM 505 and FM 506.)

FM 546
Fixed Income Trading Strategies

This course will present basic trading concepts related to fixed income instruments. Also covered will be the analysis of repos and fixed income derivatives, such as forwards and futures, options and spreads. Trading strategies will be discussed, including yield curve strategies, basis trading, and various types of spread trading using many different instrument types. Students will make trading decisions and modify their portfolios in order to familiarize themselves with the instruments and techniques introduced. Swaps, Swaptions, Caps and Floors will be introduced, time permitting. (Prerequisite: Both FM 505 and FM 506, or MSF 551)

FM 545
Futures and Options Trading Strategies

This advanced trading course provides students with an opportunity to develop and manage market positions utilizing commodities, currency and fixed income futures and options. Students will research these markets then design, implement and manage market positions based on both current and simulated market data. Students will access market information and implement their positions using the Microhedge trading system. Along with the instructor and classmates, students will track their results and assess trading decisions. Prerequisite: both FM 505 and 506 or MSF 551. (3.6-0-3.6)

FM 592
Enterprise Formation & Finance

This course is a model for entrepreneurs who want to form and finance business enterprises. A team of experienced entrepreneurs, venture capitalists and lawyers guide students as they create vision statements and strategic concepts; design business models; evaluate business incubators; construct staffing and compensation schemes; practice valuation analysis; compare and contrast alternative financial sources; structure business plans; compose offering documents; determine securities to offer; examine private placement processes; analyze negotiation strategies; and review the implications of financing terms. (3.6-0-3.6)

FM 597
Independent Study

This course involves directed research arranged on an ad-hoc basis between a student and a full-time faculty member willing to sponsor the work. Eligible activities must include a substantial academic component and result in a work product, such as a paper or report that can be evaluated for its quality under traditional academic standards. The student and the sponsoring professor must have regular contact during the quarter for which credit is given to evaluate progress. Practical projects, tied to the industry, are welcomed, but the practical, work aspects must be tied to a body of theory and be linked by a work product as described. Credit may vary, depending on the nature of the activity, but may not exceed the number of quarter-hours associated with a regular course. (Prerequisite: Instructor's consent)

HM 500
Management of Health Care

This course is an introduction to the topic of health management. The course covers such areas as the unique attributes of the field of health care, and the basic concepts and practices used by managers in healthcare delivery organizations and in related components of the sector. Some topics of current interest include leadership, organization design, and decision processes in health delivery organizations. (3.6, 0, 3.6)

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HM 510
Health Systems and Technology
This course focuses on understanding the role that health and medical technology plays in health organizations. As a major cause of health expenditures, technology is considered a major component of health delivery, management and policy. Topics include: innovations and their impacts on health organizations and the evaluation of medical technologies. (3.6, 0, 3.6)

HM 520
Health Informatics
The use of information technology (IT) in health organizations is the focus of this course. Students learn about IT as an enabler of health delivery and management. Topics include computerized medical records, telemedicine, and other applications of informatics. (3.6, 0, 3.6)

IB 515
International Trade
A survey of major economic issues affecting international trade. Topics include the theory of international economics, tariff protection, foreign investment, balance of payments, commodity agreements, and OPEC and international monetary institutions. (3.6, 0, 3.6)

IB 525
International Finance
A comprehensive study of international financial markets and currencies. Topics include the nature of foreign exchange risk, determination of exchange rates, Eurocurrency markets, international investments, and the use of futures and options contracts to hedge exchange rate risk. Prerequisite: MBA 550. (3.6, 0, 3.6)

IB 560
The Global Enterprise in the Competitive Environment
An analysis of the challenges facing multinational business. Topics include the influence of cultural, political, and economic factors on the decision-making process; the strategy of foreign involvement; the interaction between national industrial policies and global enterprises; and the differences between U.S. multinationals and their counterparts in Europe and Asia. (3.6, 0, 3.6)

IM 510
Strategic Management of Information Technology
This course addresses the use of information technology (IT) to improve global business strategy and performance in this digital age. Topics include leveraging IT for competitive advantage, IT as an enabler of organizational change, the management of business knowledge, applications systems architecture and business processes, and IT governance, structure and outsourcing. Includes the essentials of application development including systems analysis and forms (Web page) design. Case studies and projects reinforce this desired business-technology alignment theme. (3.6, 0, 3.6)

IM 512
Management of Enterprise Data
This course teaches structured management of cross-functional data to improve business operations and decisions. It addresses the design of Web and legacy databases, and data warehouses. Some specific topics include alternative data models, embedded business rules, data validation, and SQL queries. These design issues will be studied through exercises with database software. Prerequisite: IM 510. (3.6, 0, 3.6)

IM 514
Data Mining
The digital enterprise enables significantly more data about customers, suppliers, and partners to be captured. The challenge, however, is to transform this vast data repository into actionable business intelligence. Data mining can provide valuable business insights. A leading data mining tool, e.g., SPSS's Clementine will be used to investigate hypotheses and discover patterns in enterprise data repositories. Both data cleaning and analyses, e.g., decision trees, neural networks, and clustering, will be discussed and applied to sample data. Case studies will address business analytics system implementation and benefit measurement challenges.

IM 516
Marketing in the Networked Economy
Consumer and business buying behavior through the Internet presents new challenges and opportunities. For example, a single Web site including products partnered with other companies provides consumers a new, interactive product category shopping space (e.g., car purchasing with financing, insurance, repair and auto club options). Thus planning for value propositions, pricing, banding, promotion, and sales channels will be re-examined. Web site visitor behavior and e-mail content also offer new sources for market research analyses. Case studies will illustrate these new marketing strategies. Prerequisites: IM 510 or MC 551. (3.6, 0, 3.6)

IM 518
Supply Chain Management
This Course examines the flow of goods, services, and information in a global economy. It introduces and describes the challenges of optimal supply chain management, and presents and integrated framework for analyzing demand, fulfillment, manufacturing, and transportation in any industry. Prerequisite: IM 510. (3.6, 0, 3.6)

IM 520
Emerging Technologies and Competitive Advantage
In this digital age, faster information and communications technology innovations are a significant factor for business survival and growth. Business strategy models, in particular, must be re-examined to blend with the need for a highly adaptive enterprise. Emerging technologies and their impacts on business strategies, processes, employees, and information technology infrastructure will be addressed. Case studies will facilitate discussion of these changes. Prerequisite: IM 510. (3.6, 0, 3.6)

MBA 510
Financial and Managerial Accounting

An introduction to the basic financial and managerial accounting topics: GAAP, the major financial statements, accrual accounting, financial reporting alternatives, financial statement analysis, cost behavior, cost systems, short- and long-term decision-making and product costing. (3.6, 0, 3.6)

MBA 520
Organizational Behavior

Builds awareness and understanding of the behavior of individuals and groups in organizations, preparing managers to be more effective within their organizational contexts. Topics include individual differences in motivation, perception, culture and learning style; group and organizational dynamics; and the impact of organizational structure and culture on behavior. Leadership techniques for influencing other organizational members, creative problem-solving and decision-making, ethics and values-based managing are covered. This course helps students relate basic theories, concepts, and techniques to real-world situations through the extensive use of case studies. (3.6, 0, 3.6)

MBA 530
Managerial Economics

The behavior of firms and households and the determination of prices and resource allocation in a market economy. Topics include empirical demand, production and cost functions, monopoly, oligopoly, and pricing practices. (3.6, 0, 3.6)

MBA 540
Statistical Methods

Statistical methods and their application to managerial decision-making. Topics include probability, sampling, estimation, hypothesis testing, linear regression, and goodness-of-fit tests. (3.6, 0, 3.6)

MBA 550
Managerial Finance

An introduction to the basic concepts and practices used by managers in making financial decisions. Topics include cash flow analysis, capital budgeting, short- and long-term financial planning, cost of capital, financial leverage, and dividend policy. (3.6, 0, 3.6)

MBA 560
Marketing Management

Introduction to marketing concepts, processes, functions and institutions. Topics include economic and behavioral foundations of marketing, market segmentation, product positioning, marketing mix (including product, price, channel, distribution, and communication factors), the product life cycle, and linkages with the company's other functional areas. (3.6, 0, 3.6)

MBA 570
Operations Management

The course focuses on decisions to be made by operating managers in managing the technology, capital, and human resources of organizations in the process of producing goods and services. Topics include: equipment, technology, and process selection; product/process integration and innovation and the basic tools required for process design; work force, materials, and quality management; and aggregate planning and scheduling. (3.6, 0, 3.6)

MBA 580
International Business

A study of the major issues in international business. The main objective of the course is to prepare managers to function effectively in the global business environment. Topics include the sociocultural, economic, and political forces facing business, exchange rate determination, hedging, international sourcing and production, wholesaling, retailing, and commercial documentation. Contemporary issues are analyzed, including the rise of Pacific Rim nations, the European Union, and developments in NAFTA. (3.6, 0, 3.6)

MBA 590
Business Policy

An integrative approach to the role of the general manager and the tasks of creating an effective business unit: crafting strategy; designing and maintaining an organization for implementing strategy; leadership and change management; and corporate governance. The course is designed around a model of the "fit" between industry structure—business strategy, organization design, and financial, operational and behavioral outcomes—and the complex task of maintaining that "fit" over time. Special attention is paid to drivers of change and sources of complexity, such as size, market diversity, and rate of growth. Case studies are used to develop total organization perspectives, to focus on individual leadership and management skills, and to emphasize the linkages between theory and practice. As the capstone course of the MBA program, this course must be taken during the final quarter. Prerequisite: Consent of adviser. (3.6, 0, 3.6)

MC 502
Brand Management

The most valuable assets that company has are the brands that firm has invested in and developed over time. This is true for large conglomerates as well as small start-up companies. Students will learn the concept of organizing marketing activities and P&L responsibility around the introduction, promotion and optimization of brands and brand portfolios. Students will learn how consumer beliefs and attitudes regarding a brand or business often cannot be easily reproduced. Like people, brands have their own individual personality. This differentiation drives the ability for a brand to grow and expand or it could limit a company's potential if not managed effectively. (3.6, 0, 3.6)

MC 504
Account Planning

This will be a course based heavily on the practice of creating insights for advertising strategy through qualitative research and relationship development with the consumer. The end products are well-rounded insightful creative strategies that lead to effective and more dynamic creative. The role of account planning has become an increasingly

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primary function in the development of excellent marketing communications. Account planning exists for the sole purpose of creating advertising that truly connects with consumers. Account planners are the strategists that represent the voice of the consumer within advertising agencies. They are a critical link between the client objectives, account management and the creative development team. (3.6, 0, 3.6)

MC 510
Marketing Foundations

This course teaches students how to develop and evaluate marketing plans. Topics include: how to interpret overall company business plans; how products/services are designed, created, tested, produced, priced, positioned and distributed; market segmentation and product life cycles; the economic foundations of marketing; and sales and cost-benefit analyses. Marketing models and case studies are employed. (3.6, 0, 3.6)

MC 511
Healthcare Marketing Strategies

This class sharpens strategic skills to enable students to develop successful strategies to target specific segments of the diverse healthcare audiences. Students will learn to segment the healthcare audience into more manageable universes that permit tailoring the message to the audience; to analyze the purchase cycle dynamics as they apply to the healthcare consumer, the healthcare provider and the healthcare dispenser at wholesale and retail; and to develop a working knowledge of the marketing communication tools available and their strengths and weaknesses in effectively reaching the diverse healthcare target audiences. (3.6, 0, 3.6)

MC 512
Organization Dynamics

In this course, students learn to integrate and manage the people, departments, skills, and activities involved in the marketing communication process. Interpersonal communication, decision-making and perception, and attitude formation are studied. The course guides students through the skills needed to manage an enterprise where working members of a team have different sets of expertise. Case histories and role-playing are employed to illustrate problems and their solutions. (3.6, 0, 3.6)

MC 514
The Marketing Communication Plan

In this course, students learn how to develop and write and to evaluate marketing communication plans that effectively integrate a mix of communication channels. Based on a competitive analysis, the major elements of a communication plan are put in place: media, message, target audiences, testable objectives, and budgets. Students learn to measure consumer and business target audiences by their demographic and psychographic characteristics and to analyze the style and appeal of messages within campaigns. Students learn how to develop a balanced marketing communication plan that includes print and TV ads, as well as sales literature and direct marketing, and promotional and public relations materials. (3.6, 0, 3.6)

MC 516
Marketing and Advertising Research

An introduction to the purposes and methods of research. The course concentrates on how research provides critical information for marketing and communication decisions. Topics include identification of the research problem, research design, data-gathering techniques, sampling procedures, data analysis, and report preparation. The course exposes the student to basic statistical methods. Students learn how to critically read and evaluate a market or consumer research study. (3.6, 0, 3.6)

MC 520
Understanding the Target Audience

Understanding the demographics and psychographics of target audiences is essential to an effective marketing communication strategy. In this course, social, cultural, and psychological factors are explored with particular attention to motivation, how attitudes are shaped and altered, how information is processed, and learning in the formation of purchasing decisions. Theories and models of consumer behavior are examined to learn how to apply behavioral research findings. (3.6, 0, 3.6)

MC 521
The Healthcare Consumer (concentration)

This course covers the segmentation of the healthcare market and how the healthcare consumer is different from consumers generally. Additional topics include: perception and information processing, attitudes toward healthcare issues and values brought to the access process in healthcare, perceived value in healthcare products and services, choice-making and buyer behavior in the healthcare environment.

MC 522
Media Strategy and Implementation

This course focuses on the major aspects of developing and evaluating media plans and on some key factors in efficient media buying. Beginning with the development of media strategies that flow from overall marketing communication goals, the course analyzes various media from the perspectives of cost, targeting, audience characteristics, and the nature of the product/service. The course also includes examinations of information sources, such as Arbitron, Nielsen, and Simmons, and software, such as Manas, IMS, Telmar, Adware, and Tapscan. (3.6, 0, 3.6)

MC 524
Creative Strategies

This course deals with the development and execution of the products of marketing communication: the print, TV, radio, direct mail, Internet, and other advertisements delivered to consumer and business audiences. Based on the development of creative goals and strategies, the major elements of advertising are studied: the central idea to be communicated (unique selling proposition, positioning, brand personality, or campaign theme), the appeal of the creative

concept (informational, news, emotional), and the style or approach of the creative message (slice of life, testimonial, corporate image, celebrity presenter). The creative process is followed from copy platform to the major components of advertisements (headline, body copy, logo, design) to production (printing, photography, video). The role of research is reviewed in the development and assessment of the creative statement. (3.6, 0, 3.6)

MC 526
The Database as Marketing Tool
This course describes how database marketing matches consumers with products and products with consumers, making ongoing relationships with customers possible; and how a company's database can be utilized to develop tactics and strategic planning. Students also learn to access and utilize database information in areas such as competitive product data and in consumer preferences, needs, media habits, demographics, and psychographics. (3.6, 0, 3.6)

MC 528
Writing and Presentation Skills
The ability to present ideas in a clear and convincing manner is a key element in the successful management of a marketing communication enterprise. Persuasion is often the critical factor in the success or failure of a project. Students learn to write and present marketing and media plans, new business proposals, creative proposals, copy platforms, and research findings. In-class delivery of written assignments and presentations. (3.6, 0, 3.6)

MC 530
Direct Marketing
A comprehensive study of the elements of direct marketing and its fit into the strategy to reach target audiences effectively. Topics include comparison of consumer and business-to-business direct marketing techniques, use of databases, circulation planning, creative executions, lists and media, direct mail, catalog marketing, telemarketing, Internet marketing, and response analysis. (3.6, 0, 3.6)

MC 532
Sales Promotion Techniques
This course provides an overview of merchandising and sales promotion tools and the planning and execution of sales promotion programs. The use of sales promotion techniques is studied in a wide variety of product/service marketing strategies. Students learn the sophisticated analysis required to determine the effectiveness of sales promotion events against the costs of media advertising. (3.6, 0, 3.6)

MC 534
Fundamentals of Public Relations
An overview of the applications and techniques of public relations, this course demonstrates how business communicates and participates in society's public forums and identifies the tools of the public relations specialist, including special services and media sources, how to locate them, what they cost, and how they fit into an overall marketing communication plan. Measurement techniques are reviewed and evaluated and special problems in public relations, such as corporate and product crisis management, are carefully studied. (3.6, 0, 3.6)

MC 536
Practicum
This capstone course is designed to integrate all the skills learned in the Marketing Communication program in a practical context. Student teams will compete as mini-agencies with an assignment from a major Chicago area marketer. Briefed in detail by their client, they will develop a marketing plan and a complete, detailed marketing communication plan. Based on secondary research and original research conducted by the teams, the marketing communication plan will include a media plan, a creative program, budget recommendations, and recommendations for the use of public relations, database marketing, promotion, online marketing, event marketing, and so on. Teams will make formal presentations of their plans to client senior management. (3.6, 0, 3.6)

MC 538
International Marketing Communication
A study of major concepts in international marketing. The objective of the course is to prepare marketing communication managers to function effectively in a global environment. Topics include the development of communication strategies in interconnected economies and the impact of cultural differences on those strategies. The student will examine the differences among Pacific Rim nations, the European Union, and others as they relate to marketing problems. (3.6, 0, 3.6)

MC 546
Communication Strategies in the Digital Environment
Advertising on the Internet is only the beginning. Permission e-mail marketing has quickly become a critical tactic and a discipline with its own rather intricate set of rules. Sales promotion in the online environment is a new and different skill set. Database marketing helped shape all of e-commerce marketing, and now e-commerce is reshaping the database business. The public relations specialist is finding that Web sites are among the most critical target media. For the marketing communication professional, these new digital tools and tactics will be essential for success. (3.6, 0, 3.6)

MC 551
Business Strategy in the Network Economy: Best Practices
The explosion of information in the digital economy, and the rise of the Internet as medium, marketplace, and management tool have transformed the ways companies organize themselves and do business. But that transformation is far from complete. This course will acquaint the student with some of the best current thinking and practice among companies that are succeeding in the new environment. It deals with business models, supply chain strategies, value propositions, revenue sources, new ideas about the marketing of information, and how entrepreneurial ventures go about constructing a business plan. It includes presenta-

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tions from and conversations with senior managers of e-commerce enterprises, their agencies, and consultants. (3.6, 0, 3.6)

MC 552
Marketing Strategy in the Digital Environment

Both the buyer's behavior and the marketer's opportunities are fundamentally different in the online environment. There are many ways in which digital assets can be substituted for conventional marketing resources. There is a new spectrum of distribution alternatives. Online branding presents its own set of challenges. There are new product development issues in a space where the method of delivery has become part of the product. Digital communities present a new marketing opportunity. New pricing strategies become available. This course will help the digitally-empowered marketer plan, budget, and adapt to a new world. (3.6, 0, 3.6)

MC 554
Customer Relationship Management

In a world where it costs five times as much to acquire a new customer as it does to keep an existing relationship, companies are learning that they must manage those current customer relationships in order to survive. Around this insight, a new discipline has emerged, using some of the tools of database management and some of the new tactics of digital communication to reduce attrition, and maximize the lifetime value of a customer. Customer Relationship Management (CRM) is making fundamental changes in the way companies operate. It is a critical point of merger, where e-business becomes a part of all business. This course will engage the student in the diagnosis of CRM issues, the building of CRM plans, the measurement of their effectiveness, and the new tools available to get all these things done economically, in Internet time. (3.6, 0, 3.6)

MC 563
Web Page Design

The content, organization, presentation, and functionality of Web sites are critical to attracting and retaining customers or members of an audience. Subtle issues of design and organization can have profound consequences on a site's ability to persuade, communicate, compete, and close a transaction. Principles of effective site design will be used to evaluate existing sites. An authoring tool, e.g., Dreamweaver or Frontpage, will be used to build a Web site. (3.6, 0, 3.6)

MC 577
The Healthcare Marketplace

This course examines the components and structure of the healthcare market in the United States and the many components of the healthcare delivery system, involving diverse audiences and needs. Students will be exposed to the history, function and basic principles of public health, and the conceptual and organizational aspects of the U.S. health care system in both the public health sector and the private health sector. They will examine the relationships among health services organizations, health professionals and payment mechanisms, and the impact of changes, as well as identify the major trends, participants, issues, and challenges involved in financing health care in the United States. (3.6, 0, 3.6)

MGT 516
Individual Effectiveness

This course is aimed at preparing the student to better cope with and succeed in organizational life by expanding self awareness, improving personal creativity, sharpening logical reasoning and problem solving skills; and by developing the student's ability to collaborate, lead and communicate with others in wide range of settings. The course covers a variety of topics related to individual performance and effectiveness within organizations, but several common themes are: using written tools and instruments to improve self knowledge, becoming more objective in observing and analyzing behavior

(one's own and others'), and applying proven tools and techniques to enhance creative and critical thinking. (3.0-0-3.6)

MGT 545
Business Information and Management Control

In this networked world,successful organizations need innovative management control systems to promote agility and learning. The main theme of this course is the Effective Execution of Business Strategy. How are (1) organizations, processes, *projects,* tasks, and business intelligence structured AND (2) people incented to implement the chosen strategy in a dynamic, not static, business environment? What information and metrics will facilitate recognizing potential problems before the impact occur? What management control systems and practices are needed to comply with regulatory requirements, e.g., Sarbanes-Oxley and NYSE? What type of control system fits best with the adopted business strategy? How does information technology facilitate the analysis of business intelligence and the execution of management controls? Cases and computer exercises provide an opportunity to apply the business intelligence and management control concepts discussed. (3.6-0-3.6)

MGT 551
Organization Design and Theory

Develops insight into how organizational structure and culture affect organizational effectiveness and shifting organizational culture values while building skills for analyzing and designing organizational systems. Specific methods of organizational analysis from many perspectives are covered including systems, the learning organization, knowledge-creating organizations, virtual organizations, etc.
Prerequisite: MBA 520. (3.6, 0, 3.6)

MGT 553
Organizational Leadership and Management of Change

Prepares managers to influence the human side of developing and implementing changes in organizations. Theory and exercises help managers

understand the socio-technical perspective of change, to see leadership as invoking "followership," to understand their own ability to influence others, and to understand the leadership success of noted leaders from all walks of life. Exercises allow students to apply course concepts to projects in their interest areas—information systems, marketing, etc. Prerequisite: MBA 520. (3.6, 0, 3.6)

MGT 555
Industry Structure and Competitive Strategy

Study of the structure-conduct-performance model of the economy as a basis for determining business strategy. Topics include: the impact of various microeconomic industry structures on the competitive behavior of firms; techniques for predicting the profitability of an industry and specific competitive strategies over time; economics of pricing, capacity, product and process innovation; and integration decisions. Cases and readings. Prerequisite: MBA 520. (3.6, 0, 3.6)

MGT 556
Legal, Ethical, and Political Issues in Business

An exploration of the social foundation of law and ethics and selected topics of law and public policy. The course covers topics in commercial law (traditional and emerging), legal and social control mechanisms of corporations (antitrust, securities, regulation, corporate responsibilities), and classic and emerging legal issues (employment, environmental, and international law). Readings and discussion. (3.6, 0, 3.6)

MGT 557
Management and Development of Human Resources

Covers a breadth of techniques and skills related to management, motivation, and improving the work of others; especially the many issues which are usually handled by human resource departments. These include such legal and policy issues in the employment relationship as recruiting and selection, affirmative action and diversity, labor relations, international considerations, supervising

in various industries, performance evaluation, compensation issues, and downsizing and termination management. Prerequisite: MBA 520. (3.6, 0, 3.6)

MGT 565
Project Management

You will study the analytical, computer-based procedural, and behavioral skills for effective project management. Given well-defined project objectives and requirements, you will learn how to create a project team and work breakdown structure, estimate task times and costs, allocate and level resources, prepare visual Gantt and Critical Path and milestone charts, perform risk analysis, manage team motivation and conflicts, assess earned value, and evaluate time and cost deviations with corrective actions. MS Project will be the project management tool. Project management concepts and methods will be applied through exercises and cases. Prerequisites: MBA 520, MBA 540. (3.6-0-3.6)

MGT 585
Integrated Functional Management

A team-based Business Game Simulation designed to integrate functional and analytical concepts and tools within a framework of strategic management. The course offers a second opportunity (in addition to the required MBA 590 Business Policy course) for students to integrate their learning and practice what they have learned in a "near-real" situation. (3.6, 0, 3.6)

MKT 541
Marketing Research

An overview of the marketing research process, the course focuses on basic principles that permit the decision-maker to understand and make better use of research results. Topics covered include problem identification, research and data instrument design, and sampling. Methods for estimating short- and long-term market potential for new and existing products will also be discussed. Prerequisites: MBA 540, MBA 560. (3.6, 0, 3.6)

MKT 544
Strategic Marketing

An analysis of the problems confronting managers in planning, implementing, and controlling marketing programs. Topics include the development and use of models in market selection, new product development and management, pricing, promotion, channels, and distribution decisions. Prerequisite: MBA 560. (3.6, 0, 3.6)

MKT 545
Industrial Marketing

A survey and analysis of how consumer and business-to-business or organizational purchases are made. Topics include: motivation, consumer information processing, values, and perceptions; economic, social, and cultural influences; decision process models for organizational buying; and implications of all these factors for marketing managers. Prerequisite: MBA 560. (3.6, 0, 3.6)

MKT 548
International Marketing

An examination of the role of international marketing in the development of an overall business strategy. Topics include the design of international pricing, promotion, and product strategies. These concepts will be applied to the markets of specific countries, taking into account the cultural and economic environment. Prerequisite: MBA 560. (3.6, 0, 3.6)

MSC 534
Queueing

Basic queueing techniques used in inventory and manufacturing decisions, and single, multiple and tandem service facilities. Poisson and Erlang input, exponential, uniform and arbitrary output, priority discipline. (3.6, 0, 3.6)

MSC 535
Models for Decision-Making

Models for decision analysis in various functional fields including finance, marketing, and operations. Applications include media selection, capital budgeting, portfolio selection, advertising effectiveness, plant location, distribution planning, and production planning. The focus of the course is building models and using software to aid in decision-making. (3.6, 0, 3.6)

MSC 538
Simulation

Generating random variables for discrete, continuous, and joint distributions for simulation applications. Data analysis, validation of techniques, optimizing response functions, and design of experiments. Prerequisite: MSC 570. (3.6, 0, 3.6)

MSC 545
Spreadsheet Modeling

Spreadsheets are a popular model-building environment for managers. Add-ins and enhancements to Excel have made powerful decision-making tools available to the manager. This course covers how to use the spreadsheet to develop and utilize some of these decision-making aids. Visual Basic for Excel allows the nonprogrammer to create modules for functions, subroutines, and procedures. Topics include forecasting (both regression and time series), decision-making under uncertainty and decision trees, using SOLVER for optimization, and probabilistic simulation using @RISK. (3.6, 0, 3.6)

MSC 549
Advanced Spreadsheet Modeling

This course uses the Excel/VBA environment for developing models. Students will develop spreadsheets and write programs for forecasting, financial price simulation, option pricing, and financial statements. Add-ins are used for optimization, simulation, and decision analysis. (3.6, 0, 3.6)

MSC 550
Topics in Quality Management

The understanding, development, and implementation of total quality management systems with a focus on customer satisfaction and economics of quality. Theoretical and empirical research will be the basis of this course. (3.6, 0, 3.6)

MSC 554
Scheduling Theory

This course introduces students to current research in scheduling: scheduling of new systems, including those based on advanced manufacturing technology; and the use of new methods for analyzing scheduling problems, such as generalized networks, artificial intelligence, neural networks, and complexity theory. (3.6, 0, 3.6)

MSC 560
Optimization Techniques I

Optimization techniques, with the primary emphasis on linear programming, and applications interspersed to illustrate the applicability of the optimization techniques. At least two-thirds of the course will be linear programming techniques, including the simplex-method and its variants, interior point algorithms, and duality and sensitivity analysis. Other types of optimization problems will be introduced, including integer linear programming, nonlinear programming, and dynamic programming. (3.6, 0, 3.6)

MSC 562
Optimization Techniques II

The theory and computational methods of nonlinear programming. Convex analysis and unconstrained methods. Kuhn-Tucker theory, saddle points, and duality. Quadratic, linearly constrained, nonlinearly constrained, penalty and barrier methods. Prerequisite: MSC 560. (3.6, 0, 3.6)

MSC 564
Optimization Techniques III

Development of the theory of computational methods of integer programming: cutting plane, branch-and-bound, and Lagrangian relaxation methods. Model formulation with integer variables. Development of the theory and computational methods of dynamic programming. Application of dynamic programming to deterministic and stochastic decision problems. Prerequisite: MSC 560. (3.6, 0, 3.6)

MSC 570
Probability and Statistics

A survey of the fundamentals of statistics and their applications for problem-solving. Topics include probability, univariate and multivariate random variables, estimation, order statistics, and reliability. (3.6, 0, 3.6)

MSC 571
Advanced Data Analysis

Point estimates, confidence intervals, and tests of hypothesis. Design and analysis of experiments. Linear and multiple regression. Nonparametric statistics, Markov chains, and statistical decision theory. (3.6, 0, 3.6)

MSC 573
Time-Series Analysis

This course covers methods of analysis and forecasting of time series, including smoothing and Box-Jenkins techniques, vector autoregression and innovation analysis, and introduces flexible models, including Markov switching models and nonparametric methods. The course will use the Quantitative Research Lab for short projects devoted to applications of these methods. (3.6, 0, 3.6)

MSC 576
Practicum in Teaching and Curriculum Skills

This course enables Ph.D. students to address overall issues of pedagogy, as well as the development of personal classroom skills. The course covers curriculum development, sources of classroom materials, and use of various teaching methods. (1 credit)

MSC 595
Research Seminar

MSC 596
Special Topics Seminar

This course treats a specific topic, varying from quarter to quarter, in which there is particular student and faculty interest. Topics may include quality management, operations management, technology management, or global business and world trade. Prerequisite: Consent of instructor.

MSF 511
Financial Economics I

This course provides a systematic exposition of the primary mathematical methods used in financial economics. Mathematical concepts and methods include logarithmic and exponential functions, algebra, mean-variance analysis, summa-

tions, matrix algebra, differential and integral calculus, and optimization. The course will include a variety of financial applications including compound interest, present and future value, term structure of interest rates, asset pricing, expected return, risk and measures of risk aversion, capital asset pricing model (CAPM), portfolio optimization, expected utility, and consumption capital asset pricing (CCAPM).

MSF 512
Financial Economics II
This course focuses on the macroeconomic influences on financial markets. The course begins with a discussion of consumption, investment, government expenditure and the trade balance using modern business cycle and growth theory. The focus develops the consumption CAPM as the solution to the intertemporal utility maximization problem and the role of macroeconomic factors in the valuation of equity shares. The course also includes a review of economic modeling of the term structure of interest rates and the exchange rate.

MSF 513
Financial Theory
This course introduces the modern theory of mathematical finance, using primarily discrete time models. Topics include single period and multiperiod consumption and investment models, derivatives pricing for non-interest rate and interest rate instruments, and the mathematical frameworks required to develop a coherent pricing theory. These include utility theory, stochastic processes and martingales, stochastic calculus, contingent claims, complete and incomplete securities markets, fair value calculations for derivatives, binomial and Markov models, portfolio analysis, and VAR. The course objective is to provide the student with basic tools to comprehend journal articles on these topics from Financial Analyst's Journal and Journal of Portfolio Management. (Prerequisite: MSF 511)

MSF 521
Financial Modeling I
This course is the first of three subjects that form the Financial Modeling Sequence. It is designed to provide students with the necessary programming skills necessary to create realistic financial models. It is an essential core subject and must be completed in order to obtain the MSF degree. Modeling I focuses on the implementation of financial models in MS Excel using Visual Basic for Application (UBA).

MSF 522
Financial Modeling II
This course extends the financial ideas and programming techniques introduced in the earlier course Financial Modeling I. It is concerned with the ideas, mathematics and programming code behind the construction of derivative financial models. In order to master this course it will be necessary to understand such ideas as risk-neutral pricing, stochastic calculus, finite difference schemes, binomial and trinomial trees, lattice models and Monte Carlo simulation and their application to the pricing of exotic options. (Prerequisites: MSF 521).

MSF 523
Financial Modeling III
This course extends the financial ideas and programming techniques introduced in the earlier course Financial Modeling II. It describes the ideas, mathematics and programming code behind the construction of derivative interest rate models. Whereas the preceding course focused on equity models and their options while assuming that the interest rate was fixed, this course will relax that assumption to include the possibility of time varying interest rates or the "term structure of interest rates". In order to master this course it will be necessary to comprehend such ideas as portfolio replication, stochastic calculus, implied binomial and trinomial trees, forward rate curves and popular interest rate models like Vasicek, Ho and Lee and HJM. (Prerequisites: MSF 521 and MSF 522)

MSF 532
Corporate Finance
This course is an advanced introduction to modern corporate finance. Topics include cash flow forecasting, optimal dividend policies, mergers and acquisitions, structured finance, capital at risk, and the risk of adjusted return on capital. The philosophical foundation of the course is the concept of shareholder value added. Students will learn how financial decisions can contribute to the value of a modern corporation.

MSF 533
Marketing of Financial Products
Institutional financial products are the final manifestation of an evolutionary process that typically begins with advances in academic research. Examples include the development of index funds as a response to the concept of efficient markets, the development of structured financial products as a response to the concept of arbitrage pricing theory. This course explores the evolutionary process through a series of case studies focusing on companies that have introduced revolutionary financial products.

MSF 541
Valuation and Portfolio Management
The course is a survey of asset pricing theory. The fundamentals of bond and option pricing are covered as well as the CAPM, APT and the Fama French models. Excel spreadsheet modeling is used to illustrate and understand the concepts of Markowitz's Mean Variance Optimization, equity valuation, option pricing, and utility theory.

MSF 542
Structured Fixed Income Portfolios
Fixed income instruments differ from equities because the cash flows from fixed income instruments are known in the absence of issuer default. As a result, fixed income portfolios tend to have a longer time horizon, tend to be more highly leveraged, and tend to use derivatives for hedging relative to equities. This course develops portfolio management procedures for fixed income portfolios. This course

begins at the short end of the curve with multi-currency portfolios of short term non-deliverable swaps. The course then proceeds out the maturity spectrum to consider investment strategies based upon the shape of the yield curve. Concepts developed in the course will be tested using a simulated trading environment.

MSF 543
Quantitative Investment Strategies

This course develops the primary quantitative tools used in the portfolio selection process. The applied focus of the course centers on global asset allocation for equities, bonds, and currencies. The course covers the estimation of efficient portfolios, factor models, forecasting models, and risk analysis. (3.6, 0, 3.6)

MSF 551
Futures, Options and OTC Derivatives

This course provides the foundation for understanding the price and risk management of derivative securities. The course starts with simple derivatives, e.g., forwards and futures, and develops the concept of arbitrage-free pricing and hedging. Based upon the work of Black, Scholes, and Merton, the course extends their pricing model through the use of lattices, Monte Carlo simulation methods, and more advanced strategies. Mathematical tools in stochastic processes are gradually introduced throughout the course. Particular emphasis is given to the pricing of interest rate derivatives, e.g., FRAs, swaps, bond options, caps, collars, and floors. (Prerequisites: Background in calculus, probability and statistics, and knowledge of Excel spreadsheets.)

MSF 552
Market Risk Management

This course introduces the importance of financial risk management by developing practical risk measurement tools. The risk measurement aspect of the course begins with the development of the Value-at-Risk (VaR) methodology for financial instruments traded in open markets including equities, bonds, foreign currencies and their derivatives. The course develops analytic VaR models for instruments with non-linear pay-offs and non-normal distributions and it also develops simulation methodologies for risk analysis. Statistical tools in volatility forecasting, tail events, and expected shortfall are introduced as appropriate. The emphasis of the course is on market risk, but in addition to the traditional analysis of trading rooms, the course also considers regulatory and compliance risk, corporate risk and risk analysis for investment managers. (Prerequisites: MSF 551 and Excel programming experience.)

MSF 553
Enterprise Risk Management

This course follows up on MSF 552 (Market Risk Management). It focuses on the other two main silos of risk in the financial industry, namely, credit risk and operational risk. The course will also discuss asset and liability management, interest risk management, integration of credit risk and market risk, regulatory and compliance issues, and performance measurement and capital management. The quantitative aspects of the course include: volatility and correlation modeling, Monte Carlo simulation, stress-testing and scenarios analysis, extreme and tail events modeling. (Prerequisites: MSF 521 and MSF 522)

MSF 561
Financial Time Series Analysis

This course develops a portfolio of techniques for the analysis of financial time series. Distribution theory covers the normal, Student T, Chisquared, and mixture of normals models. Technical analysis covers a variety of trading rules, including filters, moving averages, channels, and other systems. The first two topics are then combined into an analysis of non-linear time series models for the mean. The course concludes with a review of volatility models, including GARCH, E-Garch, and stochastic volatility models. Prerequisite: MSF 562. (3.6, 0, 3.6)

MSF 562
Econometric Analysis

This course presents the major conclusions of the econometric techniques used in finance. Ordinary least squares, maximum likelihood, generalized method of moments, and simulation methods are covered. These tools are presented through computer simulation of the various models, followed by detailed analysis of the distributions of estimators. Hypothesis testing is covered in detail. Particular attention is placed on the properties of various estimators when model assumptions do not hold. For students who qualify, a final project applying econometrics to a financial modeling problem may be chosen. Students not familiar with matrix algebra and elementary statistics should plan to make up the deficit early in the course. Additional lectures will be provided for these students.

MSF 563
Bayesian Inference in Econometrics

Most statistical applications in finance require that the forecasting models be revised in response to the arrival of new information. This course develops the Dynamic Linear Model (DLM) as an updating model based upon Bayesian decision theory. Applications of the DLM, including regressions, autoregressions, and exponential trend models will be covered. Special emphasis will be given to the development of intervention and monitoring systems and the use of simulation methodologies. Students not familiar with matrix algebra and elementary statistics should plan to make up the deficit early in the course. Additional lectures will be provided for these students. (Prerequisite: MSF 562, however, MSF 561 is not required)

MSF 571
Computational Finance I

This course is the first of three subjects which form the Computational Finance Sequence. It is designed to provide students with the necessary mathematical and programming skills necessary to simulate financial models on the modern computational environment. It is a companion

series to the Financial Modeling sequence and extends some of its ideas for the computational evaluation of derivative instruments. The ten-week course describes the concepts, mathematics and Mathematica code behind the construction of partial differential equations required for the evaluation of derivative financial models. In order to master this course it will be necessary to learn to program in the symbolic programming language Mathematica. It will also be necessary to comprehend such ideas as portfolio replication, risk-neutral pricing, stochastic calculus, finite difference schemes, as well as binomial and trinomial trees. This course assumes some prior financial and computational training, as well as familiarity with the program Mathematica. (Prerequisite: MSF 521).

MSF 572
Computational Finance II
This course is the second in the Computational Finance Sequence. The ten-week course follows Computational Finance I, a necessary prerequisite, and closely follows the material met in the earlier course. It describes the concepts, mathematics and Mathematica code behind the construction of partial differential equations required for the evaluation of complex derivative financial models. In order to master this course it will be necessary to program in the symbolic programming language Mathematica. It will also be necessary to comprehend such ideas as stochastic calculus, finite difference schemes, binomial and trinomial trees, supersymmetric trees, Monte Carlo simulation, Stochastic Interest Rate models, elasticity models and the construction of yield curves. (Prerequisite: MSF 571)

MSF 573
Computational Finance III
This course is the final subject in the Computational Finance Sequence. The course is built around the numerical solution of SDEs using the computer. It describes the mathematics and algorithms behind the construction of Stochastic Differential Equations. In order to master this course it will be necessary to comprehend such ideas as stochastic processes, power series expansions, stochastic Taylor series expansions, Ito stochastic calculus, Stratanovich stochastic calculus, ordinary and partial differential equations and computer programming. All of the above topics will be studied using the programming language Mathematica. It will be shown that Stochastic Differential Equations (SDEs) are capable of being simulated on a computer and that most financial problems are expressible in terms of such SDEs and hence can also be simulated computationally. (Prerequisite: MSF 521)

MSF 596
Research Seminar in Finance
The primary focus of this advanced seminar course is on the analysis of credit risk in the financial industry. Credit risk management will cover both corporate banking and investment banking. The course will also review industry applications of credit risk methodology through a review of technical documents and research papers. The course will discuss important and timely classes of credit risk models, e.g., Merton's structural form, reduced form, actuarial, and scoring, in addition to rating techniques provided by the rating agencies. In addition, regulatory guidance and banks' own development in internal ratings systems and credit risk models (expected loss, unexpected loss, default correlation, and loss distributions) will be examined in depth. Students are expected to present

recent research and classic papers in the field. (Prerequisites: MSF 521, MSF 551 either Acct 501 or MSF 532 and strong quantitative and programming skills. MSF 552 is strongly recommended.)

OM 510
Operating Systems Design and Management
A survey of the concepts and techniques of design and management of enterprise operating systems. The course includes studies of different topologies for delivery of products and services and of the underlying infrastructure, such as MRP and scheduling and control mechanisms. Performance measures of operating systems, such as flow time, service level, and asset utilization are studied to understand their impact on competitive advantage. Prerequisite: MBA 570 or consent of instructor. (3.6, 0, 3.6)

OM 522
Management of Manufacturing and Service Enterprises
An exploration of contemporary policy, strategy, and management issues in manufacturing and service organizations. The course will focus on an integrated "product delivery" system in the marketplace: how to formulate policy and develop strategy for it and how to design it. The course includes studies of different topologies for delivery of products and services, and of their underlying infrastructure. (3.6, 0, 3.6)

OM 530
Inventory, Logistics and Supply Chain
Forecasting, order size, safety stock, service levels, and SKU's. The production plan, master production schedules, materials requirement planning, capacity planning, and just-in-time. Warehouse planning and management, distribution, transportation, packaging and third party logistics. Costs, design, and management on the inventory flow

between suppliers, manufacturers, warehouses, distribution centers, stores, and customers. Prerequisite: MBA 540, MBA 570. (3.6, 0, 3.6)

QLM 512
Quality Management
This course integrates principles and practices of quality management leading to business excellence. The course focus is on customer delight, employee satisfaction, process excellence, and operational performance. Students will learn about world-class performance from the best-in-class companies. The course should help leaders and general managers to forge ahead of competitors in the global marketplace. Readings, case studies, and final project. Prerequisite: MBA 540. (3.6, 0, 3.6)

TM 510
Strategic Management of Technology and Innovation
A systematic examination of issues relating to the general management of innovation, R&D, and new product-process design and development. Focuses on strategic, behavioral, inter-functional (team) and international considerations. Topics include technology as a source of competitive advantage, promoting creativity in the organization, management of cross-functional activities, technology transfer, entrepreneurship, and project management for accelerating commercial introduction. Readings and case studies. Prerequisite: Core courses or instructor's consent. (3.6, 0, 3.6)

Technical Communication (Lewis Department of Humanities)

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Chair:
Kathryn Riley, Department of Humanities

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Effective communication is critical in times of rapid technological change, wherever increasing amounts of information must compete for the attention of people with limited time to absorb it. Professionals who can package technical, scientific and other information using the newest technological tools are in demand in business, industry, nonprofit organizations, and government.

To meet these needs, the Lewis Department of Humanities offers graduate programs in technical communication and information design, information architecture, instructional design, technical and professional communication, and international technical communication. Students gain the knowledge and skills needed to create, organize and present technical information in a variety of media, learning from faculty who are experienced practitioners in the field of technical communication. Programs are oriented toward working professionals and can be taken on a part-time basis.

Degrees Offered

Master of Science in Technical Communication
and Information Design
Master of Science in Information Architecture

Doctor of Philosophy in Technical Communication

Certificate Programs

Instructional Design
International Technical Communication
Technical Communication

Ethics in the Workplace: Business, Engineering and Government (via the Center for the Study of Ethics in the Professions)

Research Facilities

The department has a state-of-the-art computer lab equipped with 31 Pentium PCs connected to a local area network (LAN), which provides remote access to an external network, printers, a scanner, a theater-style projector, and multimedia software and hardware. The lab is arranged in clusters to promote collaborative work. The department also supports a Usability Testing and Evaluation Center and an editing center, Edit IIT.

Research Areas

Faculty conduct research in the areas of the rhetoric of science and technology; technical communication; usability testing, including testing and evaluating a communication product using prototyping, sampling surveys, and experimental design; instructional design, including analysis of human performance problems, strategic interventions, learning tasks, and validation instruments; documentation and online design, including desktop publishing, Web site development and management, online applications, hypertext, multimedia, and hypermedia; linguistics; cultural studies; history (including history of science and technology); philosophy (including workplace ethics); film; history of art and architecture.

Technical Communication

Faculty

Matthew J. Bauer, Assistant Professor of Linguistics. B.A., University of Minnesota, Duluth; M.S., Ph.D., Georgetown University.

Glenn J. Broadhead, Associate Professor of English, Director of Technical Communication Programs, and Director of Communication Across the Curriculum. B.A., Los Angeles State College; M.A., Ph.D., University of California, Davis.

James Dabbert, Senior Lecturer, English. B.A., M.A., Indiana University.

Michael Davis, Professor of Philosophy. B.A., Western Reserve University; Ph.D., University of Michigan.

Susan Feinberg, Professor of English and Director of the Usability Testing and Evaluation Center. B.A., University of Michigan; M.A., University of Louisville Kentucky; Ph.D., Kent State University.

Kevin P. Harrington, Professor of Architectural History. B.A., Colgate University; M.A., Ph.D., Cornell University.

Robert F. Ladenson, Professor of Philosophy. B.A., University of Wisconsin; Ph.D., Johns Hopkins University; J.D., DePaul University.

Jo Mackiewicz, Assistant Professor of Technical Communication. B.S., University of Wisconsin, Superior; M.A., University of Minnesota, Duluth; Ph.D., Georgetown University.

Margaret Power, Associate Professor of History. B.A., Ph.D., University of Illinois, Chicago.

Gregory J. Pulliam, Senior Lecturer of English. B.A., Memphis State University; M.A., Ph.D., University of Missouri.

Kathryn Riley, Professor of English, Chair of the Department of Humanities, and Director of Edit IIT. B.A., University of Maryland; M.A., Georgia State University; Ph.D. (English), University of Maryland; Ph.D. (Linguistics), Louisiana State University.

Warren S. Schmaus, Professor of Philosophy. A.B., Princeton University; M.A., Ph.D., University of Pittsburgh.

John W. Snapper, Associate Professor of Philosophy. B.A., Princeton University; M.A., Ph.D., University of Chicago.

Michael Tillmans, Assistant Professor of Technical Communication. B.A., University of Northern Iowa; M.A., Arizona State University; Ph.D., Florida State University.

Admission Guidelines (Ph.D. Program)

The doctoral program in technical communication at IIT prepares students for careers in teaching at the university and community college levels, as well as for advanced supervisory and research positions in business and government. Building on a base of skills in workplace practices, the program incorporates theory-oriented advanced readings, seminars, and dissertation research leading to original contributions to scholarship in the field.

Our students enter the Ph.D. program from a wide range of undergraduate majors and masters degree fields in the humanities, sciences, and technology—that is, not just technical writing, English, journalism, communication, history, and philosophy, but also computer science, psychology, design, biology, engineering, and many other areas. The program's goal is to help students build on existing strengths and develop new areas of expertise while mastering the techniques and literature of research in technical communication.

Applicants must have completed a bachelor's or master's degree in technical communication or any field that, in combination with the 30-credit-hour technical core, would provide a solid basis for the advanced study of communication in business, industrial, corporate, government, and other institutional settings. A partial list of examples would include human factors psychology, history of technology, computer science, sociology, anthropology, and library science among many others. The relevance of previous degrees to the doctoral program will be assessed by the program director.

In addition to the application form, the applicant must submit the following:
1. Official transcripts, or certified copies thereof, of all academic work at the college level or above
2. Three letters of recommendation
3. Professional statement
4. Required test scores

All applicants are required to submit the Graduate Record Exam (GRE) scores with a combined minimum score of 1200 (for tests taken prior to Oct. 1, 2002), or 900 (quantitative + verbal) and 2.5 (analytical writing) (for tests taken on or after Oct. 1, 2002).

International students must submit TOEFL scores unless they are exempt. Students who score below 600/250* on the TOEFL must take the English Proficiency Review (EPR) to assess the level of their skill in written and spoken English. Students who show deficiency on the EPR exam may be refused admission to this graduate program. U.S. citizens are exempt from the requirement, and students from a number of countries are exempt from the TOEFL requirement. (For details, see the current Graduate Bulletin.)

Admission decisions are made on a rolling basis, and applications are accepted any time during the year. However, it may be to your advantage to apply as early as possible.

* Paper-based test score/computer-based test score.

Admission Guidelines (Masters Degrees)

Applicants to the department's technical communication programs come from a broad variety of backgrounds. Some students enter with strong writing or design ability and learn to apply those skills in technical and scientific areas, while other students enter with a background in a technical or scientific field and work to enhance their communication skills. Successful students in the technical communication and information design and information architecture programs have had undergraduate or previous graduate degrees in fields such as business administration, engineering, computer science, graphic arts, design, English literature, communication, journalism, technical writing, rhetoric/composition, and others. The program's goal is to help students build upon existing strengths and develop new areas of expertise so that no specific field of prior study is required. (However, the certificate program in instructional design requires prior or concurrent experience in technical communication.)

Applicants must have a bachelor's degree from an accredited four-year institution with a minimum cumulative GPA of 3.0/4.0.

Applicants must submit Graduate Record Exam (GRE) scores with a combined minimum score of 1200 (for tests taken prior to Oct. 1, 2002), or 900 (quantitative + verbal) and 2.5 (analytical writing) (for tests taken on or after Oct. 1, 2002). [Note: this GRE requirement is only for applicants to the information architecture program and is waived for those applicants with bachelor's degrees from accredited U.S. educational institutions with a minimum cumulative GPA of 3.0/4.0.]

International students must submit TOEFL scores, unless they fall under the rules of exemption as stated in the "Admission" section of this bulletin (see "International Applicant Requirements"). Students who score below 600/250* on the TOEFL must take the English Proficiency Review (EPR) to assess the level of

their skill in written and spoken English. Students who show deficiency on the EPR exam may be refused admission to this graduate program. (U.S. citizens are exempt from the English as a foreign language proficiency requirement.) If applicants do not meet these guidelines, they may seek probationary admission or may simply enroll in classes as a non-degree student (if permitted), in order to demonstrate an ability to work successfully at the graduate level.

Note: Enrolling in courses does not guarantee later acceptance into the technical communication and information design or information architecture programs, nor does

meeting the minimum GPA and test score requirements. Students who enter as non-degree students should first discuss their plans with the director of technical communication. Admission decisions are made on a rolling basis, and applications are accepted any time during the year. However, for maximum consideration, applications should be completed by April 1 for the fall semester or November 1 for the spring semester.

* Paper-based test score/computer-based test score.

Doctor of Philosophy in Technical Communication

84 credit hours beyond the bachelors degree, including
    Technical communication core (30 credit hours)
    Electives (minimum of 12 credit hours)
    Dissertation research (minimum of 24 credit hours)
    Additional electives or dissertation research (as
    needed to achieve total of 84)
Qualifying examination (oral)
Comprehensive examination (oral)
Dissertation
Dissertation examination (oral)

Transfer Units
Students who have already earned masters degrees or undertaken graduate work in relevant fields may transfer credit hours toward the doctoral degree (up to 36 credit hours for graduate coursework in relevant fields at IIT, up to 30 credit hours for graduate coursework in relevant fields at other institutions).

Course Requirements (Details)

Required Courses
Technical Communication Core (30 credit hours)

COM 525	Research and Usability Testing
COM 528	Document Design
COM 529	Technical Editing
COM 530	Online Design
COM 535	Instructional Design
COM 537	Documentation and Project Management
COM 538	Entrepreneurship in Technical Communication
COM 541	Indexing and Information Retrieval
COM 542	Knowledge Management for Technical Communicators
COM 561	Teaching Technical Communication

Electives (at least 12 credit hours)

COM 532	Rhetoric of Technology
COM 536	Proposal and Grant Writing
COM 545	Writing for Publication
COM 551	Language Issues in International Communication
COM 552	Multiculturalism in International Communication
COM 553	Globalization and Localization in International Communication
SEP 501	Foundation of Ethics in the Professions
SEP 503	Ethics and Cultural Differences in the Workforce
SEP 505	Environmental Issues
SEP 507	Ethics and Technological and Social Change

Other courses in history, philosophy, psychology, sociology, political science, business, etc., as approved by the director of technical communication programs

Methodology and Dissertation Research

COM 601	Research Methods and Resources in Technical Communication (3 credit hours)
COM 691	Research and Dissertation for Ph.D. degree (at least 24 credit hours)

Additional Courses
Additional coursework or dissertation research sufficient to meet the requirement of 84 credit hours beyond the bachelors degree. All work for a doctoral degree should be completed within six calendar years after the approval of the program of study; if it is not, then the student must re-pass the Qualifying Examination.

Examinations
The Qualifying examination is a structured discussion based on a portfolio consisting of four elements: (1) deliverables and explanatory material for a masters-level project (or its equivalent); (2) a collection of significant course papers and assignments completed as part of the Technical Communication Core (or as part of equivalent study elsewhere); (3) a bibliographic essay identifying significant trends in recent research in technical communication; (4) a substantial essay that introduces and analyzes the other materials in the portfolio and shows how they constitute a coherent program of study in preparation for advanced work toward the doctorate. The examining committee must include a minimum of four faculty members. The Qualifying Exam must be taken

within the first year of work toward the doctoral degree, and the student must be registered when the exam is administered. If the student fails the Qualifying Examination, the examining committee may recommend a re-examination. At least one semester of additional preparation is considered essential before re-examination. The second chance for taking the Qualifying Exam is regarded as final. Any additional considerations must be petitioned and approved by the graduate dean.

The Comprehensive Examination is a structured discussion based on (a) a portfolio of course papers, projects, and readings completed as part of coursework undertaken in preparation for the doctorate, along with (b) a proposal for the doctoral dissertation. The examinee should demonstrate expertise in the area or areas relevant to the proposed dissertation. The examining committee must consist of at least four tenured or tenure-track faculty members, including three members of the technical communication faculty and one other faculty member from a program other than technical communication. In some cases, students may wish to add a fifth member from the Humanities Department (e.g., history, philosophy, composition, art & architecure history, litera-

ture). Students usually take the Comprehensive Exam at the end of the second year of doctoral study, but no later than one year prior to the Dissertation Examination. The student must be registered at the time of the exam.

The Dissertation Examination is a structured discussion of the dissertation and its scholarly context. Like the Comprehensive Examination Committee, the Dissertation Committee must consist of at least four tenured or tenure-track teachers, including three from technical communication and one from another program. (This exam is called the "Final Thesis Examination" in the current Graduate Bulletin.)

Dissertation

The dissertation should constitute an original contribution to scholarship in technical communication— including areas of interaction between technical communication and other disciplines (especially the Humanities disciplines of art & architecture history, history, linguistics, literature, philosophy, and rhetoric/composition). The research topic and method may be empirical (perhaps employing the facilities of the Usability Testing and Evaluation Center), pedagogical, historical, or theoretical.

Master of Science in Technical Communication and Information Design

30-34 credit hours
Project or Thesis
Internship (may be waived for students
with workplace experience)

The M.S. in Technical Communication and Information Design provides an understanding of communication practices, familiarity with information and communication technologies, and an awareness of the importance of collaboration in enhancing the flow of information throughout an organization. Candidates admitted to the master's program must have a bachelor's degree from an accredited institution. The program is interdisciplinary, and qualified students may enroll from a wide range of undergraduate major fields.

Students preparing for careers as technical communicators are advised to take the project option, which requires 33–34 credit hours, while students preparing for a Ph.D. in a relevant field may wish to take the thesis option, which requires 30–31 credit hours. For both options, a required one-credit-hour internship may be waived for students with workplace experience. Students may apply up to six hours of credit in one of the following courses: COM 594 (Project) or COM 591 (Thesis).

Required courses

COM 525	Research and Usability Testing
COM 530	Online Design
COM 537	Documentation and Project Management
COM 538	Entrepreneurship in Technical Communication
COM 528	Document Design (OR COM 424 Document Design)

COM 529	Technical Editing (**OR** COM 425 Editing)
COM 585	Internship (may be waived for students with workplace experience)

Electives

COM 428	Verbal and Visual Communication
COM 532	Rhetoric of Technology
COM 536	Proposal and Grant Writing
COM 541	Indexing and Information Retrieval
COM 542	Knowledge Management for Technical Communicators
COM 551	Language Issues in International Communication
COM 553	Globalization and Localization in International Communication
COM 552	Multiculturalism in International Communication
COM 435	Intercultural Communication
MBA 520	Organizational Behavior
CS 565	Computer-Assisted Instruction Using Multimedia
CS 460	Multimedia

Other courses as approved by the director of technical communication programs

Students may incorporate coursework for the technical and professional communication, instructional design and/or international technical communication certificates into their work toward the technical communication and information design degree (so long as those courses were not applied to another degree).

Technical Communication

Master of Science in Information Architecture

33-37 credit hours
Project or Thesis
Internship (may be waived for students
    with workplace experience)

The Master of Science in Information Architecture
enhances a technical communication core with special-
ized concepts, skills and tools for designing, imple-
menting and managing Web sites and related media
such as CD-ROMs. This degree provides students with
expertise for a number of tasks relevant to mid-level
and advanced positions in the workplace: Web site
design, Web site project management, information
retrieval, knowledge management, usability testing and
evaluation. Because of the global reach of the Internet,
students may wish to incorporate a certificate in
international technical communication as part of their
coursework toward the information architecture degree.

Students preparing for careers as technical communica-
tors are advised to take the project option, which requires
36–37 credit hours, while students preparing for a Ph.D.
in a relevant field may wish to take the thesis option,
which requires 33–34 credit hours. For both options, a
required one-credit-hour internship may be waived for
students with workplace experience. Students may apply
up to six hours of credit in one of the following courses:
COM 594 (Project) or COM 591 (Thesis).

Required courses

COM 525	Research and Usability Testing
COM 530	Online Design
COM 537	Documentation and Project Management
COM 538	Entrepreneurship in Technical Communication
COM 541	Indexing and Information Retrieval
COM 542	Knowledge Management in Technical Communication
COM 585	Internship (may be waived for students with workplace experience)
COM 528	Document Design **OR**
COM 424	Document Design

Electives

Students may specialize in relevant clusters of courses,
such as web design (COM 430, Basic Web Design; COM
431, Intermediate Web Design; COM 432, Advanced Web
Design), databases, e-commerce, visual design; or they
may seek a broad-based understanding by selecting
courses from different clusters.

Courses from relevant disciplines may also be applied
with permission of the director of technical communica-
tion programs.

Certificate Programs

All coursework taken toward any of the three certificates
and passed with a grade of "B" or better may also
be applied to the M.S. in Technical Communication
and Information Design or the M.S. in Information

Architecture (for students who are admitted to one
of those programs).

Certificate in Technical Communication

This certificate is designed for students seeking an entry-
level position as a technical communicator in a broad
range of fields (e.g., industry, manufacturing, health care,
publishing and advertising, and government agencies).
Applicants must have a four-year bachelor's degree from
an accredited institution with a minimum cumulative
GPA of at least 2.5/4.0 and must be admitted as graduate
certificate students. The program consists of 12 credit
hours of coursework (four courses) and a one credit-hour
internship (which may be waived for candidates with pro-
fessional experience). Courses taken in this program may
be applied toward the master's degree for students admit-
ted to the degree program.

Required courses

COM 525	Usability Testing
COM 529	Document Design **OR**
COM 424	Document Design
COM 529	Technical Editing **OR**
COM 425	Editing
COM 530	Online Design **OR**
COM 428	Verbal and Visual Communication **OR**
COM 435	Intercultural Communication

Elective approved by the director of technical communica-
tion COM 585 Internship (may be waived for candidates
with extensive workplace experience).

Certificate in Instructional Design

This certificate is primarily for experienced technical communicators who wish to acquire focused competency in instructional design. Applicants must have a four-year bachelor's degree from an accredited institution with a minimum cumulative GPA of at least 2.5/4.0. Graduates of this certificate program can serve as information specialists to systematically design and develop instructional materials and training programs for businesses, individuals, health and education institutions, and government.

IIT offers a certificate program in instructional design that teaches the core concepts, instructional methods and assessment instruments for designing materials using various forms of text and visual media, computers and instructional techniques. Four required courses and one elective totaling 15 credit hours make up the certificate program in instructional design:

Required courses

COM 525	Usability Testing	
COM 530	Online Design	
COM 535	Instructional Design	
COM 424	Document Design **OR**	
COM 529	Document Design	

One of the following (or another course approved by the director of technical communication):

COM 430	Introduction to Web Design and Management
COM 431	Intermediate Web Design and Management
COM 432	Advanced Web Design and Management
CS 565	Multimedia
COM 585	Internship (may be waived for candidates with extensive workplace experience)

Certificate in International Technical Communication

This certificate helps experienced writers, editors, project managers, information architects, and web designers to acquire competency in special topics of internationalism, multiculturalism, globalization, localization and language differences.

Applicants must have a four-year bachelor's degree from an accredited insitution with a minimum cumulative GPA of at least 2.5/4.0.

The program requires 12 credit hours of coursework (four courses) plus a one credit-hour internship (which may be waived for candidates with extensive professional experience). Courses taken in this program may be applied toward a Master of Science degree in either information architecture or technical communication and information design (for students admitted to one of these degree programs).

Required courses

COM 551	Language Issues in International Communication
COM 553	Globalization and Localization in International Communication
COM 552	Multiculturalism in International Communication **OR**
COM 435	Intercultural Communication

Elective approved by the director of technical communication

COM 585	Internship (may be waived for candidates with extensive workplace experience)

Recommended

Fluency in two languages, or fluency in one language with reading/writing ability in two non-native languages

Ethics in the Workplace: Business, Engineering and Government

This program provides an understanding of ethical issues in the workplace, along with analytical skills for dealing responsibly with such issues. Students may select a nine credit-hour or a 12 credit-hour option. Applicants must have a four-year bachelor's degree from an accredited insitution with a minimum cumulative GPA of at least 2.5/4.0.

Required course

SEP 501	The Foundation of Ethics in the Professions, Business and Government

Electives

SEP 503	Doing Business and Engineering Around the Globe: Ethics and Cultural Differences in the Workforce and in the Foreign Locale
SEP 505	Environmental Issues: Practical and Responsible Approaches
SEP 507	Facing the Future: Ethics and Technological and Social Change

Additional accelerated-course electives (students should consult page 41 for the definition of "accelerated course.") A selection of one-credit and one-half-credit accelerated courses will be offered each semester and will address issues of practical and professional ethics, energy, e-commerce and other selected topics. Accelerated courses are numbered at the 700 level. A maximum of six credit hours of accelerated courses may be counted toward certificate completion.

Technical Communication

Course Descriptions

Numbers in parentheses indicate class, lab and credit hours, respectively.

Technical Communication and Information Design

COM 501
Introduction to Linguistics
Objective analysis of language structure and structural hierarchies; a survey of the basic concepts of linguistics; the phoneme, the morpheme, language change over time and space.

COM 506
World Englishes
Analysis of the variations of the English language throughout geographic and cultural regions of the world.

COM 508
Structure of Modern English
Analysis of English grammar from four major perspectives: prescriptive, descriptive, transformational-generative, and contextual perspectives. Different methods for analyzing sentences, ways of applying each method to problems in editing and writing, and contributions of linguists such as Noam Chomsky. While focusing on sentence structure, students also look at the structure of words (morphology) and larger units of text (discourse) at various points in the semester.

COM 509
History of the English Language
Study of the origins and development of key features of the English language through its important stages, including Old, Middle, and Early Modern English.

COM 515
Discourse Analysis
Analysis of basic terminology and concepts used to analyze texts on the intersentential and metalinguistic levels (e.g., the particulars of semantic roles; given-new info and syntactic strategies for manipulating it; deixis and anaphora; presupposition and entailment; direct and indirect speech acts; schema theory). Attention to both spoken and written discourse. Applications to social and professional issues: intercultural communication; sociopolitical discourse; discourse in legal and medical settings; discourse in educational settings; narratives and literary texts.

COM 521
Key Concepts in Technical Communication
Broad and intensive readings of key concepts in technical communication, such as usability, audience analysis, task analysis, and information design.

COM 525
Research and Usability Testing
An introduction to methods available for conducting research and usability testing. Students will learn how to plan and conduct tests that measure the efficiency and effectiveness of a design or product. Course work includes identifying and testing tasks, interpreting data and reporting findings. (3-0-3)

COM 528
Document Design
An investigation of the theory and practice of document and information design as applied to paper media. This course focuses on planning the design and development of documents and evaluating the document for a variety of applications, including manuals, instructional design, brochures, newsletters, graphics and tables. (3-0-3)

COM 529
Technical Editing
A study of the art of insuring the clarity of technical works. The course highlights professional standards for the presentation of prose exposition, tables and graphic materials, as well as the means for insuring satisfaction of those standards. (3-0-3)

COM 530
Online Design
An exploration of the theory and practice of structuring information in on-line environments. This course will enable students to analyze styles of graphical user interfaces for a variety of applications and to customize their own design projects. (3-0-3)

COM 532
Rhetoric of Technology
An exploration of the rhetorical convention of various literary, theoretical and historical discourses about what has come to be viewed as "contemporary technology." The course studies works from diverse disciplines and literary genres, including science fiction, cyberpunk literature, cultural studies, anthropology, political science, writing theory and education theory. (3-0-3)

COM 535
Instructional Design
Teaches the essentials for the development of instructional materials, including analysis of human performance problems, strategic interventions, specified learning tasks, and validation instruments. (3-0-3)

COM 536
Proposal and Grant Writing
Principles and practices for writing proposals and grants, with study tracks for (a) students in scientific and technical areas (emphasis on practices within their own discipline) and (b) specialists in technical communication (emphasis on general concepts from current research in argumentation and persuasion). Attention to both individual and team skills. (3-0-3)

COM 537
Publication
Preparing, writing, editing and testing documentation for products and processes (especially software documentation). Managing documentation projects for quality in all phases: information planning, content specification, implementation, production and evaluation. (3-0-3)

COM 538
Entrepreneurship in Technical Communication
Corporate and independent roles of technical communicators. Concepts and techniques needed to market services or to address the marketing

needs of clients. Modes, goals and strategies for verbal and written interaction with clients, corporate decision-makers, and communication staff, with attention to presentation technologies. (3-0-3)

COM 541
Indexing and Information Retrieval

Principles, practices and tools for indexing either print or electronic documents, along with methods and tools for storing, maintaining and accessing information for communication roles in corporate, institutional and government settings. Emphasis on web-based strategies, techniques and tools. (3-0-3)

COM 542
Knowledge Management in Communication

Analysis of the nature and uses of systems and knowledge in business and professional settings, focusing on the technical communicator's roles and tasks in generating and transferring data, information and knowledge within organizations. (3-0-3)

COM 545
Writing for Publication

Participants study tasks commonly associated with academic publication: (1) analyzing, evaluating, and gaining practice in preparing various written academic genres (both publishable genres and job-search items such as a CV and professional website); (2) analyzing and evaluating journals in the participant's academic field; (3) understanding strategies for and logistics of submitting items to journals and conferences; (4) managing time during the research, writing, and publication process; (5) revising work and providing feedback to others; (6) understanding and practicing the rhetorical, organizational, and stylistic conventions of academic writing; (7) preparing a presentation for a conference or academic job interview.

COM 551
Language Issues in International Communication

Translation concepts, strategies and resources. Exploration of relevant linguistic theory and approaches to style, syntax, culture and borrowings across languages. Familiarization with minimalism and controlled-language strategies, as well as computer tools such as online dictionaries, parsing programs, translation databases, internet resources, and international versions of software for page layout, web design and word processing. (3-0-3)

COM 552
Multiculturalism in International Communication

Principles and procedures in analyzing and adapting to disparate societies and corporate cultures. Exploration of differences between innate characteristics (human factors psychology) and learned characteristics (ethnography). Special attention to gender-based distinctions in international contexts. (3-0-3)

COM 553
Multiculturalism in International Communication

Localization and globalization in international communication. Special problems in managing publication projects for global audiences (acontextual) and local audiences (highly contextualized), with emphasis on design issues, personnel issues, quality assurance, software internationalization), and ISO 9000 standards. (3-0-3)

COM 561
Teaching Technical Communication

Analysis of common teaching responsibilities and curriculum design for technical communicators at the college level, focusing on including technical writing (service courses for engineers & scientists) and technical communication (specialized courses for career technical communicators), but also devoting attention to remedial writing, first-year composition, tutoring or supervision of a writing center. Such topics have variations based on language (native vs. nonnative speakers of English) or class level (undergraduate vs. graduate), and in some cases involve attention to special needs such as physical infirmity.

COM 573
Writing about Technology, Science, and Business

This course focuses on techniques for "translating" technical, scientific, and business/economic information from the dense, jargon-heavy discourses of the disciplines into prose that is readable and clear to laypersons.

COM 577
Communication Law and Ethics

This course explores ethical and legal issues concerning communication in diverse contexts: mass media (e.g., print, broadcast, and electronic); government and politics; organizations (e.g., workplaces in public and private sectors); academic life (e.g., classroom student, and faculty affairs); and interpersonal relations (e.g., love friendship, marriage). Students research and write an article-length paper, and may also do additional research and/or classroom work. Credit Hours: 3 Prerequisite: Graduate standing

COM 580
Topics in Communication

An investigation into a topic of current interest in communication, which will be announced by the instructor when the course is scheduled. Advanced study of communication issues, theories, and practices relevant to science, technology, and industry settings. Repeatable for up to 9 credit hours. (3-0-3)

COM 585
Internship

The internship is a cooperative arrangement between IIT and industry. It provides students with hands-on experience in the field of technical communication and information design. Prior internships or professional experience may fulfill this requirement. Credit: Variable. (Most M.S. students take one credit of internship.) (3-0-3)

COM 591
Thesis

Individual study of a topic relevant to a degree or certificate in technical communication, information design, or instructional design. (3-0-3)

Technical Communication

COM 594
Project

Projects will require students to complete a theoretically based analysis of a practical communication situation, create a document appropriate to the situation, and write an analysis of or commentary on the choices made in the production of the document. (Credit: Variable. Most M.S. students take six credits of project studies.) (3-0-3)

COM 597
Special Problems

Advanced topics in literature, language or communication studies.

COM 601
Research and Methodologies

This course explores the theory and practice of designing research projects for studying and solving problems in the discipline. The goal of the course is to enable students to study and evaluate research methodologies for a variety of functional contexts and to develop a knowledge base for their own research applications. The course focuses on the methods of empirical research in technical communication and information design. Credit Hours: 3

COM 691
Research and Thesis Ph.D.

This is a variable credit course for Ph.D. candidates working on their dissertation. Credit hours: 1-20. Prerequisites: Ph.D. candidates only.

Ethics in the Professions

SEP 501
The Foundation of Ethics in the Professions, Business and Government

Sources and substance of business and government standards and professional codes, focusing on issues that concern all these institutions— for example, confidentiality, loyalty, conflict of interest, and obligations to the public.

SEP 503
Doing Business and Engineering Around the Globe: Ethics and Cultural Differences in the Workforce and in the

Foreign Locale

Issues raised by real and apparent differences in standards in different countries, with attention to bribery, compensation standards, and workplace safety, as well as cultural differences in the composition of the workforce in the home country and abroad and issues of respect for persons and fair treatment that arise.

SEP 505
Environmental Issues: Practical and Responsible Approaches

Responsibilities of members of business and government organizations and of the professions with respect to activities that have impact on the environment, such as strategies for engineers who design or oversee plant processes that affect the environment. Areas to be covered include water quality, energy, transportation, packaging and waste disposal.

SEP 507
Facing the Future: Ethics and Technological and Social Change

Issues such as privacy, ownership and responsibility generated by information technologies in the online world that is taking shape, with a focus on impacts of computers in business, government and the professions, as well as issues associated with gene patenting, gene therapy, food technology (including issues about testing and labeling), and sophisticated biomedical engineering.

Undergraduate level courses applicable to degrees and certificates

COM 401
Advanced Composition and Prose Analysis

Critical analysis of various types of prose, with stress on the art as well as the craft of writing. The student is required to write several critical papers. Prerequisite: Satisfaction of IIT's Basic Writing Proficiency Requirement. (3-0-3) (C)

COM 421
Technical Communication

Principles and practice in the communication of technical materials. Students work on the design, writing

and revising of reports, articles, manuals, procedures and proposals, including the use of graphics. Works by modern writers are analyzed. Credit not granted for both COM 421 and MT 301. Prerequisite: Satisfaction of IIT's Basic Writing Proficiency Requirement. (3-0-3) (C)

COM 423
Communication in the Workplace

A study of communication related to science and technology in entrepreneurial, corporate, government, and public service environments. This course focuses on problem-solving genres (proposals and recommendation reports) and on common patterns of ideas found in such documents (e.g., process/steps, whole/parts, event/effects, event/causes, claim/reasons). Prerequisite: Satisfaction of IIT's Basic Writing Proficiency Requirement. (3-0-3) (C)

COM 424
Document Design

Theory and practice of designing scientific, technical, and business documents whose primary aim is usability. Focus on overall organization, page design, visuals and typography. Emphasis on print genres such as brochures, reports, and user manuals, but with attention to parallels in screen-based media (Web, CD-ROM). (3-0-3)

COM 425
Editing

Principles and strategies for revising technical and scientific works for usability, clarity, consistency and reliability. Examination of professional standards and practices for text, tables, graphics and documents, but with emphasis on cohesion (signals of the line of thought), style and usage. (3-0-3)

COM 428
Verbal and Visual Communication

Introduces students to the issues, strategies, and ethics of technical and professional presentation, and provides students with opportunities to engage in public address, video presentations and conferencing, and group presentations. Analysis of

audience types and presentation situations, group dynamics, persuasive theories, language and mass media. (3-0-3)

COM 430
Introduction to Web Design and Management

Presupposing only that students know how to use a web browser, this course teaches beginning HTML, basic page layout and design principles, basic multimedia, and the structures of websites, and also introduces students to WYSIWYG webpage-generation software and FTP software. (3-0-3)

COM 431
Intermediate Web Design and Management

A continuation of COM 430, this course goes more deeply into HTML, multimedia, and some of the advanced features of WYSIWIG editors. Prerequisite: COM 430 or permission of instructor. (3-0-3)

COM 432
Advanced Web Design and Management

A continuation of COM 430 and COM 431, this course covers the most current web technologies. Prerequisite: COM 431 or permission of instructor. (3-0-3)

COM 435
Intercultural Communication

An introduction to the problems of communication across cultures, with emphasis on the interplay of American civilization with those of other cultural areas. Prerequisite: A 100-level humanities course and junior standing. (3-0-3) (H) (C)

COM 437
Video Documentation

Video Documentation Planning and managing digital-video projects to document concepts and procedures in technology, science, business, and education. Attention to scripting, shooting, editing, and distribution media. Students will work on individual activities and collaborate on a community-service or other client-centered project. (C) Credit Hours: 3

COM 438
Technical Exhibit Design

Technical Exhibit Design Planning and managing informative and instructional exhibits in technical, scientific, and business contexts. Attention to characteristics and constraints of space, multimedia, and other resources, along with principles and goals of viewer access and flow. Students will work on individual activities and collaborate on a community-service or other client-centered project. Instruction will incorporate Chicago-area resources such as the Museum of Science and Industry. (C) Credit Hours: 3

COM 440
Introduction to Journalism

Introduction to the principles and practices of modern American journalism. Students will analyze news stories and media, and will cover and report on campus area events. Student-generated news stories will be discussed, analyzed and evaluated. (H,C) Credit Hours: 3 Prerequisites: A 100-level humanities course.

Other Undergraduate Courses Available to Graduate Students

AAH 491
Independent Reading and Research in Art and Architectural History

CS 460
Fundamentals of Multimedia

EG 425
Computer Graphics for Non-Engineers

HIST 491
Independent Reading and Research in History

PHIL 491
Independent Reading and Research in Philosophy

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Faculty Emeriti

William Applebaum
Associate Professor of
History, 1972–1995

Robert Arzbaecher
Professor of Electrical
Engineering and Director
of the Pritzker Institute of
Medical Engineering,
1981-2001

Charles R. Bauer
Associate Professor of
Computer Science,
1985–1996

Robert John Bonthron
Professor of Mechanical
and Aerospace
Engineering, 1947–1991

Fred P. Bosselman
Professor of Law,
1991-2003

Harold Walter Bretz
Associate Professor of
Microbiology, 1957–1986

Norman Nathan Breyer
Professor of Metallurgical
and Materials
Engineering, 1964–1991

Ilene J. Burnstein
Associate Professor of
Computer Science,
1986–2003

Ray Aaron Burnstein
Professor of Physics,
1965–2001

George D. Byrne
Professor of Applied
Mathematics, 1994–1998

Thomas Manuel Calero
Associate Professor of
Management, 1968–1993

Kwang–Han Chu
Professor of Civil
Engineering, 1956–1984

**Joseph San–Hoon
Chung**
Professor of Economics,
1964–1995

Martin Alvin Cohen
Associate Professor of
Economics Management,
1964–1980

William White Colvert
Associate Professor of
Physics and Director
of the Evening Division,
1919–1964

George Edson Danforth
Professor of Architecture,
1940–1981

William Frank Darsow
Associate Professor of
Mathematics, 1961–1990

Pearce Davis
Professor of Economics,
1948–1973

John DeCicco
Professor of Mathematics,
1962–1976

Platon C. Deliyannis
Professor of Applied
Mathematics, 1962–2001

Lloyd Hamilton Donnell
Research Professor of
Mechanics, 1939–1962

John Drac
Associate Professor of Law,
1957–1980

John Thomas Dygdon
Professor of Engineering
Graphics, 1952–1996

Joseph A. Erwin
Associate Professor of
Biology, 1967–2001

Martha Evens
Research Faculty of
Computer Science,
1975-2000

Paul Edward Fanta
Professor of Chemistry,
1948–1984

Andrew Akos Fejer
Professor of Mechanics and
Mechanical and Aerospace
Engineering, 1958–1978

Robert Filler
Professor of Chemistry,
1955–1994

Glen O. Geist
Professor of Psychology,
1971-2003

Lois Graham
Professor of Mechanical
Engineering, 1949–1985

Nicholas Grecz
Professor of Microbiology,
1963–1982

Peter H. Greene
Research Professor of
Computer Science,
1974-2000

Sidney A. Guralnick
Perlstein Distinguished
Professor of Engineering
1958-2004

R. Ogden Hannaford
Professor of Architecture,
1960–1986

Boyd A. Hartley
Associate Professor of Fire
Protection and Safety
Engineering, 1966–1985

Isidore Hauser
Professor of Physics,
1958–1986

Warren Heindl
Professor of Law,
1949–1994

Fred F. Herzog
Professor of Law and Dean
of Chicago–Kent College
of Law, 1947–1973

Geoffrey Trevor Higgins
Professor of Materials
Engineering, 1969–1998

Robert Francis Irving
Associate Professor of
English, 1967–1995

Donald Komen Jasper
Professor of Biology,
1969–1996

Serope Kalpakjian
Professor of Mechanical
and Materials
Engineering, 1963-2001

Henry Knepler
Professor of English,
1947–1989

Daniel Koblick
Associate Professor of
Physiology, 1963–1991

Willis George Labes
Professor of Fire Protection
Engineering, 1946–1979

Zalman Lavan
Professor of Mechanical
and Aerospace
Engineering, 1965–1991

Robert Joseph Malhiot
Professor of Physics,
1956–1987

Jordan J. Markham
Professor of Physics,
1962–1981

Kenneth Phillip Milbradt
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Engineering, 1946–1985

**Mark Vladimir
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Professor of Mechanical
Engineering, 1967–1982

Lester Charles Peach
Professor of Electrical and
Computer Engineering,
1956–1987

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Associate Professor of
Applied Mathematics and
Dean of Graduate Studies,
1954–1994

Faculty Emeriti

Robert William Porter
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and Aerospace
Engineering, 1966-2001

Bernard Rasof
Professor of Mechanical
Engineering, 1964–1982

John Theodore Rettaliata
Professor of Mechanical
Engineering and President
Emeritus, 1945–1973

Robert Mark Roth
Professor of Biology,
1968-2003

Allan H. Roush
Professor of Biochemistry,
1951–1982

Abe Sklar
Professor of Mathematics,
1956–1995

Spencer B. Smith
Professor of Management
Sciences and Industrial
Management, 1966–1996

Harold Norman Spector
Professor of Physics,
1966–2001

Leon Eugene Stover
Professor of Anthropology,
1965–1995

Paul Amandus Thomas
Associate Professor of City
and Regional Planning,
1958–2003

T. Paul Torda
Professor of Mechanical
Engineering and Director
of the E^3 Program Center,
1962–1977

San Utsunomiya
Associate Professor of
Architecture, 1966–1993

John Lawrence Way
Professor of Mechanical
and Aerospace
Engineering, 1970–2001

Erwin Wilbur Weber
Associate Professor of
Electrical and Computer
Engineering, 1961–1998

Dale Arroy Webster
Professor of Biology,
1968–2001

William F. Zacharias
Professor of Law and Dean
of the Chicago–Kent
College of Law, 1933–1970

David Mordecai Zesmer
Professor of English,
1962–1992

Earl Frederick Zwicker
Professor of Physics,
1956–1991

Maps

Main Campus

To Chinatown
To Downtown
Dan Ryan Expwy. (90/94)
State St.
Michigan Ave.

Stuart Field
Stuart
Keating

← To Dan Ryan Expwy. (Bridgeport)
31st St.
To Lake Shore Drive →

Life Sciences
Bailey
Cunningham

Morton Park
E1
Gunsaulus

VanderCook College of Music
Carman
PERMIT PARKING

PERMIT PARKING

Alumni
Chapel
Commons
North
Fowler

1 N

Hermann Union Building
South
East

Perlstein
Wishnick
McCormick Tribune Campus Center
McCormick Student Village
Graduate

Machinery
Lewis

Red Line E

32rd St.
33rd St.

PERMIT PARKING
U.S. Cellular Field

Main
Siegel
Farr

Galvin Library
State Street Village
PKP
Greek Housing
LAW
SPE
TX
DTD
Crown
ASP
PKS
TRI

34th St.
34th St.

Aspect Intensive English Institute

IIT Biomedical Research & Development Complex
IIT Tower

Red Line E
← To U.S. Cellular Field
Green Line E
35th St.
Chicago Police Headquarters

MAIN CAMPUS MAP
V = Visitors' Metered Parking   E = Entrance to CTA Line

ILLINOIS INSTITUTE OF TECHNOLOGY

Downtown Campus and Institute of Design

Randolph

Washington

Des Plaines
Jefferson
Clinton
Canal
Madison

Monroe Street

Adams Street

Wacker Drive
Franklin

■ IIT Downtown Campus

Jackson Blvd.

Van Buren Street

Eisenhower Expwy. (290) / Congress Pkwy

Rice Campus

38 Roosevelt Road 38

Naperville Road
Blanchard Road
53

355
56

Jahn's Drive
Rice Campus Wheaton
West Loop Road
East Loop Road
56
Butterfield Road

Butterfield Road
Naperville Road
53
North/South Tollway
88

Warrenville Road

88 East-West Tollway

Ogden Avenue
355

S N
Map Not to Scale

Getting to the Main Campus

Airports
IIT and Chicago are served by O'Hare International Airport and Midway Airport. Public and private transportation is available from the airports to downtown Chicago and IIT campuses.

Train
Commuter railroads to Union and Northwestern train stations (both off Canal Street), then public transportation, taxi or IIT shuttle bus from the Downtown Campus at 565 W. Adams Street to Main Campus.

Bus
To Greyhound terminal, then taxi or public transportation to IIT.
Public Transportation
1. CTA Red Line (Howard-Dan Ryan) to 35th Street Station.
2. CTA Green Line (Lake-Englewood-Jackson Park) to 35-Bronzeville-IIT station.
3. CTA bus lines with stops on State Street (#29) or Michigan Avenue (#35).

Automobile
From North: Dan Ryan Expressway east to 31st Street exit, continue south to 33rd Street, turn left (east) to just past State Street. Visitor parking is on the right (southeast corner). From South: Dan Ryan Expressway west to 35th Street exit, continue north to 33rd Street, turn right (east) to just past State Street. Visitor parking is on the right (southeast corner). From Lake Shore Drive: Exit at 31st Street, go inland (west) to State Street, turn left (south) to 33rd Street, turn left and visitor parking is on the right (southeast corner).

Parking
Some visitor parking is available in lots at the southeast corner of 33rd and State streets and the northeast corner of 31st and State streets. By special arrangement, events parking is usually available in the fraternity lot at 33rd and Wabash and, for evening events, in the lot west of Hermann Union Building. A few hourly spaces are available just south of the Commons Building and west of Hermann Union Building. Please call the Public Safety Department at 312.808.6300 if you need assistance in finding parking.

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