

Foreword

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 2014-2015 and 2015-2016. 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 advisor from the student's major department is the best source for current curriculum information. Updates are also listed on www.iit.edu/graduate_college/. The graduate dean's office can also refer students to the appropriate administrative office for current policies and procedures.

Illinois Institute of Technology is a multicultural community that values and respects its members. We take pride in the fact that our faculty, staff, and students come from various backgrounds and all parts of the world, and we welcome their diverse perspectives and contributions. It is our policy to provide a working and learning environment in which faculty, staff, and students are able to realize their full potential as productive members of the IIT community.

To this end, IIT affirms its commitment to equal opportunity and nondiscrimination in employment and education for all qualified individuals regardless of race, religion, color, national origin, gender, age, sexual orientation, gender identity, disability, applicable veteran status, or any other characteristic protected by applicable federal, state, or local law. Further, IIT is committed to taking affirmative action to increase opportunities at all levels of employment and to increase opportunities for participation in programs and activities by all faculty, staff, and students.

Every member of the IIT community: faculty, staff, and student, is expected to cooperate fully in meeting these goals.

Any student, applicant, or employee of Illinois Institute of Technology 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, Equal Employment Opportunity and Affirmative Action, IIT Tower, Illinois Institute of Technology.

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

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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.

Accreditation

IIT is accredited by the Higher Learning Commission of the North Central Association of Colleges and Schools. www.ncahlc.org

Specific professional curricula are accredited by the Engineering Accreditation Commission and the Computing Accreditation Commission 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.

Graduate College

Christopher White, Vice Provost for Academic Affairs
Jamshid Mohammadi, Associate Dean
of Graduate College
10 W. 35th St.
Suite 7D7-1
Chicago, IL 60616
312.567.3024
www.iit.edu/graduate_college/

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 Academic Affairs; Graduate Enrollment; and

the Office of Editorial Assistance (Thesis Examiner). The associate dean chairs the Graduate Studies Committee, 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.

31 separate Master of Science (M.S.) degrees, which typically include a thesis requirement, are offered. The professional Master's (MAS) degree, which does not require a thesis, has 53 separate offerings. Doctoral degrees (Ph.D.s) are offered in 22 fields.

The Colleges of Illinois Institute of Technology

Armour College of Engineering

Natacha DePaola
Carol and Ed Kaplan Armour Dean of Engineering
Perlstein Hall, Suite 224
10 W. 33rd St.
Chicago, IL 60616
312.567.3009
www.iit.edu/engineering

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 100 full-time faculty, more than 2,500 undergraduate, graduate and doctorate students, and the academic 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 (ABET). All IIT graduate and undergraduate programs are also accredited by the North Central Association (NCA).

The mission of 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.

Chicago-Kent College of Law

Harold J. Krent, Dean
Downtown Campus
565 West Adams Street
Chicago, IL 60661
312.906.5000
www.kentlaw.iit.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, Master of Laws, and Doctor of the Science of Law, and participates in joint-degree programs with IIT Stuart School of Business and the University of Illinois-Chicago.

College of Architecture

Wiel Arets, Dean
S.R. Crown Hall
3360 S. State St.
Chicago, IL 60616
312.567.3230
www.iit.edu/arch

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, a National Historic Landmark, one of Mies' most significant buildings, and a major contribution to Chicago's rich architectural heritage. The College emphasizes applied studio work under the instruction of practicing architects; the study of architectural theory; interdisciplinary learning; digital technologies; sustainability; design/build; and international study.

College of Science

R. Russell Betts, Dean
220 Engineering 1 Building
10 W. 32nd St.
Chicago, IL 60616
312.567.3800
science.iit.edu

IIT College of Science traces its roots to the Lewis Institute, founded in 1895, and to Armour Institute of Technology, founded in 1892. The college offers more than 90 rigorous and relevant programs in mathematics and the sciences at the undergraduate and graduate level (including master's, professional master's, and Ph.D.) through five departments: Applied Mathematics; Biological and Chemical Sciences; Computer Science; Mathematics and Science Education; and Physics.

Institute of Design

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

Since its founding as the New Bauhaus in 1937, the Institute of Design has grown into the largest full-time graduate-only design program in the U.S. with students from around the world. The school offers a professional

Master of Design degree program with areas of study in communication design, interaction design, product design, strategic design, systems thinking, and user research; a dual Master of Design/M.B.A. degree program in partnership with the IIT Stuart School of Business; the Master of Design Methods, a nine-month program for mid-career professionals; and a Ph.D. in Design. The Institute of Design created the country's first Ph.D. design program in 1991.

Lewis College of Human Sciences

Christine Himes, Dean
IIT Tower, Suite 1400
10 W. 35th St.
Chicago, IL 60616
312.567.3580
www.iit.edu/human-sciences

Lewis Institute was founded in 1895; in 1940 it was brought together with Armour Institute to create IIT. We proudly bear the Lewis name and house the departments of Humanities, Psychology and Social Sciences. IITs

Lewis College of Human Sciences rests at the nexus of knowledge, methods for discovery, human thought, and action. Human sciences enable us to explore and explain the world at a time when technological innovation frames the world in which we live. Our programs emphasize the free spirit and broad perspectives of a traditional liberal arts program with the quantitative and technical rigor of science and methods. In addition to traditional undergraduate programs, we offer six unique interdisciplinary undergraduate programs with partners such as the business school. We also offer professional graduate training in psychology and technical communication.

School of Applied Technology

C. Robert Carlson, Dean
10 W. 33rd St.
Perlstein Hall 223
Chicago, IL 60616
312.567.5290

Daniel F. and Ada L. Rice Campus
201 East Loop Road
Wheaton, IL 60187
630.682.6000
applied.tech.iit.edu

The School of Applied Technology (SAT), established in 2010; was formed to prepare students to become innovators, entrepreneurs, and leaders of the future. Programs and courses at the School of Applied Technology provide a blend of theoretical content and practical application that utilize a hands-on, reality-based approach to education. The degree and certificate programs provide an innovative experience where students work on cutting-edge, industry-sponsored projects, allowing students to apply what they learn in class to solve real-life problems.

IIT SAT offers Bachelor's and Master's degrees from the Department of Information Technology & Management in Information Technology & Management and in Cyber Forensics and Security; Master's degrees from the Department of Food Science & Nutrition in Food Process Engineering and Food Safety & Technology; and Bachelor's and Master's degrees from the Industrial Technology & Management program in Industrial Technology & Management.

IIT SAT is affiliated with the renowned Institute for Food Safety & Health and hosts the Center for Cyber Security and Forensics Education (C2SAFE) and the Center for Innovation Science and Applications.

In addition to degree-seeking programs, the School of Applied Technology, through its Office of Professional Development and IIT Online, combines university-wide resources to establish a common administration and support structure for online and non-degree programs. Programs include: University wide ESL assessment and instruction, technology-oriented training and certificates, employee and professional development, and short courses and seminars.

Stuart School of Business

Harvey Kahalas, Dean
IIT Tower 18th Floor
10 W 35th Street
Chicago, IL 60616
312.906.6500
www.stuart.iit.edu

IIT Stuart School of Business provides intellectually rigorous business and management education at all levels, from baccalaureate to doctoral. All IIT Stuart programs are designed to educate tomorrow's global innovators through the unique concept of strategic competitiveness. Constructs including creativity, innovation, entrepreneurship, incisiveness, leadership, and sustainability are interwoven throughout coursework and professional development opportunities, offering students thorough preparation for the challenges of the next economy.

IIT Stuart was established in 1969 with a gift from IIT alumnus and noted financier Harold Leonard Stuart. The school houses the IIT Entrepreneurship Academy, the Center for Financial Innovation, and the Center for Strategic Competitiveness.

IIT Stuart offers the following degrees: B.S. in Business Administration, Co-Terminal B.S.B.A and M.P.A., Master of Business Administration (M.B.A.), Masters of Mathematical Finance (M.M.F.) offered in partnership with IIT College of Science Applied Mathematics Department, M.S. in Environmental Management and Sustainability, M.S. in Finance, M.S. in Marketing Analytics and Communication, Master of Public Administration (M.P.A.), and Ph.D. in Management Science. A series of dual degrees with IIT's Chicago-Kent College of Law and IIT's Institute of Design are also offered, as well as numerous Graduate Certificate Programs.

IIT History and Campuses

In 1890, when advanced education was often reserved for society's elite, Chicago minister Frank Wakely Gunsaulus delivered what came to be known as the "Million Dollar Sermon." From the pulpit of his South Side church, near the site Illinois Institute of Technology now occupies, Gunsaulus said that with a million dollars he could build a school where students of all backgrounds could prepare for meaningful roles in a changing industrial society.

Inspired by Gunsaulus' vision, Philip Danforth Armour, Sr. (1832-1901) gave \$1 million to found the Armour Institute and Armour, his wife, Malvina Belle Ogden Armour (1842-1927) and their son J. (Jonathan) Ogden Armour (1863-1927) continued to support the university in its early years. When Armour Institute opened in 1893, it offered professional courses in engineering, chemistry, architecture, and library science.

Illinois Tech was created in 1940 by the merger of Armour Institute and Lewis Institute. Located on the west side of Chicago, Lewis Institute, established in 1895 by the estate of hardware merchant and investor Allen C. Lewis, offered liberal arts as well as science and engineering courses for both men and women. At separate meetings held by their respective boards on Oct. 26, 1939, the trustees of Armour and Lewis voted to merge the two colleges. A Cook County circuit court decision on April 23, 1940 solidified the merger.

The Institute of Design (ID), founded in Chicago by László Moholy-Nagy in 1937, merged with Illinois Tech in 1949.

Chicago-Kent College of Law, founded in 1887, became part of the university in 1969, making Illinois Institute of Technology one of the few technology-based universities with a law school.

Also in 1969, the Stuart School of Management and Finance - now known as the Stuart School of Business

- was established thanks to a gift from the estate of Lewis Institute alumnus and Chicago financier, Harold Leonard Stuart. The program became the Stuart School of Business in 1999.

The Midwest College of Engineering, founded in 1967, joined the university in 1986, giving Illinois Tech a presence in west suburban Wheaton with what is today known as the Rice Campus-home to Illinois Tech's School of Applied Technology.

In December 2006, the University Technology Park at Illinois Institute of Technology, an incubator and life sciences/tech start-up facility, was started in existing research buildings located on the south end of Main Campus. As of April 2014, the University Tech Park at Illinois Institute of Technology is home to many companies.

Today, IIT is a private, Ph.D.-granting university with programs in engineering, science, human sciences, applied technology, architecture, business, design, and law. One of the 22 institutions that comprise the Association of Independent Technological Universities (AITU), IIT offers exceptional preparation for professions that require technological sophistication. Through a committed faculty and close personal attention, IIT provides a challenging academic program focused by the rigor of the real world.

The university has five campuses in the Chicago area. The 120-acre Main Campus, centered at 33rd and State Streets in Chicago, as well as many of its buildings, was designed by Ludwig Mies van der Rohe, who directed the architecture program (arch.iit.edu) at IIT from 1938 to 1958 and was one of the 20th century's most influential architects. S. R. Crown Hall, home of IIT College of Architecture, was named a National Historic Landmark in 2001, and part of the IIT Main Campus was entered into the National Register of Historic Places in 2005.

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 south-western 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 2013)		Student Demographics		Degrees Awarded 2012-2013	
Undergraduate	2,926 students	Male	64%	Bachelor	612
Graduate	3,913 students	Female	36%	Master	1,574
Law	1,011 students	Minority*	17%	First Professional	285
Total	7,850 students	International	46%	Ph.D.	98
		Countries of Origin	94	Total	2,569
		Student/Faculty Ratio	12:1		

* Includes African American, Asian American, Hispanic American, and Native American

IIT Administration

The administration of Illinois Institute of Technology may be found on IIT's website.

Board of Trustees
<http://web.iit.edu/president/board-trustees>

Senior Administration
<http://web.iit.edu/president/senior-administration-and-contacts>

Office of the Provost: Administrative Offices
<http://web.iit.edu/provost/administrative-offices>

Office of the Provost: Academic Offices
<http://web.iit.edu/provost/academics>

Academic Resource Center

www.iit.edu/arc

The Academic Resource Center (ARC) is a comprehensive center with a variety of services for students and faculty. The ARC's mission is to enrich the academic experience through a student-centered approach to learning. The ARC provides peer tutoring in Mathematics, Architecture, Engineering, and the sciences on a drop-in basis and by appointment.

Undergraduate and graduate peer tutors are available during the fall, spring, and summer semesters. In addition to peer tutoring, the ARC also offers exam reviews,

workshops, supplemental instruction, group study space, and an OTS computer laboratory including PCs and Macs. The ARC also keeps some textbooks and iPads with academic apps, for your reference.

The ARC is located in the northwest corner of the Hermann Hall Building, Room 112. The ARC is open Monday through Thursday, 10:00 a.m. to 8:00 p.m., Friday, 10:00 a.m. to 3:00 p.m., and Sunday from 6:00 p.m. to 9:00 p.m. For more details, visit the ARC website: www.iit.edu/arc or call 312.567.5216.

Access, Card, and Parking Services

www.iit.edu/acaps

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 TechCash balances. Permits to park in IIT lots are available for purchase on an annual, academic year, or monthly basis. Students should visit Access, Card, and Parking Services in Hermann Hall, Room 201, for more information, or visit www.iit.edu/acaps.

Athletics and Recreation

www.illinoistechathletics.com

The Department of Athletics offers a comprehensive program of varsity sports, intramural competition, instruc-

tion, and formal recreation activities for both men and women.

Athletics

Illinois Tech is currently transitioning to NCAA Division III and is beginning year two of the provisional stage. The sports program field's competitive teams in 13 sports: men's and women's swimming and diving, cross country, track and field, basketball, and soccer, as well as men's baseball, women's lacrosse and women's volleyball.

Illinois Tech is a member of the United States Collegiate Athletic Association (USCAA) as a full member for 2014-2015. The USCAA focuses specifically on smaller institutions of higher learning and will provide current Scarlet Hawk student-athletes the opportunity to compete for National Championships and student-athlete accolades as IIT transitions to NCAA Division III full status.

The 8 USCAA sponsored sports that Illinois Tech has sports teams are baseball, men's basketball, men's cross-country, men's soccer, volleyball, women's basketball, women's soccer, and women's cross country.

IIT Women's Lacrosse will be a member in the Midwest Lacrosse Conference in 2014-15. IIT Men's and Women's Swimming competes in the Liberal Arts Conference in 2014-15. IIT Men's and Women's Swimming competes in the Liberal Arts Championships. Men's and Women's Track and Field compete in several prestigious invitational events.

Recreation

The Intramurals and Recreation program offers a variety of fun, recreational, social, and competitive activities for IIT students regardless of experience and ability. Traditional offerings include basketball, volleyball, flag football, dodgeball, soccer, and softball. Other sports include racquetball, badminton, cricket, kickball, and ultimate frisbee. Fitness classes are also available for students including, but not limited to yoga, Zumba, Salsa

dancing, and Pilates. In addition, we offer open recreational play in basketball and volleyball along with open swimming in the Keating Sports Center pool. Moreover, IIT has the only disc golf course in Chicago proper, which gives students another recreational outlet and makes our university a popular destination for local area disc golf enthusiasts.

Campus Life

www.iit.edu/campus.life

The Office of Campus Life provides campus programs and events designed to enhance the student educational experience outside of the classroom. Campus Life manages the campus Orientation Program, Freshman Year Experience (FYE) programming, and provides direct

oversight to more than 100 student organizations, including the Student Government Association and Union Board. Other registered student organizations represent a variety of student interests in areas such as culture, recreation, academics, and the arts.

Career Management Center

www.cmc.iit.edu

Located in Herman Hall, 111 and 113, the Career Management Center (CMC) offers individual career advising and testing, résumé critiques, job search strategies, mock interviews, and labor market and salary data. The CMC also administers the Cooperative Education Program and the Internship Program, 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 CMC conducts a variety of professional development workshops on topics including résumé and cover letter writing, job search strategies, communications, and interviewing skills. The CMC also hosts biannual career fairs, employer spotlights, and on-campus interviews. Career related resources, workshop schedules, and a link to job postings may be accessed by students and alumni registered in JOBS4HAWKS (www.cmc.iit.edu). Individual sessions with a career counselor may be scheduled by appointment at 312.567.6800.

Cooperative Education Program

www.cmc.iit.edu

312.567.6800

Cooperative education is a learning approach that integrates university studies with professional work experience in industry, business, or government. Salaries among IIT co-op students are competitive and help defray educational expenses. The co-op experience improves employment opportunities upon graduation. Graduate students must meet co-op and internship eligibility requirements.

Part-time employment opportunities may be available for students both on and off campus. Positions may be career related co-ops or internships, part-time, or seasonal work. Co-ops, internships, and on campus jobs are posted in the Career Management Center (CMC) NACElink database.

Students interested in and eligible for employment off campus in their field of study may get job search assistance from the CMC and must attend an Introduction to Cooperative Education and Internship Workshop conducted by the CMC. Workshop schedules are posted at www.cmc.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 an F1 visa may be eligible for opportunities off campus (only if related to their field of study) through the Cooperative Education Program or the Internship Program.

Policies for graduate students:

- Graduate students enrolled in a summer coop or internship on a full-time basis are not eligible to register for a course during the summer semester.
- Graduate students enrolled in a fall or spring coop or internship on a full-time basis, for 9 credits, and who are in good academic standing (cumulative GPA 3.0/4.0) may register for 3-6 credits of academic course enrollment, which is equivalent to 15 hours of registration.
- Graduate students who have earned academic probation, from the prior semester (cumulative GPA below 3.0/4.0) are not eligible to apply for a coop or Internship, for the first time, until the cumulative GPA is raised to 3.0/4.0.
- Graduate students who have earned academic probation, during a semester in which enrollment in a coop or internship is concurrent with academic course registration, are not eligible for continued enrollment in a coop or internship without prior approval of the Associate Dean for Graduate Academic Affairs.
- Graduate students, who are completing a 2nd degree at IIT, when the 1st degree was also earned at IIT, are eligible for a coop or internship, after one semester of full-time graduate enrollment, in a fall or spring semester.
- Graduate students, who are completing a 2nd degree at IIT, when the 1st degree was earned at a different institution, are eligible for a coop or internship after two semesters of full-time graduate enrollment, in fall and spring semesters.

Campus Resources

Part-Time Employment

www.iit.edu/financial_aid/student_employment

Part-time employment opportunities may be available for students both on and off campus. Positions may be career related co-ops or internships, non-Federal Work Study jobs, part-time, or seasonal work. Co-ops, internships, and on campus jobs are posted in the Career Management Center (CMC) JOBS4HAWKS database. Federal Work Study positions and information can be found on the Financial Aid website www.iit.edu/financial_aid/student_employment. Graduate students should note that they are not eligible for some of these positions.

Students interested in and eligible for employment off campus in their field of study may get job search assis-

tance from the CMC and must attend an Introduction to Cooperative Education and Internship Workshop conducted by the CMC. Workshop schedules are posted at www.cmc.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 an F1 visa may be eligible for opportunities off campus (only if related to their field of study) through the Cooperative Education Program or the Internship Program.

Communication Across the Curriculum Program

www.iit.edu/cac

The Communication Across the Curriculum (CAC) Program helps students understand the role of writing and speaking in their academic and professional lives. Both on its website (www.iit.edu/cac) and through the IIT Writing Center (see page 23), located in Siegel Hall 232/233/234, 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), communication-intensive courses (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 Campus Life in the McCormick Tribune Campus Center.

Disability Resources

www.iit.edu/cdr

Services for persons with disabilities are coordinated by the Center for Disability Resources. Persons with disabilities who are interested in applying for admission to any of IIT's education programs are invited to call the center or to email disabilities@iit.edu prior to their arrival

on campus to discuss their individual needs. Enrolled students with disabilities are encouraged to contact the director of the Center for Disability Resources to register and request accommodations.

Fraternity and Sorority Life

Website: www.iit.edu/housing/greek_life

The Greek community at IIT is focused on giving students the chance to learn both inside and outside of the classroom. IIT's six fraternities and three sororities uphold their own missions through brotherhood and sisterhood activities. These groups also concentrate heavily on the values of their organizations by participating in regular philanthropic and community service events. Each

fraternity and sorority has its own operating structure and allows students to develop valuable leadership and interpersonal skills. Academics and scholarship are an integral part of the Greek system, and the community works hard to uphold rigorous scholastic standards as a part of their daily functioning. Membership is open to both residential and commuter students.

Idea Shop

ipro.iit.edu/ideashop

A catalyst for innovation, the Idea Shop is a 13,000-square-foot facility composed of a state-of-the-art 3D rapid prototyping lab, a Dell laptop lab, an iPad library, an iMac lab for mobile app development and video editing, collaborative teaming areas, formal classrooms, and flexible open spaces. The Idea Shop is home to IIT's Interprofessional Projects Program (IPRO), entrepreneurship initiatives, and the Exelon Summer Insitute, an accelerated program for incoming first-year students. The Idea Shop is located in the University Technology Park at IIT, a newly remodeled incubator

space for researchers and companies requiring robust infrastructure.

The Idea Shop helps to build the competency and professional perspectives of IIT students at all levels. It is an inviting place for returning alumni, students, and prospective students to interact and participate in workshops. The Idea Shop also serves the Chicago-area entrepreneurial community and facilitates the process by transforming student and faculty generated ideas into actual businesses, products, and patents.

IIT Online

IIT was one of the first universities in the Chicago area to offer microwave delivery of live courses to area companies. As early as 1977, IIT was delivering course lectures to remote students and over the years, IITV - as IIT Online was then known - delivered countless hours of courses and programming to as many as 72 corporate and non-corporate locations. IIT Online continues that strong tradition - video lecture capture is a distinctive hallmark of an IIT Online course.

IIT Online delivers over 9000 course lectures per year from interactive video conferences to on-demand internet access. That represents over 400 hundred courses from almost every academic department. IIT Online supports students and faculty in these courses with:

- Student Services - staff coordinate room scheduling, exams, proctors, exam & homework return, as well as troubleshoot technical issues like video playback, etc.
- Production - student technical directors are used for every class session of every course to record faculty instruction and ensure a quality recording;

- Faculty Support - staff assist faculty with Blackboard and instructional design services.

Most online programs are designed for graduate students and courses follow the same 16-week semester academic calendar as the University. Courses have the same faculty, and follow the same syllabus. If the course uses exams, exams follow the same schedule. Exams are typically administered at local testing centers for students in the United States.

Prospective students who wish to take courses online at Illinois Institute of Technology must first be admitted to a degree, certificate, or professional development program. Individuals are welcome to apply to take courses in a non-degree capacity, but please note that non-degree status does not confer automatic admission into a degree-granting program and limits to the number of overall credits that can be taken.

Students taking IIT Online courses are IIT students and are subject to all of the same policies and procedures as on-campus students in face-to-face courses.

International Center

www.ic.iit.edu

The purpose of the International Center is to promote international education and cultural exchange by (1) supporting international students, faculty, staff, and students studying abroad, (2) assisting in the compliance of immigration and other related regulations, (3) providing study abroad advising for students interested in studying in another country, and (4) providing services and resources to the IIT community. These services include: individual and group orientations to the University and community; assistance with document preparation for employment and other related non-immigrant benefits;

workshops for faculty, staff, and students on issues affecting international students and scholars; cross-cultural activities and programs that promote intercultural perspectives and address adjustment issues; study abroad advising for students interested in studying in another country.

All international students, scholars, and faculty are required to report to the International Center immediately upon arrival.

Interprofessional Projects

www.ipro.iit.edu

The Interprofessional Projects (IPRO) Program coordinates the IPRO course, a general education requirement for all undergraduates and a possible elective for graduate students. The IPRO course organizes students in semester-long multidisciplinary project team sections based on contemporary problem-solving challenges that are proposed by students, faculty members and sponsoring organizations 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, business and social challenges with faculty and sponsor mentors. Entrepreneurial IPRO (EnPRO) teams address the added challenge of developing a

technological entrepreneurship opportunity analysis that can lead to 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 (applied technology, architecture, business, design, engineering, law, political science, technical communication, psychology, and the sciences). Integrating these perspectives within a project team stimulates student and faculty interaction across the boundaries of individual disciplines and experiences. Learn more and review the current or future course listings by visiting <http://ipro.iit.edu> or the IPRO Program Office at 3424 South State Street, Central Building, 4th Floor.

Leadership Academy

Website: leadershipacademy.iit.edu

The Leadership Academy is an integral component of IIT's interprofessional approach to undergraduate education. Its objectives are to create and implement an effective leadership development curriculum for IIT undergraduate students, to identify and support students with exceptional leadership potential, and to evaluate leadership development outcomes at individual and pro-

gram levels. Currently, the academy offers scholarships and mentors to the scholarship recipients. It also offers the Sophomore Leadership Retreat, a series of engaging leadership development seminars, which any IIT full-time undergraduate student can attend and earn points toward a certificate in leadership studies.

Libraries

library.iit.edu

IIT's libraries include Paul V. Galvin Library; the Center for the Study of Ethics in the Professions (Main Campus); the Graham Resource Center (Main Campus); the Chicago-Kent College of Law Library at the downtown

Campus; the Institute for Food Safety and Health Library (Moffett Campus); and the IIT Archives (Main Campus).

Paul V. Galvin Library

library.iit.edu

As the University's central library, Paul V. Galvin Library combines digital access with traditional library services. The library's physical holdings include more than one million volumes and library spaces accommodate both individual and collaborative learning. Computers, scanners, copiers, and printers are available for patrons. Virtual services are provided 24 hours per day with access to dozens of online databases indexing millions of journal articles, approximately 62,000 full text e-journals, more than one million e-books, and I-Share, a statewide resource sharing system of more than 80 aca-

demic libraries. Galvin Library also provides web-based delivery of a variety of materials including documents requested via interlibrary loan. The library's instruction program serves the IIT community by teaching skills needed to locate, retrieve, and evaluate information. Library instructors teach at all levels from introductory to advanced and they can cover a broad range of information and retrieval techniques. Subject specialists can specifically tailor instruction sessions for coursework or programs.

Graham Resource Center **library.iit.edu/grc**

Housed in Crown Hall, the Graham Resource Center (GRC) is IIT's architecture library, serving students and faculty of the College of Architecture (COA), and a branch of Paul V. Galvin Library. The GRC supports the educational and curricular goals of the COA by acquiring, preserving, and serving materials in various media to COA students, faculty, and staff; providing reference and research assistance to patrons about architecture, landscape architecture, and city planning, and offering bibliographic instruction to all GRC and architecture researchers and users.

The collections of the Graham Resource Center includes more than 15,000 books, 40 journal titles, and many electronic resources to meet research and reference needs. The GRC also holds special collections focused on Mies van der Rohe and Chicago architecture, as well as a circulating collection of iconic chairs.

Phone number: 312.567.3256

Center for the Study of Ethics in the Professions **ethics.iit.edu**

The Center, located in Hermann Hall, contains a variety of materials dealing with topics in practical and professional ethics, such as autonomy, confidentiality, conflict of interest, and self regulation. The library provides

bibliographic assistance to students and researchers and assists visiting scholars and practitioners.

Phone number: 312.567.6913

Chicago-Kent College of Law Library **www.kentlaw.iit.edu/library**

The law library at the downtown campus serves Chicago-Kent College of Law and other IIT programs taught at the downtown facility. The law library is one of the largest in the country, with more than 500,000 volumes of legal materials covering federal, state, local, and international jurisdictions. The law library is a depository for U.S. Federal, United Nations, and European Union materials. The law librarians provide research and in-

structional assistance to faculty and students of the downtown campus, as well as tours and instruction to others who use the law library. Special collections include the Library of International Relations, the Law School Archives, and the Law School's growing institutional repository.

Phone number: 312.906.5600

Institute for Food Safety and Health Library **library.iit.edu/ifsh**

Located on IIT's Moffett Campus in Bedford Park, the Branch Library at the Institute for Food Safety and Health (IFSH) supports both the academic curriculum for IIT's Department of Food Science and Nutrition, and the food safety and technology research being conducted

at IFSH. A depository library for the FAO (Food and Agriculture Organization of the United Nations), the library provides digital access to all of the Galvin Library's databases, as well as services such as interlibrary loan, web-based document delivery, and library instruction.

One Stop **onestop.iit.edu**

The One Stop has been established to provide services to students with maximum efficiency and a minimum of confusion. This office, representing the the Offices of the Registrar, Financial Aid, Academic Affairs, and Student Accounting is the starting point for all IIT students (prospective, new, and continuing) seeking administrative and academic assistance.

At the One Stop, you can get assistance, ask questions, and be pointed in the right direction for registration, change of major, student petitions, enrollment verification, transcripts, and more. You can get personal assistance with financial account information, paying tuition and fees, housing bills, and parking tickets, as well as obtaining information about financial aid.

Registrar

www.iit.edu/registrar

The Office of the Registrar serves as the official data steward of institutional academic information and student records to support the needs of students, faculty, staff, and alumni at Illinois Institute of Technology. The office maintains accurate, timely, and secure information to

support and enforce academic policy, registration, grading, enrollment and degree certification, course information, the production of diplomas and official transcripts, and other related university functions.

Research Institutes

IIT Research Institute (IITRI)

www.iitri.org

IITRI is IIT's not-for-profit contract research affiliate. With a focus on biomedical research, IITRI's staff of approximately 100 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 Senior Vice-President and Director, can be reached at 312.567.4972.

The Institute for Food Safety and Health (IFSH)

www.iit.edu/ifsh

IFSH is a world class research institute that produces knowledge-based outcomes in the areas of food safety, food defense, and nutrition for stakeholders in government, industry, and academia. IFSH builds on and expands the vital work of the National Center for Food Safety and Technology (NCFST), a unique research consortium of IIT, the U.S. Food and Drug Administration (FDA), and the food industry. For more than 25 years, the center has provided a collaborative environment where scientists from industry, academia, and government pool their scientific expertise and institutional perspectives to ensure the production of safe, wholesome

foods. IFSH has four operating centers that support the institute: the National Center for Food Safety and Technology (NCFST), Center for Nutrition Research (CNR), Center for Processing Innovation (CPI), and Center for Specialty Programs (CSP).

Within the FDA staff, Richard McDonald is Director, Division of Food Processing Science and Technology. Within the IIT Staff, Robert Brackett, IIT Vice President and IFSH Director, can be reached at 708.563.1577 or rbrackett@iit.edu. Jason Wan, IFSH Associate Director, can be reached at 708.563.8287 or jwan1@iit.edu.

Pritzker Institute of Biomedical Science and Engineering

www.iit.edu/pritzker_institute/

The Pritzker Institute is an umbrella organization that enhances the biomedical science and engineering research activities on the IIT campus. The Medical Imaging Research Center (MIRC), the Center for Integrative Neuroscience and Neuroengineering research (CINNR), and the Engineering Center for Diabetes Research and Education (ECDRE), the Center for the Study of Condensed Soft Matter μ COSM, and the Biophysics Collaborative Access Team (BioCAT) are some of the Centers and ac-

tivities that operate under the Institute. Each of the Centers has a Director and is described in more detail elsewhere in this document. The Pritzker Institute develops and coordinates relationships and programs with traditional science and engineering departments within IIT, as well as outside institutions, especially, Argonne National Laboratory, Rush Presbyterian Medical Center and the University of Chicago. Vincent Turitto, Director, can be reached at 312.567.6927.

Wanger Institute for Sustainable Energy Research (WISER)

www.iit.edu/wiser

WISER's mission is to continue to improve the quality of life and positively impact society while preserving our natural resources and the environment for future generations. Fulfillment of this mission will reduce our dependence on fossil fuels and, at the same time, provide sufficient and affordable sources of clean energy and water.

WISER cultivates close collaboration among numerous programs at IIT with a focus on development of energy-related interdisciplinary educational and research initiatives and proposals. Current WISER activities

involve more than 60 faculty members from throughout IIT, spanning engineering, design, architecture, business, psychology, the sciences, and law. WISER plans to further enhance research and educational partnerships with the City of Chicago, State of Illinois, industry, national laboratories, and other universities. The goal of the institute is to play a leading role in identifying future research directions for shaping national and international energy policy and sustainability initiatives. Hamid Arastoopour, Director, can be reached at 312.567.3038 or at arastoopour@iit.edu or contact Peg Murphy, Assistant Director, at 312.567.6881, murphy@iit.edu.

Research Centers

Center for Accelerator and Particle Physics (CAPP) www.capp.iit.edu

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 and Argonne National Laboratory (ANL). Daniel Kaplan, Director, can be reached at 312.567.3389 or at kaplan@iit.edu.

Center for Complex Systems and Dynamics (CCSD) www.ccsd.iit.edu

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 com-

plex 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. Fouad Teymour, Director can be reached at 312.567.8947 or teymour@iit.edu.

Center for Diabetes Research and Policy (CDRP) www.iitdiabetes.org

CDRP is a multi-disciplinary center that includes scholars from engineering, scientific, social scientific, and legal fields who focus on various aspects of diabetes research, prevention, diagnosis, and treatment. The Center unites IIT entities that undertake scientific research, make policy assessments and recommendations, and provide legal advice for individuals with diabetes-related conditions who are participating in research, seeking access to care, or have been discriminated against because they have or

are likely to develop diabetes. It also undertakes research into understanding the diseases mechanisms, designing new treatments, and discovering methods of monitoring and treating the complications of the disease. CDRP collaborates with community and professional groups to increase education, awareness, and prevention. Sarah Blenner, Director, can be reached at 312.906.5393 or sblenner@kentlaw.iit.edu.

Center for Electrochemical Science and Engineering www.chee.iit.edu/research/cese/cese.htm

The Center 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.

Center of Excellence in Polymer Science and Engineering www.chbe.iit.edu/research/cepse

The Center 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. Dave Venerus, Director, can be reached at 312.567.5177 or venerus@iit.edu.

Center for Integrative Neuroscience and Neuroengineering Research (CINNR) www.cinnresearch.org

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. Nicholas Hatsopoulos, Co-Director, can be reached at 773.702.5594 or nicho@uchicago.edu. David Mogul, Co-Director can be reached at 312.567.3873, or mogul@iit.edu.

Center for the Molecular Study of Condensed Soft Matter (μ CoSM) www.iit.edu/ucosm/

The Center is a multi-disciplinary center dedicated to the research of soft matter, both biological and synthetic. The center has substantial expertise in cell membranes, collagen, ECM, peptide mimetics, entangled polymers, networks, and the cytoskeleton. Particular emphasis is paid to establishing molecular structure/property/function relationships. The center houses faculty from Biology, Engineering, and Physics, and is a member of the Pritzker Institute of Biomedical Sci-

ence and Engineering. Research relies equally on experimental, computational, and theoretical components, including neutron diffraction, x-ray diffraction and scattering, atomic force microscopy, Forced Rayleigh Scattering, micro- and bulk rheology, molecular dynamics simulations, and stochastic and statistical mechanical modeling. Jay Schieber, Director, can be reached at 312.567.3046, or schieber@iit.edu.

The Center for Nutrition Research (CNR) www.iit.edu/ifsh/research_centers/ncnr/

The Center supports the work of the Clinical Nutrition Research Center (CNRC), which conducts human nutrition and clinical research to determine the health benefits of foods and food components in a variety of study areas, including nutrient properties and bioavailability, obesity

and satiety, diabetes and cardiovascular disease risk reduction, and infant and child nutrition. The unit also manages projects related to IFSH's Health Promoting Foods research arm. Britt Burton-Freeman, Director can be reached at 708.563.8276 or bburton@iit.edu.

The Center for Processing Innovation (CPI) www.iit.edu/ifsh/research_centers/ncpi/

The Center provides expanded process control and process validation capabilities for applied research through IFSH's GMP processing area, kitchen and pilot plant, BSL-2 processing innovation laboratory, fresh produce processing line, and the newly commissioned BSL-3 lab-

oratory and biocontainment pilot plant. The unit also administers education and training services, and other targeted commercial projects. Alvin Lee, Director can be reached at 708.563.8277 or alec@iit.edu.

The Center for Specialty Programs (CSP) www.iit.edu/ifsh/research_centers/css/

The Center administers key specialized programs, including customized laboratory proficiency testing services for all stakeholders. The Center also manages and coordi-

nates research projects that require select agent registrations. Robin Kalinowski, Director, can be reached at 708.563.8822 or kalinowski@iit.edu.

Center for Strategic Competitiveness (CSC) <http://stuart.iit.edu/research>

The Center for Strategic Competitiveness develops global partnerships to enhance innovation and creativity, and is the foundation for IIT Stuart's strategically competitive curriculum. The Center's mission is to develop Strate-

gic Competitiveness into an approach to business that will enhance the ability of individuals, organizations, and governmental units to respond proactively and innovatively to global market challenges in the next economy.

Center for the Study of Ethics in the Professions (CSEP) <http://ethics.iit.edu/>

CSEP was established in 1976 to promote research and teaching on practical ethical issues in the professions. Within IIT, CSEP pursues this mission by integrating ethics into IIT programs and courses and collaborating with faculty in teaching and research. The first 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, engineering, and related areas of business. CSEP is committed to multi-disciplinary and multi-institutional research, to projects that combine empirical investigation with conceptual analysis, and projects that introduce and

propagate innovations in teaching. Past projects have focused on such topics as intellectual property, decision-making involving engineers and managers, and ethics and societal implications of nanotechnology. There is a continuing emphasis on projects that integrate ethics education into technical courses, for example the development of methods of micro-insertion and Ethics Across the Curriculum. CSEP's initiatives to integrate ethics in the IPROs offer models for raising ethics awareness and providing experience of ethics problem solving for students in all IIT's disciplines and professional programs. Elizabeth Hildt, Director, can be reached at 312.567.3017.

Center for Synchrotron Radiation Research and Instrumentation **www.csrii.iit.edu**

The Center promotes application of the tools and techniques of synchrotron radiation to science and engineering research, with a particular focus on developing and operating experimental beam line facilities to serve the

needs of various collaborative access teams at the Advanced Photon Source at Argonne National Laboratory. Carlo Segre, Director, can be reached at 312.567.3498.

Center for Work Zone Safety and Mobility (CWZSM) **www.cwzsm.iit.edu**

CWZSM works towards providing long-term solutions to transportation work zone safety and mobility problems, by building a consortium of major work zone stakeholders including transportation agencies, contractors, trucking industry, and the insurance industry. By working together through the consortium, the stakeholders can combine their resources and knowledge, and work towards preventing the 50,000 work zone injuries and hundreds of fatalities that occur every year. The initiatives of

the center focus on (1) developing work zone safety audit guidelines by addressing the concerns and interests of all stakeholders; (2) discovering/developing/transferring new technologies and measures for improving work zone safety and minimizing negative impacts on private industries and the national economy; and (3) providing work zone safety training and education to the transportation community and the public. Zongzhi Li, Director, can be reached at 312.567.3556 or lizz@iit.edu.

Electric Power and Power Electronics Center (EPPEC) **www.power.iit.edu**

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 en-

hance 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. Mahesh Krishnamurthy, Interim Director, can be reached at 312.567.7232 or kmahesh@ece.iit.edu.

Engineering Center for Diabetes Research and Education (ECDRE) **www.iit.edu/ecdre/**

ECDRE's objective is to use engineering and science-based techniques to develop treatment modalities for diabetes and its many complications. ECDRE is the first engineering center in the U.S. to focus on diabetes treatment. IIT faculty members, in collaboration with investigators and clinicians at the University of Chicago, University of Illinois at Chicago, and Argonne National

Laboratory, are working on a variety of diabetes-related research projects, including the development of artificial pancreas systems. 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 312.567.3042 or cinar@iit.edu.

Fluid Dynamics Research Center **<http://fdrc.iit.edu>**

The Center consists of six faculty engaged in experimental, computational, and analytical studies of fluid flow and its control. The center has numerous research-quality experimental facilities including, high and low Mach number wind tunnels, jet facilities, water channels, anechoic room and an axial flow compressor. Exten-

sive computational resources are available for numerical flow simulations. Areas of focus include active flow control for aerospace applications, aeroacoustics, contaminant dispersion predictions and vortex-surface interactions. David R. Williams, Director, can be reached at 312.567.3192.

High Performance Computing Center (HPCC)

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. Alex Flueck, Director, can be reached at 312.567.3625 or flueck@iit.edu.

Illinois Institute of Technology Architecture Chicago Research Center (IITAC-Research Center)

The keynote of the IITAC-Research Center is "Rethinking Metropolis," the architecture of the multiple, competing entities defining urban life in the new millennium. Urban migrations and the proliferation of information technologies have rendered obsolete the logistical premises and architectural values of the traditional city. We can no longer view architecture as a singular enterprise of making buildings and it is time for a radical critique of our approaches. The task of rethinking our habitats and landscapes in a fundamental way entails a multi-faceted and interdisciplinary approach. It will draw upon the cultural, social, economic, and biological sciences, but it will also demand a particular talent and sensitivity to be cultivated in the architect who is ethically charged with environmental interventions. Richard Neutra some

years ago opened a book with the somber note that "Nature has too long been outraged by design of nose rings, corsets, and foul-aired subways." Today this observation has become ever more relevant because the problems associated with the metropolis have grown even more acute. We have choices to make as a profession. And if the 21st century is to succeed in improving living conditions for the world's populations, it will be because we have adopted the tools at our disposal and energetically stepped forth with a dynamic vision. The purpose of the IITAC-Research Center is to promote and promulgate invention - to proffer a new vision. Harry Francis Mallgrave, Director, can be reached at 312.567.3269 or mallgrave@iit.edu.

International Center for Sensor Science and Engineering (ICSSE) www.icsse.iit.edu

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 ar-

rays 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. Rong Wang, Director, can be reached at 312.567.3121 or wangr@iit.edu.

Medical Imaging Research Center (MIRC) www.iit.edu/mirc/

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 and a profes-

sional masters degree in Electrical and Computer Engineering. Current projects include: mapping the human brain, new x-ray imaging techniques, computer-aided diagnosis, and imaging the heart. Miles Wernick, director, can be reached at 312.567.8818 or wernick@iit.edu.

National Center for Food Safety and Technology (NCFST) www.iit.edu/ifsh/research_centers/ncfst/

NCFST, IFSH's cornerstone principal operating center, continues to operate under its long-time cooperative agreement between IIT and FDA, focusing on design and performance of a variety of collaborative and cooperative research projects across several focus areas, includ-

ing microbiology, chemical constituents, allergens, food processing, packaging, methods validation, and nutrition. Robert Brackett, IIT Vice President and IFSH Director, can be reached at 708.563.1577 or rbrackett@iit.edu.

Robert W. Galvin Center for Electricity Innovation **www.iitmicrogrid.net**

The mission of the Robert W. Galvin Center for Electricity Innovation is to pursue groundbreaking work in the generation, transmission, distribution, management and consumption of electricity. The Galvin Center brings together faculty, students, researchers, industry, government, innovators, and entrepreneurs to collaborate to

improve the reliability, security and efficiency of the electric grid and overcome obstacles to the national adoption and implementation of the smart grid. Mohammad Shahidehpour, Director, can be reached at 312.567.5737 or ms@iit.edu.

Thermal Processing Technology Center (TPTC) **<http://tptc.iit.edu>**

Through 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.

Wireless Network and Communications Research Center (WiNCom)

Founded in 2006, WiNCom is an initiative of the Computer Science and Electrical and Computer Engineering Departments. Motivated by the continuing explosion in the use of the radio frequency spectrum, and the desire to increase RF spectrum utilization and efficiency, WiNCom fuses the creative talents of faculty and students from across IIT. WiNCom's signature achievement is the 2007 establishment and ongoing operation of the IIT Spectrum Observatory, which is creating a continuous record of RF spectrum utilization in Chicago. Research programs include RF spectrum measurements; RF measurement data storage and analysis techniques; cognitive

radio; communication system modeling; RF coexistence; and RF interference modeling and mitigation. Application areas are licensed and unlicensed spectrum, public safety, smart grid, and spectrum sharing. The Center has generated numerous technology transfers and spinoffs, including a commercial RF spectrum observatory network. Center researchers have ongoing engagements with the FCC and other government entities including the U.S. Commerce Department Spectrum Management Advisory Committee. Cynthia Hood, Director, can be reached at 312.567.3918. Dennis Roberson, Co-Director, can be reached at 312.567.3032.

Residence and Greek Life

www.iit.edu/housing

More than half of IIT's full-time undergraduates live on campus. Residence and Greek Life offers a wide range of accommodations, programs, and services designed to enhance campus life. Residence and Greek Life maintains residence halls and apartments designed to meet the different needs of IIT students, faculty, and staff. Within

these buildings, the staff members coordinate academic and social programming, assist students with personal and academic concerns, supervise resident advisors and community desk assistants, and advise the Residence Hall Association. Please contact Residence and Greek Life for further information about these options.

Service, Education, and Outreach Centers

Center for Research and Service
www.iit.edu/~psycrcs/

The Center offers professional consulting services through the College of Psychology at IIT. The center supports its clients through research-based solutions that improve individual, team, and organizational performance.

Graduate & Undergraduate students have opportunities to work on projects in their field of study. George M. Langlois, Director, can be reached at 312.567.6471

Center for Sustainable Enterprise
www.stuart.iit.edu/cse/home.html

The Center 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. M. Krishna Erramilli, Director, can be reached at 312.906.6543 or krish@stuart.iit.edu.

Energy/Environment/Economics (E³)

E³ is an academic program of research and coursework for students in engineering. The research program encompasses areas of specialization that relate to energy,

sustainable development, industrial ecology and environmental design. Hamid Arastoopour, WISER Director, can be reached at 312.567.3038 or arastoopour@iit.edu.

Grainger Power Electronics and Motor Drives Labs (GPEMDL)

GPEMDL focuses on studies related to electric power generation transmission, distribution, operation and controls. GPEMDL houses several graduate and undergraduate laboratories. Annual research support of more

than \$250,000 is provided by federal and private agencies. Mahesh Krishnamurthy, Director, can be reached at 312.567.7232. or kmahesh@ece.iit.edu

Institute for Science, Law & Technology
www.kentlaw.iit.edu/islat

The Institute for Science, Law & Technology provides a forum to produce and disseminate knowledge on the social and legal implications of emerging technologies. 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, research, and student educational

opportunities in the Institute focus on biotechnology, genetics, nanotechnology, diabetes policy, environmental science, social networks, and intellectual property. 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 or landrews@kentlaw.iit.edu.

Invention Center

The 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.

Office of Intellectual Property and Technology Transfer
www.iit.edu/research/services/ttip/

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. Assistance with business startup issues is available. Herb Munsterman, Director, can be reached at 312.906.5259 or hmunster@kentlaw.iit.edu.

Spiritual Life and Service Learning

www.iit.edu/spiritual.life

The Office of Spiritual Life and Service Learning serves students of all faith traditions, as well as secular humanists and atheists. Together with student religious organizations and other university offices, the office sponsors activities for faith development, worship, socializing, and service. The office sponsors interfaith learning opportunities on campus, and provides information about religious resources both on and off campus. The director is also available to discuss personal or spiritual issues.

Home to IIT's Service Learning programs, the office sponsors and supports regular community service activities, advises the Service Learning theme community, and connects interested students with volunteer opportunities both on and off campus.

The Office of Spiritual Life is located in MTCC 213. The director can be contacted at 312.567.3160, spiritual.life@iit.edu or service@iit.edu.

Student Affairs

www.iit.edu/student_affairs

The Office 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, consult the IIT Student Handbook.

Student Center for Diversity and Inclusion

www.iit.edu/scdi

The purpose of the Center is to provide programs, research, advocacy, and advise on issues, policies and practices that affect the universities commitment to diversity and inclusion. We are dedicated and committed in our work to continually evolve through the review of best

practices. In support of that commitment, the work of the Center is organized around a concept of diversity that is practical and includes multiple social and cultural identities, such as race, gender, sexual orientation, class, group affiliation, ability, national origin, and religion.

Signature Programs

- Sharing Table
- Mixing It Up at a Lunch Day
- "My Dream Is" Martin Luther King Jr. Celebration
- IIT Globe Trekker Reading Program
- Welcome to Campus Dinner
- Graduation: Parent Tea
- Chicago Great Migration Series

National Observances

- Hispanic Heritage Month
- LGBTQ Pride Month
- Native American Heritage Month
- African American History Month
- Asian American History Month
- Women's History Month
- Martin Luther King Birthday

Support & Services

- Educational and Cultural Programs
- Personal and Professional Development
- Student Networking Events
- Cultural Events Calendar (announcement for off-campus events)
- Diversity and Inclusion Library Guides

Student Health and Wellness Center

www.iit.edu/shwc

The Student Health and Wellness Center (SHWC) at Illinois Institute of Technology provides quality and cost-sensitive healthcare tailored to the unique and diverse needs of our students. The goal of SHWC is to provide campus health and wellness resources that enable students to successfully achieve their academic goals and promote lifelong wellness. The SHWC provide primary care, specialty care, urgent care, diagnostic services, psychotherapy and mental health support, health promotion, and wellness programs.

SHWC provides diagnosis and treatment of common illnesses and injuries with the ability to dispense medication and/or provide appropriate prescriptions. We also provide immunizations, allergy injections, and walk-ins for urgent care. In addition, SHWC provides gynecological care and sexual health screening for men and women. A small fee may incur for labs, diagnostic tests, immunizations, and medication given on site.

The SHWC provides administrative oversight of the IIT Student Health Insurance Plan. Aetna Health insurance

is offered to currently enrolled students at IIT. Health insurance is not a requirement to use the SHWC.

Our counseling services include psychotherapy, referral, and medication management. Treatment length varies, depending on individual needs, and can last up to 16 individual counseling sessions per student while group therapy imposes no session limits. Our counselors are experienced to address many issues students may face including, but not limited to, loneliness, relationship concerns, family issues, self-esteem, depression, anxiety, concentration difficulties, sleeping difficulties, eating disorders, addiction, sexual concerns, anger management, cultural adjustment, and other personal issues.

The SHWC clinical services are provided by a team of culturally sensitive professionals. We provide comprehensive clinical services and outreach programs to IIT students. In addition, SHWC is a resource for consultation to faculty, staff, and parents of IIT students. We are located in the IIT Tower, 3rd Floor. To schedule an appointment call 312.567.7550.

Technology Commercialization

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. Assistance with business startup issues is available. Herb Munsterman, Director, can be reached at 312.567.7214 or hmunster@kentlaw.iit.edu.

Technology Services

www.iit.edu/ots

The Office of Technology Services (OTS) supports IIT's primary technology systems, including administrative systems, myIIT, Banner, and the network and telephone infrastructures. OTS maintains approximately 600 computers in its classrooms, labs and public terminals throughout the Main, Downtown, Rice and Moffett campuses, including an online virtual computer lab. To ensure that students have access to equipment that supports their academic goals, the computers in the classrooms and labs are refreshed on a three-year cycle. The classroom and lab instructional software is reviewed every semester by the IIT Software Committee and updated after thorough testing for compatibility with existing hardware and software.

OTS also supports remote printing from personal laptops/desktops and mobile devices to printing release stations located in various computer labs and public areas. Additional information about these services is available on the IIT Print channel and the OTS portal website, accessible through the myIIT Training and Support tab.

OTS manages the myIIT web portal my.iit.edu, which provides personalized access to email, Google Apps, online course registration, Blackboard, OTS Support, student financial information, student life, weblinks, tools and other content. All IIT students receive an email address integrated into each student's Google Apps for Education account, which is accessed via the myIIT portal. Google Apps for Education also includes collaboration tools such as Google Docs, Sites, Groups, and more. Supplemental class materials are available through Blackboard, IIT's course management system, where instructors post lectures, notes and other course information. IIT distance learning content and video lectures are also accessed through Blackboard.

The OTS Support Desk is the central point of contact for technology support at IIT. Support Desk staff provide technical troubleshooting, account management, and configuration assistance for all IIT students, faculty and staff. OTS Support is available through myIIT and includes a knowledge database (<http://support.iit.edu/>) with how-to information for common technical issues and questions. A request for technical support may be submitted by opening a ticket through the OTS Support feature in myIIT, sending a request via email (supportdesk@iit.edu), or by calling the Support Desk at 312.567.3375 (on-campus 7-DESK).

IIT provides traffic-shaped Internet access through its wired and wireless networks. Most campus buildings have wired Internet access and secured wireless Internet access is available campus-wide. Visit the OTS website to view IIT's current WiFi zones http://www.iit.edu/ots/wifi_coverage.shtml. Instructions for connecting to the Internet through the IIT network, including how to configure and register personal computers and mobile devices, are also available on the OTS website.

Visit the OTS website: www.iit.edu/ots and the portal website on the *Training and Support* tab in myIIT for the most up-to-date information and useful details about IIT's technology.

Undergraduate Academic Affairs

www.iit.edu/ugaa

The Office of Undergraduate Academic Affairs (UGAA) provides a variety of academic support services for all undergraduate students from the time of admission to graduation. These services include academic advising; evaluation of transfer credits from both United States and international schools; academic program audits; student petitions; course repeats for a change of grade; change of major; monitoring of academic progress; certification

of student's eligibility for degree conferral; granting an official leave of absence; and official withdrawal from the University. In addition, this office reinstates former undergraduate students to the University and maintains the official academic files for all undergraduate students. DegreeWorks, the online degree audit system is monitored and maintained by the Office of Undergraduate Academic Affairs.

Writing Center

www.iit.edu/csl/hum/resources/writing_center.shtml

IIT students can seek assistance with written and oral assignments at the IIT Writing Center, located in Siegel Hall 232/233/234. Tutors are available to assist students enrolled in writing-intensive courses (Introduction to the Profession, C-courses, and IPROs). Tutors specializing in English as a Second Language are also available to

assist students whose primary language is not English. Appointments can be made in advance on the sign-up sheets on Siegel 232/233/234 doors. Walk-in appointments are also possible when tutors are not working with other students. Tutoring is free of charge, and both undergraduate and graduate students are welcome.

Graduate Degree Programs and General Requirements

The university's Armour College of Engineering, College of Architecture, Chicago-Kent College of Law, Institute of Design, Institute of Psychology, School of Applied Technology, 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
Collegiate Mathematics Education
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

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

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

Master of Science Degrees

Applied Mathematics
Applied Physics
Architectural Engineering
Architecture
Biology
Biomedical Engineering
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
Electrical Engineering
Environmental Engineering
Environmental Management and Sustainability
Finance
Food Process Engineering
Food Safety and Technology

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

** application to these programs does not require the GRE*

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.

Applied Mathematics
Architecture (full-time only)
Architecture/Integrated Building Delivery (dual degree)
Architecture/Landscape Architecture (dual degree)
Architectural Engineering (M.E.)
Biology
Biological Engineering
Biomedical Engineering (M.E.)
Biomedical Imaging and Signals
Business Administration (M.B.A.)
Business Administration/Master of Design (dual degree)
Business Administration/ M.S. in Environmental
Management and Sustainability (dual degree)
Business Administration/M.S. in Finance (dual degree)
Business Administration/ M.S. in Marketing
Analytics and 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 Chemistry

Computer Science
Construction Engineering and Management (M.E.)
Cyber Forensics and Security
Data Science
Design (full time only)
Design Methods
Electrical and Computer Engineering
Electricity Markets
Environmental Engineering (M.E.)
Food Process Engineering
Food Safety and Technology
Geoenvironmental Engineering (M.E.)
Geotechnical Engineering (M.E.)
Health Physics
Industrial Technology and Operations
Information Technology and Management
Integrated Building Delivery
Intellectual Property Management and Marketing
Landscape Architecture
Manufacturing Engineering (M.E.)
Materials Science and Engineering (M.E.)
Mathematical Finance
Mathematics Education
Mechanical and Aerospace Engineering (M.E.)
Network Engineering
Power Engineering
Public Administration (M.P.A.)
Public Works (M.E.)
Science Education
Structural Engineering (M.E.)
Telecommunications and Software Engineering
Transportation Engineering (M.E.)
VLSI and Microelectronics

Co-Terminal Degree Programs

Co-terminal degrees allow outstanding IIT undergraduate students to simultaneously complete both an undergraduate and graduate degree (Bachelor's degree and Master's degree).**

Co-terminal degrees provide an opportunity for students to gain greater knowledge in specialized areas while completing a smaller number of credit hours with increased scheduling flexibility than the completion of two degrees separately. Because most co-terminal degrees allow students to share course credit (a maximum of 9 credit hours), students may complete both a Bachelor's and Master's degree in as few as five years. All degree requirements must be completed within six years of undergraduate matriculation, or the student will be dismissed from the co-terminal degree program.

Co-terminal students maintain their undergraduate student status while completing graduate coursework, and can maintain financial aid eligibility when applicable.

** The following are co-terminal degrees approved as of July 2014. Please consult the Graduate Admissions website for an updated degree list: <http://admissions.iit.edu/graduate>

Applied Mathematics

Bachelor of Science in Applied Mathematics/Master of Science in Applied Mathematics
Bachelor of Science in Computer Science/Master of Science in Applied Mathematics

Biological and Chemical Sciences

Bachelor of Science in Biochemistry/Master of Biology with Biochemistry specialization
Bachelor of Science in Biochemistry/Master of Science in Biology with Biochemistry specialization
Bachelor of Science in Biology/Master of Biology
Bachelor of Science in Biology/Master of Science in Biology

Business Administration

Bachelor of Science in Business Administration/Master of Public Administration

Chemical, Biological, and Food Process Engineering

Bachelor of Science in Chemical Engineering/Master of Biological Engineering
Bachelor of Science in Biomedical Engineering/Master of Chemical Engineering
Bachelor of Science in Chemical Engineering/Master of Chemical Engineering
Bachelor of Science in Chemical Engineering/Master of Food Process Engineering

Civil and Architectural Engineering

Bachelor of Architecture/Master of Engineering in Construction Engineering and Management
Bachelor of Science in Architectural Engineering/Master of Engineering in Architectural Engineering
Bachelor of Science in Architectural Engineering/Master of Engineering in Construction Engineering and Management
Bachelor of Science in Architectural Engineering/Master of Engineering in Structural Engineering
Bachelor of Science in Chemical Engineering/Master of Engineering in Environmental Engineering
Bachelor of Science in Civil Engineering/Master of Engineering in Construction Engineering and Management
Bachelor of Science in Civil Engineering/Master of Engineering in Environmental Engineering
Bachelor of Science in Civil Engineering/Master of Engineering in Geotechnical Engineering
Bachelor of Science in Civil Engineering/Master of Engineering in Structural Engineering
Bachelor of Science in Civil Engineering/Master of Engineering in Transportation Engineering

Computer Science

Bachelor of Science in Applied Mathematics/Master of Computer Science
Bachelor of Science in Applied Mathematics/Master of Science in Computer Science
Bachelor of Science in Biology/Master of Computer Science
Bachelor of Science in Biology/Master of Science in Computer Science
Bachelor of Science in Computer Science/Master of Computer Science
Bachelor of Science in Computer Science/Master of Science in Computer Science
Bachelor of Science in Physics/Master of Computer Science
Bachelor of Science in Physics/Master of Science in Computer Science
Bachelor of Science in Computer Engineering/Master of Computer Science
Bachelor of Science in Computer Engineering/Master of Science in Computer Science

Electrical and Computer Engineering

Bachelor of Science in Biomedical Engineering/Master of Biomedical Imaging and Signals
Bachelor of Science in Computer Engineering/Master of Electrical and Computer Engineering
Bachelor of Science in Electrical Engineering/Master of Electrical and Computer Engineering
Bachelor of Science in Computer Engineering/Master of Science in Computer Engineering
Bachelor of Science in Computer Engineering/Master of Science in Electrical Engineering
Bachelor of Science in Electrical Engineering/Master of Science in Electrical Engineering

Food Safety and Technology

Bachelor of Science in Biochemistry/Master of Food Safety and Technology

Bachelor of Science in Biology/Master of Food Safety and Technology

Bachelor of Science in Chemistry/Master of Food Safety and Technology

Industrial Technology and Management

Bachelor of Industrial Technology and Management/
Master of Industrial Technology and Operations

Information Technology and Management

Bachelor of Information Technology and
Management/Master of Cyber Forensics and Security

Bachelor of Information Technology and
Management/Master of Information Technology
and Management

Intellectual Property Management and Markets

Bachelor of Computer Science/Master of Intellectual
Property Management and Markets

Mechanical, Materials, and Aerospace Engineering

Bachelor of Aerospace Engineering/Master of
Engineering in Materials Science

Bachelor of Aerospace Engineering/Master of
Engineering in Mechanical and Aerospace Engineering

Bachelor of Mechanical Engineering/Master of
Engineering in Materials Science

Bachelor of Mechanical Engineering/Master of
Engineering in Mechanical and Aerospace Engineering

Physics

Bachelor of Science in Physics/Master of Health Physics

Bachelor of Science in Physics/Master of Science in
Physics

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.

With a few exceptions, IIT's graduate certificate programs are eligible for the Gainful Employment Programs (see page 57). For a complete list of eligible certificates, see www.iit.edu/grad_adm/.

Biological and Chemical Sciences

- Analytical Method Development
- Analytical Spectroscopy
- Characterization of Inorganic and Organic Materials
- Chromatography
- Regulatory Science
- Synthesis and Characterization of Inorganic Materials
- Synthesis and Characterization of Organic Materials

Chemical and Biological Engineering

- Biological Engineering
- Current Energy Issues
- Particle Processing
- Pharmaceutical Engineering
- Polymer Science and Engineering
- Process Operations Management

Civil, Architectural, and Environmental Engineering

- Air Resources
- Construction Management
- Earthquake and Wind Engineering Design
- Geoenvironmental Engineering
- Hazardous Waste Management
- Indoor Air Quality
- Infrastructure Engineering and Management
- Transportation Systems Planning
- Water and Wastewater Treatment

Computer Science

- Computational Intelligence
- Computer Networking and Telecommunications
- Cyber-Physical Systems
- Data Analytics
- Database Systems
- Distributed and Cloud Computing
- Information Security and Assurance
- Software Engineering

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

Environmental Management

- Compliance Pollution Prevention
- Sustainable Enterprise

Food Science and Nutrition

- Food Process Engineering
- Food Processing Specialist
- Food Safety and Technology

Information Technology and Management

- Advanced Software Development
- Cyber Security Management
- Cyber Security Technologies
- Data Center Operations and Management
- Data Management and Analytics
- Digital Voice and Data Communications Technologies
- Information Technology Innovation Leadership and Entrepreneurship
- System Administration
- Systems Analysis
- Web Design and Application Development

Lewis Department of Humanities

- Instructional Design
- Technical Communication

Mechanical, Materials and Aerospace Engineering

- Computer Integrated Design and Manufacturing
- Product Quality and Reliability Assurance

Physical Sciences

- Radiological Physics

Institute of Psychology

- Compensation Management
- Psychiatric Rehabilitation
- Rehabilitation Counseling
- Rehabilitation Engineering Technology

Professional Certificates

Stuart School of Business

Business Administration

Business Analyst
Compliance and Pollution Prevention
Corporate Finance
Entrepreneurial Finance
Financial Economics
Financial Modeling
Financial Toolbox
Fundamentals of Finance
Innovation and Emerging Enterprises
Investments

Marketing Management

Risk Management

Sustainable Enterprise

Trading

Public Administration

Economic Development and Social Entrepreneurship

Nonprofit and Mission-Driven Management

Public Management

Security, Safety, and Risk Management

Undergraduate Programs

A complete description of undergraduate programs and admission requirements is available from the Office of Undergraduate Admission at <http://admissions.iit.edu/undergraduate/>.

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.iit.edu/graduate.college/academic_affairs/FormsGradStu.shtml.

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 email from the Office of Graduate Admission outlining terms of admission offer, or informing the student that admission has been denied.
For admitted and continuing M.S. students		
3.	Registration	Registration may be completed online at my.iit.edu, under the Academics tab. Continuing students who are not enrolling for the current term must file a request for leave or university withdrawal (see the section on Leave of Absence).
4.	Approval of the program of study	Form G401 must be submitted by the student online at www.iit.edu/graduate__college/academic__affairs/FormsGradStu.html and may be electronically revised with advisor approval.
5.	Preliminary M.S. thesis approval	Form G501A (if required).
6.	Final thesis/ comprehensive examination for M.S. or MAS where applicable	Department submits Form G303. (if required).
7.	Final M.S. Thesis Committee appointed	Form G301B (if required).
8.	Thesis fee (if applicable)	Bursar's receipt.
9.	M.S. thesis approval signed by the thesis examiner	Form G501B.
10.	Completion of courses and other requirements	Listed on Form G401 and Form G406.
11.	Listed on Form G401 and Form G406.	Listed on Form G401 and Form G406.
12.	Fulfillment of all financial obligations to the university	
13.	Application for graduation	
14.	Commencement (attendance is voluntary)	Registrar announces details in spring semester (one ceremony per year).
15.	Diploma	Registrar will mail diplomas four to six weeks after semester grades are reported, except spring semester when diplomas are distributed at the commencement ceremony to participants who have met all degree requirements.

For admitted and continuing Ph.D. students

- | | |
|---|--|
| <ol style="list-style-type: none"> 3. Registration 4. Approval of the program of study 5. Ph.D. qualifying examination 6. Ph.D. comprehensive examination 7. Fulfillment of Ph.D. residency requirement 8. Appointment of the thesis examining committee/comprehensive examination committee 9. Preliminary Ph.D. thesis approval 10. Final Ph.D. thesis committee appointed 11. Final thesis defense /oral examination 12. Thesis fee 13. Ph.D. thesis approval signed by the thesis examiner 14. Completion of courses and other requirements 15. Application for Graduation (including application fee(s)) 16. Fulfillment of all financial obligations to the university 17. Commencement (attendance is voluntary) 18. Diploma | <p>Registration may be completed online at my.iit.edu under the Academics tab. Continuing students not enrolling for the current term must submit a request for leave or university withdrawal form (see the section on Leave of Absence).</p> <p>Form G401 must be submitted by the student online at www.iit.edu/graduate_college/academic_affairs/FormsGradStu.html and will be electronically approved by the faculty advisor and academic unit head/department chair. The form may be revised electronically with advisor approval.</p> <p>Department administering exam submits Form G303*.</p> <p>Form G301A. Department submits exam results on Form G309.*</p> <p>No form needed.</p> <p>Form G301A.</p> <p>Form G501A</p> <p>Form G301B.</p> <p>Department submits exam results on Form G309.*</p> <p>Bursar's receipt.</p> <p>Form G501B</p> <p>Listed on the Program of Study or Revised Program of Study that are filed and approved electronically.</p> <p>Application for Graduation Form G527 is filed electronically in Banner Self-Service. (Check deadline listed in the Academic Calendar for the semester of desired graduation.)</p> <p>Registrar announces details in spring semester (one ceremony per year).</p> <p>Registrar will mail diplomas four to six weeks after semester grades are reported, except spring semester when diplomas are distributed at the commencement ceremony to participants who have met all degree requirements.</p> |
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Note: Copies of the forms, applications, and the sequence of events may be obtained from the Graduate College Office of Academic Affairs website, www.iit.edu/graduate_college/academic_affairs/.

**Forms G303 and G309, Exam Results Forms, are not given to students.*

Academic units send G303 and G309 forms to the Office of Academic Affairs.

Synopsis of Co-Terminal Degree Studies at IIT

Co-terminal degrees allow outstanding IIT undergraduate students to simultaneously complete both an undergraduate and graduate degree (Bachelor's degree and Master's degree).

Co-terminal degrees provide an opportunity for students to gain greater knowledge in specialized areas while completing a smaller number of credit hours with in-

creased scheduling flexibility than the completion of two degrees separately. Because most co-terminal degrees allow students to share course credit (a maximum of 9 credit hours), students may complete both a Bachelor's and Master's degree in as few as five years. All degree requirements must be completed within six years of undergraduate matriculation, or the student will be dismissed from the co-terminal degree program.

Admission

Students applying to co-terminal studies must have completed at least 60 credit hours of undergraduate study and a least one full-semester at IIT. Students must be at least one semester away from undergraduate graduation in order to apply. Applicants are encouraged to

have a GPA of at least 3.0/4.0; however, please consult individual departments for their specific GPA requirements. Questions regarding co-terminal graduate admissions should be addressed to the Office of Graduate Admission: inquiry.grad@iit.edu.

Program of Study

Before completion of 9 credits of graduate coursework applicable to the co-terminal degree program, a Program of Study must be filed with and approved by the graduate academic advisor, the academic unit head, and the Office

of Graduate Academic Affairs. The Program of Study is used to monitor the successful completion of the master's degree requirements.

Academic Planning

The Degree Works plan is the vehicle for establishing each graduate student's program with the Office of Graduate Academic Affairs. Co-terminal students must submit a formal academic plan in Degree Works during their

first semester of enrollment in the co-terminal program. The academic plan must be approved by the co-terminal adviser, academic department, and the Office of Graduate Academic Affairs.

Academic Standing

Co-terminal students must maintain satisfactory grade point averages and a satisfactory rate of progress towards the completion of their co-terminal degrees. IIT considers co-terminal students to have an undergraduate student status throughout the course of their studies; however, students are subject to both undergraduate and graduate academic policies.

Co-terminal students who do not earn at least a 2.0 cumulative GPA, a 1.85 term GPA, a 2.0 major GPA, or who do not maintain satisfactory academic progress are placed on undergraduate academic probation. Co-terminal students who are placed on undergraduate academic probation will be dismissed from the co-terminal program.

Graduate academic standing review will be initiated when a co-terminal student completes nine hours of graduate or shared coursework. In order to remain in good academic standing on the graduate level, co-terminal students must maintain a GPA of 3.0/4.0. Students who achieve a GPA of less than 3.0/4.0 will be placed on academic probation. If in subsequent semesters the co-terminal student fails to make the requisite academic progress in accordance with graduate academic standing rules, they may be dismissed.

Dismissal

A student dismissed from co-terminal degree status may still complete the undergraduate degree following the academic rules of undergraduate study. A student who is dismissed from co-terminal degree status may apply

for non-coterminous graduate degree admission in the future, but shared credit earned may not be applied to the graduate degree..

Admission

Application for Admission

Application information and forms for degree and non-degree admission may be accessed by visiting www.admissions.iit.edu/graduate.

All documents submitted in support of an application must be the original. Documents may not be duplicated, transferred, forwarded or returned once they have been submitted to IIT. A non-refundable application/processing fee must accompany the application. Students will find current application fees, applications, and instructions at www.admissions.iit.edu/graduate. Students applying to Stuart School of Business, Chicago-Kent College of Law, and the Institutes of Design, Psychology, and Architecture should visit their respective websites for information. Any applicant or student who has 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 and request to defer their admission for up to one

year. Deferral requests may be submitted to gradstu@iit.edu. Transcripts must be submitted for all courses attempted at other institutions. Students wishing to register more than one year after the initial application must apply as a new student and resubmit all documents and fees.

Applications and information for graduate programs in business may be obtained from Stuart School of Business by visiting www.stuart.iit.edu.

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

Applications for the College of Architecture are available by visiting www.iit.edu/arch 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 G216) 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 page 35 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 of all academic work at the college level or above.
2. Professional Statement
3. Required Test Scores
4. Letters of recommendation
5. Application fee

All applicants are required to submit GRE general test scores. A minimum score of 292 (quantitative + verbal) and 2.5 (analytical writing) is required for M.S./MAS applicants. Ph.D. applicants must meet the minimum requirements of 298 (quantitative + verbal) and 3.0 (analytical writing). 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 may be 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 or GRE, 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.iit.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 online 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 better to the master's degree.

Citizens and permanent residents of the United States may apply as a non-degree student under the following classifications:

1. Applicants with incomplete degree seeking applications; who have a minimum undergraduate GPA of 2.5/4.0; or who cannot submit required documentation by the application deadline; or who are undecided on their long-term status or degree program.

A final degree-seeking admission decision may be deferred until the requisite GPA has been achieved in study as a non-degree student, or until the

required documents are submitted. Non-degree students seeking to convert to degree-seeking status must complete a regular online 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 non-degree student and passed with a grade of B or better may be applied to the degree.

2. Applicants that must complete specific prerequisite courses prior to consideration of admission to a degree-seeking program. Courses taken in this classification are not counted toward degree requirements.
3. Applicants that do not intend to acquire a graduate degree in any specific discipline and wish to enroll in a variety of courses. Students may not pursue or earn a graduate certificate or degree while admitted in this status. Course credits earned are for continuing professional education.

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 credit.

International students on an F-1 visa cannot be admitted as non-degree students in any classification.

Admission as a Non-Degree Student

Citizens and permanent residents of the United States may apply as a non-degree student under the following classifications:

1. Applicants with incomplete degree seeking applications; who have a minimum undergraduate GPA of 2.5/4.0; or who cannot submit required documentation by the application deadline; or who are undecided on their long-term status or degree program.

A final degree-seeking admission decision may be deferred until the requisite GPA has been achieved in study as a non-degree student, or until the required documents are submitted. Non-degree students seeking to convert to degree-seeking status must complete a regular online 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 non-degree student

and passed with a grade of B or better may be applied to the degree.

2. Applicants that must complete specific prerequisite courses prior to consideration of admission to a degree-seeking program. Courses taken in this classification are not counted toward degree requirements.
3. Applicants that do not intend to acquire a graduate degree in any specific discipline and wish to enroll in a variety of courses. Students may not pursue or earn a graduate certificate or degree while admitted in this status. Course credits earned are for continuing professional education.

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 credit.

International students on an F-1 visa cannot be admitted as non-degree students in any classification.

International Applicant Requirements

General Requirements

International applications are incomplete until the following are received:

1. Application fee.
2. English proficiency test scores (TOEFL, IELTS, or PTE, 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 GRE score of 292 (quantitative + verbal) and 2.5 (analytical writing) is required for M.S./MAS applicants.

Ph.D. applicants must meet the minimum GRE requirements of 298 (quantitative + verbal) and 3.0 (analytical writing). 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.

Certification of Official Transcripts

Admitted IIT graduate students are required to have earned the prerequisite degree(s), prior to enrollment in the first semester, and to present certification of the

earned degree(s) during that semester. A specific procedure must be followed to submit transcripts. See page 42 for instructions.

English Competency

Non-native English speakers must prove proficiency in English by submitting a TOEFL (Test of English as a Foreign Language), IELTS (International English Language Testing System), or PTE (Pearson's Test of English) score. The minimum total and section scores for each examination are listed in the table below.

Examination	TOEFL	IELTS	PTE
Minimum Total Score	90	6.5	47
Minimum Section Score	20	5.5	53

Applicants with any section score (or total score) which fails to meet the minimum values listed above will be required to take one or more English courses as determined by an assessment test administered during orientation week. Students are required to take the first of any such necessary courses during the first regular semester at IIT. Applicants with four or more years of undergraduate education in English as the medium of instruction will be exempt from the TOEFL, IELTS, or PTE requirement, and any English courses.

By accepting admission to the university, you are also agreeing to take any additional English courses the Graduate College deems necessary in accordance with

the English Assessment test. Students whose TOEFL, IELTS, or PTE and assessment test scores indicate they must take two or three English courses will have the opportunity to take an IIT English exam near the end of their first course to determine whether their English has improved enough to exempt them from the additional course(s). This exam will be given only to students enrolled in the English courses.

Applicants should have the official test results sent from the appropriate testing agency to the Office of Graduate Admission, Illinois Institute of Technology, 10 W. 33rd Street, Room 203, Chicago, Illinois 60616. The IIT school code number is 1318.

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. Documents must be dated within 6 months of the student's beginning date.

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 decision as soon as possible after IIT's receipt of all credentials, usually within six weeks.

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 Graduate 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 at gradstu@iit.edu.

Enrollment Confirmation and Deferral Requests

At the time of admission, the student should submit a non-binding Intent to Enroll Form in the applicant portal, 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 may be required to 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, IIT Tower, Suite 3D9-1, 10 W. 35th St., Chicago, IL 60616, 312.567.7550 or student.health@iit.edu.

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 advisor 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.

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 advisor 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 requirements:

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 Descriptions

Course descriptions are available in the Academic Programs section of this bulletin and online at my.iit.edu, under the Academics tab

Registration for Fall and Spring Semesters

Specific procedures and regulations for registration are found each semester at my.iit.edu, under the Academics tab. 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 online, in the myIIT portal. All graduate students registering for research courses numbered 591, 594, 597, and 691 must receive written or online approval from their faculty advisor 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 in good academic standing 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 Office of the Registrar at 312.567.3100 or at registrar@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. The academic unit provides the permit for this course.

Students who have successfully completed the master's thesis defense or doctoral oral defense may petition to register for GCS 600 Continuation of Graduate Study for 1 credit, at a nominal charge. The permit for enrollment in this course is approved by Graduate Academic Affairs after confirmation of the defense result. Form G701 is used to request the GCS600 permit.

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 advisor and the project advisor. 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 second week of course instruction, during the spring and fall semesters.

The Change of Registration may be completed in the myIIT portal in Banner Self Service. Students requiring assistance may contact the Office of the Registrar, registrar@iit.edu. 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 Registrar's Office. Notifying the instructor or merely discontinuing course attendance is not sufficient for withdrawal. The date of the withdrawal form will be the official date of withdrawal. All billing inquiries related to registration changes may be referred to the One Stop (onestop@iit.edu, 312.567.3810). 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 under "Who Should Register".)

Withdrawal From the University

A student who wishes to withdraw should first consult his academic advisor. The advisor may be able to suggest resources or alternate solutions to the student's problems. An international student wishing to withdraw is required to consult the foreign student advisor in the International Center as well. For withdrawal, all graduate

students must complete the electronic withdrawal form online in the myIIT portal by selecting the option from the Academic Affairs Channel. Withdrawal from IIT is not complete until an official email is received by the student confirming its completion.

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 advisor stating that the student is qualified. An Undergraduate student 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 prior to 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 Undergraduate Academic Affairs 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 under "Transfer Credits".

Interstate Registration Disclaimer

Illinois Institute of Technology is registered as a private institution with the Minnesota Office of Higher Education pursuant to Minnesota Statutes, sections 136A.61

to 136A.71. Registration is not an endorsement of the institution. Credits earned at the institution may not transfer to all other institutions.

Academic Policies for Continuation of Studies

Leave of Absence

Degree-seeking students who intend to leave IIT for one semester or more must complete the online leave of absence form in the myIIT portal by selecting the Academics tab, followed by the Academic Affairs Channel. 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 by filing a G701 Graduate Student Petition Form. 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. A student who has not renewed his leave of absence must petition for reinstatement to the Graduate College, Office of Academic Affairs. Degree-seeking students who do not plan to return to the pro-

gram should submit a Withdrawal Request. Non-degree students are not required to file a Leave of Absence Form, but will require reinstatement by petition on form G701, after a lapse in registration. Students should consult the procedures for filing a petition under the section “Right of Appeal by Petition”.

Note: International students must also receive a separate approval from the International Center. If an international student wishes not to enroll in a given term, the leave of absence must be approved by the International 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 Of-

fice of Academic Affairs, using the G701 Graduate Student Petition Form. Students should contact the Graduate College, Office of Academic Affairs for additional information. Procedures for filing a petition may be found within the “General Policies” section of this bulletin.

Grade Point Average

Satisfactory performance in the graduate divisions 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 within this bulletin for course repeat limitations.

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 by submitting form G702. Students for whom provisional enrollment is granted must not earn a semester GPA less than 3.0 while on Academic Probation. Probationary students who receive “C” or “E” grades will be required to repeat courses, subject to the limits specified within this bulletin, to improve

the cumulative GPA. Dismissal will occur when a student fails to make the requisite academic progress during the probationary period. Students may not register for Coop 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 a revised Program of Study Form G406 may be added to the program until the corresponding GPA is at least 3.0, with the approval of the Graduate College, Office of Academic Affairs.

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.

Certification of Official Transcripts

Completion of graduate studies and conferral of the higher degree requires degree-seeking admission to Illinois Institute of Technology (IIT), and prior completion of the prerequisite degree requirement, as outlined in the current Bulletin: Graduate Programs. Admitted IIT graduate students are required to have earned the prerequisite degree(s), prior to enrollment in the first semester, and to present certification of the earned degree(s) during that semester. Students with an earned degree from IIT, or prior college-level work at IIT, may be exempted from the degree certification policy at the discretion of the Graduate College, Office of Academic Affairs.

Degree certification will be completed during the first semester of enrollment. The student is responsible for requesting all required official documents and services and for the associated costs. IIT reserves the right to deny degree conferral to any student who fails to provide the required certification of official documents as outlined. In all cases, a student may not directly submit official documents to satisfy the degree certification requirement.

Master's-degree students with an earned baccalaureate degree from an accredited U.S. Institution of Higher Learning: Verification of the baccalaureate degree will be satisfied by the submission of the official certified transcript for the earned degree, sent directly from the institution conferring the degree to IIT's Graduate College, Office of Academic Affairs, during the first semester of enrollment.

Master's degree students with an earned baccalaureate degree from a foreign institution of higher learning: Verification of the baccalaureate degree will be initiated by the submission of the required documents (and English translations), sent directly from the institution(s) conferring the degree(s) to the accepted international credential

evaluation service (and English translation service as required). Credential certification will be satisfied when an affirmative report of the earned degree is received by IIT from the accepted international credential evaluation service. Visit the Graduate College web site: http://www.iit.edu/graduate_college/academic_affairs/ for details on submitting the official documents to an accepted international credential evaluation service.

Doctoral students with master's-level and/or baccalaureate degree(s) from an accredited U.S. Institution of Higher Learning: Verification of all earned degrees will be satisfied by the submission of the official certified transcript, for each earned degree, sent directly from the institution conferring the degree(s) to the Graduate College, Office of Academic Affairs, during the first semester of enrollment at IIT.

Doctoral students with master's-level and/or baccalaureate degrees from a foreign institution of higher learning: Verification of all earned degrees will be initiated by the submission of the official required documents (and English translations), sent directly from the institution(s) conferring the degree(s) to the accepted international credential evaluation service (and English translation service as required). Credential certification will be satisfied when an affirmative report of the earned degree(s) is received by IIT from the accepted international credential evaluation service. Visit the Graduate College web site: http://www.iit.edu/graduate_college/academic_affairs/ for details on submitting the official documents to an accepted international credential evaluation service.

Failure to provide the required certification of the earned degree(s) will prevent degree conferral. Should the review of official documents fail authentication, the student will be dismissed from graduate study at IIT.

Transfer Credits

For master's 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, being pursued at IIT, 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 advisor, 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 a prior earned degree, up to a maximum of 42 semester hours of credit beyond the baccalaureate degree (which may include up to 32 credits from a completed master's 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. 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.

Consistent with its past practice, research credit may not be submitted for transfer credit consideration. Research credit requirements imply work that has been completed while enrolled in an IIT research course numbered 594 (master's project research), 591 (master of science research) or 691 (doctoral research).

Graduate students who have earned credit following the IIT graduate transfer credit guidelines, as stated earlier in this section, will seek and gain initial academic approval by using the transfer credit review process in the online Program of Study, to be reviewed by the graduate academic adviser and graduate academic department. This will require that the student submit to the adviser,

a copy of the course description, course syllabus and grade report with earned credit hours (or a student copy of the transcript). The preliminary academic approval is not final without formal official transcript evaluation and approval by the Graduate College, Office of Academic Affairs as noted below.

Requested transfer credit earned from an accredited U.S. Institution of Higher Learning must be verified through the submission of the official transcript outlining the requested credit. The transcript will be requested and paid for by the student and sent directly from the institution conferring the course credit to the Graduate College, Office of Academic Affairs.

Requested transfer credit earned from an accredited Foreign Institution of Higher Learning must be verified by the student through the submission of the official attested transcript (and translation) outlining the requested credit and sent directly from the institution conferring the course credit to an international credential evaluation service. The student is responsible for requesting all documents and services and the associated costs. Visit the Graduate College web site: http://www.iit.edu/graduate_college/academic_affairs/ for further details on the process for submitting foreign transcripts to an accepted International Credential Evaluation Service.

Note: Illinois Institute of Technology accepts domestic transfer credit from institutions that have obtained regional and national accreditation from agencies, recognized by the U.S. Secretary of Education, as reliable authorities concerning the quality of education or training offered by the institutions of higher education or higher education programs they accredit. All graduate transfer credit may only be conveyed for equivalent graduate academic courses that meet the rigor and standards of graduate education as defined by IIT academic standards and policies. This policy and IIT's evaluation of requests for transfer credit is and is intended to be consistent with applicable federal and state laws and regulations, and any law or regulation adopted or modified after promulgation of this policy will automatically adjust this policy to the extent required for compliance with the same.

Transferring from Another Program

A regular student planning to transfer from one degree program to another should discuss the matter with academic advisors in both programs. The student should

then submit an application for admission to the new department 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 G401 is the mechanism for outlining and obtaining approval of a coherent program and may be accessed and submitted online at www.iit.edu/graduate.college/academic_affairs/FormsGradStu.shtml. 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 dead-

lines, 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 advisor when admitted as a regular student. An academic advisor will be officially assigned before the student's program of study is approved. The student may subsequently change advisors by filing the Change of Advisor Form, G410, online at www.iit.edu/graduate.college/academic_affairs/FormsGradStu.html.

Course Substitution

Once a student has filed a program of study, deviation from the program requires the same formal approval on a Revised Program of Study Form, G406, 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 without the approval from both the academic advisor and

the department chairman. 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. The Revised Program of Study Form G406 can be accessed and submitted online at www.iit.edu/graduate.college/academic_affairs/FormsGradStu.shtml.

Credit by Examination

With the prior approval of their respective advisors, academic unit heads and the Graduate College Office of Academic Affairs, students may obtain credit for a course by paying the published 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 limi-

tations 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 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 quar-

ter hours. Courses not taken at IIT are not included in computing the GPA. Students may access their grades online at my.iit.edu, under the academics tab.

Grade	Grade Points Per Credit Hour	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.
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.
W	N.A.*	Withdraw.
I	N.A.*	Incomplete.
NA	N.A.*	Failing due to non-attendance. This grade cannot be used to fulfill a graduate program requirement.
S/U	N.A.*	Satisfactory or Unsatisfactory.
R	N.A.*	Research result pending

Incomplete ("I") Grades

The "I" grade indicates that the student's work to date is of passing quality but is incomplete for reasons acceptable 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 students 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, 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, Office of Academic Affairs.

"R" Grades

In the case of research courses, courses numbered 591 and 691, the grade of "R" may be assigned for the reasons listed above and will remain until the student has satisfactorily completed the course work. Once assigned, the grade of "R" will remain on the student's transcript

until the research as determined by the research professor is completed. "R" grades should be removed as soon as possible and no later than the start of the semester in which the student plans to graduate.

Non-Attendance "NA" Grade

A grade of NA is assigned by the course instructor when a student does not attend a course in which s/he is officially registered. A course must be dropped by the deadline for drop/add, as published in the semester Academic Calendar to avoid financial penalty. The NA grade is

calculated as a failed grade and the student forfeits the course tuition. The student is required to repeat the course and is responsible for the new tuition incurred. The repeat is used to recalculate the GPA but is not subject to the two course repeat limit.

Academic Policies for Continuation of Studies

Withdraw (“W”) Grade

The withdraw grade is issued to students who withdraw from a class after the term has begun. The “W” cannot

be changed to a legitimate letter grade.

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 advisor, academic unit head and the Graduate College, 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”, “W”, “NA”, 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 why the change should be approved by the academic unit head. The approved form should be forwarded to the Graduate College, 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. Research (“R”) 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, 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 advisor, academic unit head, and the associate dean for academic affairs, and will also require completion of the

“Course Repeat Form”, or the G702 Probation Contract, when applicable. This form must be submitted at the time of registration and can be accessed online at www.iit.edu/registrar/registration_tools/pdfs/grad_course_repeat.pdf. The original course grade earned will remain on the student’s academic transcript.

Residence Requirement

Degree-seeking graduate students are required to register every fall and spring semester unless they receive special permission in writing from the Graduate College, 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 and credit requirements listed within this bulletin). 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 G401) must be revalidated. The petition must include a detailed plan for the completion of the degree and be endorsed by the academic advisor and the academic unit head. The student's petition for extension must be presented before the

time limit is reached. The Graduate College, 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 G504) and the expected date for the revalidation must accompany the extension approval. The M.S. or Ph.D. comprehensive or thesis 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, Office of Academic Affairs. A dropped student receives a grade of "W" 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 G303 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, 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 G501A, 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 G303 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, 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
5. The results of the qualifying examination must be submitted within fifteen days of the administration of the examination on Form G303 to the Graduate College, 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, Office of Academic Affairs.

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 repre-

senting 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 coadvisors 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, Office of Academic Affairs. The nominations must be arranged on Form G301A by the end of the third week of the semester in which the examination is going to be held. The Graduate College must be notified on Form G301A of the time and date of the comprehensive examination no later than two weeks prior to the exam date.
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, 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 G301B. 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, 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 G501A 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 G501A 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 G501A 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 G501A 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 G501B) are checked by the thesis examiner for signatures of committee members, academic unit head and the Graduate College, Office of Academic Affairs. The signatures on Form G501B 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 G301B must be received by the Graduate College, 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 G301B. Examination results reported on Form 309 must be received in the Graduate College at least 15 days before commencement. One pdf copy on a CD and three paper 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, 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, 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 the “Synopsis of Graduate Studies” at IIT portion of this bulletin 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 regarding program changes, for additional information).

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, Office of Academic Affairs for an extension. Any courses that fall outside the six-year time limit must be revalidated.

Doctoral 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 (Form G527), online with the Graduate College, Office of Academic Affairs, by the deadline listed in the Academic Calendar for the semester of graduation. Final revisions to the program of study must be filed by the graduation application deadline. Students’ names may be deleted from the graduation list upon request, but no new names will be added after the deadline. Upon submission of a graduation application, the Graduate College, 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 four to six weeks after the end of the term. Students who participate in the annual graduation commencement ceremony in spring semester will receive the diploma for their earned degree at the ceremony. Students should not file the Application for Graduation 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 one semester. However, if the student fails to graduate in the intended semester, the application will be reconsidered in the following semester. Failure

to fulfill degree requirements within the first semester of application for graduation will result in the need to enroll in a continuation of graduate study course (GCS 600 or 100). The permit for this is requested using form G701, Graduate Student Petition.

A late graduation fee will be charged to any graduate student who seeks special consideration for failing to apply for graduation by the semester deadline, as published in the Academic Calendar. The student is required to include an explanation of the extenuating circumstance that requires this consideration. A late application for graduation may only be considered when filed no later than 30-days prior to the degree conferral date for the term, as published in the Academic Calendar. Paper form G527 Late Application for Graduation will be submitted by the student to the Graduate College Office of Academic Affairs to initiate this special consideration. The form is available at www.iit.edu/graduate_college/academic_affairs/. A late graduation application fee will be charged to the student’s account, in addition to the current applicable graduation application fee.

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, unless a petition approved by the academic unit and the Graduate College, Office of Academic Affairs, subject to the limits of a project course (594) and the acceptable report of final project work, is filed and approved by the academic advisor, academic unit head, and the Graduate College, Office of Academic Affairs.

Change of 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. Form G701 Graduate Student Petition is used to request this conversion.

To initiate a request to change from thesis to a non-thesis option, the student will complete an online G406 Change in Program of Study Form at www.iit.edu/graduate.college/academic_affairs/FormsGradStu.html.

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. Form G528 Application for a Graduate 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 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, 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, 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. The exact date and time is emailed to all graduation applicants by the Graduate College Office of Academic Affairs. 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.iit.edu/graduate.college/academic_affairs/Thesis_information.shtml.

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 five 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.

Appointments may be made by calling 312.567.3024.

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 the Office of the Registrar. Visit www.iit.edu/registrar/student_records/transcripts.shtml for information regarding

this process and to request transcripts. Transcripts will be released only after the student has fulfilled all financial obligations to the university.

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, how-

ever, should consult the Graduate College's Office of Academic Affairs or the academic unit head for revisions and updates. The current version of the Graduate Bulletin is maintained on the Graduate College's Web site at www.iit.edu/graduate_college/bulletin/.

Religious Accommodations

Section 1.5 of The University Religious Observances Act (110 ILCS 110/1.5) provides: "Any student in an institution of higher learning, other than a religious or denominational institution of higher learning, who is unable, because of his or her religious beliefs, to attend classes or to participate in any examination, study, or work requirement on a particular day shall be excused from any such examination, study, or work requirement and shall be provided with an opportunity to make up the examination, study, or work requirement that he or she may have missed because of such absence on a particular day; provided that the student notifies the faculty

member or instructor well in advance of any anticipated absence or a pending conflict between a scheduled class and the religious observance and provided that the make-up examination, study, or work does not create an unreasonable burden upon the institution. No fees of any kind shall be charged by the institution for making available to the student such an opportunity. No adverse or prejudicial effects shall result to any student because of his or her availing himself or herself of the provisions of this Section." IIT complies with the requirements of the foregoing statute.

Right of Appeal by Petition

A student should attempt first to resolve any departure from the stated rules with his or her advisor 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 advisor 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. The written approval must be attached to Form G701, Graduate Student Petition. Form G701 will not be accepted without a prior approval of the academic advisor and the academic unit head, unless the conflict is unresolved between the student and the advisor or the academic unit head. The graduate dean's decision regarding the unresolved conflict is final.

Change of Records Information

Students must promptly advise the Graduate College, Registrar, and their respective academic units if they change their name, Social Security Number, mailing address, or telephone number. Students can find instructions on how to update their per-

sonal information, including name, identification number, mailing address, and next-of-kin address, online at www.iit.edu/registrar/student_records/update_personal_info.shtml.

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/student_affairs/handbook.

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 university 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

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.

Financial Responsibility

Students take financial responsibility for the payment of all education related charges and fees that become a part of their student account, when those charges are due regardless of their expected reliance on third-party resources such as financial aid, family gifts, employer reimbursement, private loans, outside scholarship or sponsorships. Any balance due to IIT as the result of adjustments made to estimated or confirmed financial aid or the refusal to apply for any or all of your financial aid or the inability to complete the financial aid verification become the student's responsibility for payment. Students agree to supply the Financial Aid Office with any reasonable information or documents that they may request to complete the verification process in a timely manner. Students acknowledge that any outstanding balance due

on their student account that is not timely paid when due is subject to service charges in the amounts or at the rates established and published by IIT from time to time and that they will be prevented from registering for additional courses at IIT or obtaining official documents such as diplomas or transcripts until that outstanding balance has been paid in full. Failure to pay a past due debt may result in the debt being listed with the State Comptroller's Offset Program, referred to a collection agency and/or other authorized legal debt collection procedures. Under such circumstances, the student is responsible for all fees and costs incurred by the university in the collection of the past due debt, including collection fees and/or attorney's fees.

Charges

All university mandatory and non-mandatory charges are published regularly. The official university publication of current tuition, fees, and other charges for all students can be found at www.iit.edu/bursar on the Tuition and Fees page. All other published tuition and fee infor-

mation should be considered an estimate and not the official published rates. Continually rising costs do not permit the University to guarantee that published charges will not change. Students and parents should anticipate periodic increases in the future.

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.

No charge is assessed 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.

Some programs particularly at Chicago-Kent College of Law and at Stuart School of Business charge different rates depending on the program. Consult www.iit.edu/bursar for the official tuition rates

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 to-

ward 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 com-

plete current listing of all charges and fees, go to www.iit.edu/bursar and select Tuition and Fees.

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 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 student health insurance. The premium for the insurance will be added

to student tuition and fees as a charge. To avoid this charge, submit proof of comparable coverage online at www.iit.edu/student_health/insurance/. F1 and J1 students may only waive IIT's coverage with proof of U.S. employer provided insurance. Students must submit their waiver each Fall. Other students, spouses, and dependents of students may participate in the student health program, if desired. Students should consult the Student Health Service in IIT Tower, Suite 3D9-1, at 312.567.7550, for further details.

Parking Fee

All students parking in campus parking lots must register their cars with Access Card and Parking Services and pay a parking fee at the beginning of the semester. For current fees, students should contact Access Card and

Parking Services at www.iit.edu/~parking/ or 312-567-8968. Students authorized to park in IIT lots will receive a parking permit.

Gainful Employment Information

As of July 1st, 2011 institutions must disclose the following information about each of the institution's certificate programs that lead to gainful employment: the name of the certificate program; the CIP code and the Standard Occupation Code (SOC); tuition and fee charges, the typical cost of books and supplies, and the average cost of room and board.

IIT's accreditor does not require the calculation of job placement rates and therefore we are unable to disclose such rates. Once the National Center of Education Statistics (NCES) publishes its methodology for calculating placement rates, IIT will use it to calculate such rates.

Per Gainful Employment guidelines, if the number of students who completed a Gainful Employment program during the award year was less than ten (10), for privacy reasons the school cannot disclose median loan debt and on-time completion rate.

This information is current and accurate as of the date of this publication. The most current information related to Gainful Employment Programs may be found on the Graduate Admission website at www.iit.edu/grad_adm/.

Books and Supplies

Books and supplies are available at the University bookstores. 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.

E-bills

Each semester, a billing statement will be made available to you through the myIIT portal and such other responsible party or parties that you designate (e.g., parent or guardian) and for whom you have provided IIT with an e-mail address. This statement will detail the then-current charges, payments and other credits to your account,

including the amount you must pay and the date such payment is due. Notifications of new billing statements will be sent via email to your IIT email address as well as the e-mail for any other responsible party that you had designated. You agree to monitor your IIT email account regularly.

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

Tuition and fees, less any authorized financial aid awards, are considered a student's out-of-pocket responsibility. The due date for all out-of-pocket payments will be posted each semester at www.iit.edu/bursar. All out-of-pocket payments must be paid by the due date. Payment plan information can be found at

www.iit.edu/bursar. The deadline to enroll in a plan will be posted each semester at www.iit.edu/bursar.

Please see www.iit.edu/bursar/payments for options and instructions related to making payment.

Rejected Payments

If IIT receives notification that a payment has been rejected for any reason, the returned amount will be charged to the student account along with a \$50.00 fee. Payments rejected due to insufficient funds must be replaced with a cashier's check, money order, or credit card. Payments rejected due to invalid routing and/or account

information or a closed account may be replaced with another electronic check from a different account. Following a second rejected payment, the University will no longer accept personal or electronic checks or electronic checks from the payee. All subsequent payments must be made by cashier's check, money order, or credit card.

Outstanding Debts/Late Fees/Financial Holds

Any outstanding balance due on your student account that is not timely paid when due is subject to service charges in the amounts or at the rates established and published by IIT from time to time. 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 paid in full according to established University policies and by posted payment due

dates. Students with outstanding university debt may be suspended from current term classes. Students will be prevented from registering for additional courses at IIT or obtaining official documents such as diplomas or transcripts until that outstanding balance has been paid in full. Students also acknowledge that failure to pay any amount due by the due date may result in an unfavorable report with credit bureaus and collection activities against you, including litigation.

Tuition Waiver Policy

Under exceptional circumstances such as withdrawal from involuntary military service, serious illness or injury, or action by the university, consideration may be given by the university for the issuing of a credit or refund for unused tuition upon written request to the appropriate

office. Payments for other charges than tuition will remain the responsibility of the student. Students should consult www.iit.edu/registrar for the last day to add or drop without a penalty.

University Refund Policy

If a student's financial aid, including any disbursements of Title IV funds such as Pell grants or Federal loans, creates a credit balance on their student account, they will be refunded any such overage. If any non-financial aid payments that are made results in an overpayment of the charges on a student's account, IIT will hold these credits on the student account to be applied towards future charges, unless the student contacts the students contacts the Student Accounting Office to request a refund of the overpayment, or ceases to be enrolled.

Students must be enrolled in direct deposit to receive your student refund. Refunds from financial aid credits are processed throughout the semester. We will send an email whenever we process a refund, provided the student is enrolled in direct deposit. There is no fee for receiving a refund via direct deposit. For a full explanation of the University's policies and procedures related to refunding student account credit balances, refer to www.iit.edu/bursar/credits_and_refunds.

Title IV Federal Loan Authorizations

Health insurance fees, parking charges, and other items on a student bill cannot be automatically paid with Title IV Federal Loan funds. Students may authorize the University to pay these fees with Title IV Federal Loan funds by completing a Title IV Authorization form on the

myIIT portal and checking the "Pay Non-Institutional Charges" box. **Students who do not complete this Title IV Authorization may receive a refund and still owe IIT money.**

Employer Tuition Deferment Plan

The Employer Tuition Reimbursement Plan allows students that are employed by a company that offers tuition reimbursement an opportunity to defer the reimbursable portion of their tuition until 45 days after grades are posted. By applying for IIT's Tuition Employer Tuition Deferment Plan students recognize that their employer's tuition reimbursement plan has qualifying conditions which they must meet in order to be reimbursed. Should your company refuse to pay this bill within the usual time frame for tuition deferment, you the student will be personally responsible for this tuition and will be required to pay the bill in full. Students should also understand that a deferred payment fee of \$55.00 will be due at the time of application, and it is non-refundable.

If the tuition due under this agreement is not paid within 45 days following grades being posted, the student authorizes their employer to withhold the amount due from their pay and to pay that amount to Illinois Institute of Technology.

Students must understand that any amount not covered by the terms of their company's tuition reimbursement policy is due in full by the end of the add/drop period and is subject to fees and a hold preventing registration for the next term. If a student fails to meet the requirements to be eligible for IIT's Employer Tuition Deferment Plan by the deadline, their tuition will not be deferred and will be due.

Sponsor Billing (Third Party Invoicing)

Sponsor billing is the generation of an Illinois Institute of Technology (IIT) invoice to request payment of tuition/fees/housing for a student billed by the University to an external party or for the recovery of expenses incurred by the university on behalf of a student. Sponsors include outside parties, such as embassies, companies, and community agencies, who pay Illinois Institute of Technology directly for a student's educational expenses with funds that did not originate with the student.

Proof of Sponsorship Required

Students whose tuition and fees are paid by a sponsor need to submit proof of sponsorship from their sponsoring agency. Adequate documentation must:

- Be written in English on the sponsor's official stationery;
- Request the University to bill the sponsor for the student's charges;
- Identify the student by full name (given name first followed by family name) and CWID if available;
- Clearly state the type and percentage of charges the sponsor will pay;
- Include a billing address;
- Stipulate the exact begin and end dates of the period during which the sponsor will pay the student's charges (if the sponsor wishes to continue payment after the end date it must submit a new authorized letter);
- Contain no restrictions or contingencies (if, for example, the sponsor requires grades or transcripts prior to payment, the student must pay the original bill

then seek reimbursement from the sponsoring organization);

- Be signed by an authorized official of the sponsoring organization.

Processing/Altering Sponsorship Agreement

Invoices will be processed after the add/drop date of each semester. Any changes in eligibility for a sponsored student should be communicated to the Student Accounting Office immediately.

Students that become ineligible or have a reduction in their sponsored amount will owe this amount immediately. A restrictive hold will be placed on the account to prevent registration for subsequent terms, as well as prevent students from obtaining any official paperwork from the university.

Late Sponsorship Payment

In the event a sponsor fails to remit payment for a student, the sponsorship coverage is removed. The student is responsible for all outstanding balances on the account after the sponsorship is removed. If the student believes payment was inadvertently delinquent, it is the responsibility of the student to communicate with the sponsor to rectify this situation.

Students that fail to submit required sponsorship documentation to the Student Accounting Office in a timely manner will be held responsible for any outstanding balance on the student account, as well as penalty fees assessed to their accounts due to lack of payment.

Housing

The university offers two types of Housing: Residence Halls (furnished dormitories) for undergraduates and single graduate students and Graduate Apartments 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.)

It is not to be assumed 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 the student arrives without a housing confirmation, he/she may have to contact Hostelling International to make arrangements for temporary housing while waiting 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.

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 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.

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

Gunsaulus Hall

Each studio, 1-bedroom, and 2-bedroom apartment features kitchen appliances, window treatments, and new flooring. Gunsaulus includes amenities such as campus cable, 5-digit dialing, internet access, and a community help desk. Gunsaulus Hall also includes two lounges located on the first floor.

Carman Hall

Carman Hall is a furnished apartment building for graduate students. A variety of apartments types are available, including studio and one-bedroom with den apartments. The apartments are available through a 10-month contract. Contracts are available August to May, with an option for an additional contract during the summer months. Based on availability, contracts can be renewed for consecutive academic terms.

Resident participation in a meal plan is not required.

* Please visit www.iit.edu/housing/ for current rates, deadlines, and other housing information.

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.

The student must have a signed housing contract with IIT in order to stay in university housing. If he/she arrives 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. These scholarships are

awarded by the individual IIT departments. 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 www.iit.edu/financial_aid/.

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 Ex-

pected 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.

Application Process

All students applying for financial assistance must 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 February 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 Study 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 http://www.iit.edu/financial_aid/student_employment/. Off-campus jobs will be private, nonprofit organizations or public agencies that encourage community service work. Off-campus jobs are also advertised by the Career Management Center (www.cmc.iit.edu). This office assists students in finding summer employment and permanent jobs after graduation.

Federal Direct Loan Program

The Federal Direct Loan Program includes the Unsubsidized Stafford and PLUS loan programs for graduate students. The interest rate for new loans is set on July 1 each year and is fixed. These loans must be repaid over a period of time after a student leaves school.

Neither the Unsubsidized Stafford Loan nor the PLUS Loan are awarded based on demonstrated need and interest begins accruing from the time the loan funds are disbursed to the student. Students have the option of paying the interest or having the interest added to the principal. Fees on each loan vary and are deducted before the funds are applied to a 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 sufficient

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. 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 award from IIT, most students must provide independent finances for their first year of graduate study. International students are required to carry at least nine credit hours per semester in order to maintain their F-1 student visa status.

Please Note: The tuition scholarship, plus any loan eligibility cannot exceed attendance cost for the academic year. Previously awarded loans may be adjusted after tuition scholarship notification.

Additional Information

All federal 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, 10 W. 33rd St., 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 www.iit.edu/financial_aid/.

Alumni Tuition Discount Policy

Alumni (have an earned IIT undergraduate or IIT graduate degree) who are registered in a graduate degree-seeking program (part-time or full-time status) and maintain good academic standing are permitted a reduction of one-third of the current tuition for one three-credit hour course. Certain course exclusions, special program exclusions and scholarship exclusions apply. Continuing eligibility is subject to the rules of masters and doctoral degree completion time limit (see Completion of Studies and Graduation, Graduate Bulletin). The Alumed benefit may not be applied retroactively.

Exclusions:

- Alumni admitted in non-degree seeking status or programs. This includes students in certificate programs.
- Alumni registered in only undergraduate courses or in Proficiency of English as a Second Language Courses (PESL).

- Alumni not registered in at least one 3-credit hour course.
- Alumni registered in a Chicago-Kent degree program.
- Alumni registered in the following courses: accelerated, coop, internship, non-credit, research, and thesis.
- The alumni tuition discount combined with all other IIT scholarships may not exceed tuition charges. Moreover, the alumni tuition discount will not be applied to students receiving the alumni half-tuition scholarship.
- Concurrently admitted and enrolled doctoral and masters degree candidates.

This discount is administered by the Office of Graduate Admissions and awarded during the admissions process. Questions may be directed to gradstu@iit.edu.

Alumni Half-Tuition

Provides a half-tuition scholarship (maximum 9 credits total) during the first year of graduate studies at IIT. Available to any student who graduated from IIT within the past 2 years with an undergraduate GPA of at least 3.5 out of 4.0, enrolling in a full-time graduate program in the College of Architecture, the College of Science and

Letters, the School of Applied Technology, or the College of Psychology. Armour College of Engineering excludes all but one department. This scholarship does not apply to IIT alumni pursuing a second or additional graduate degree.

Part-Time Employment

Part-time employment opportunities may be available for students both on and off campus. Positions may be career related co-ops or internships, non-Federal Work Study jobs, part-time, or seasonal work. Co-ops, internships, and on campus jobs are posted in the Career Management Center (CMC) JOBS4HAWKS database. Federal Work Study positions and information can be found on the Financial Aid website www.iit.edu/financial_aid/student_employment.

Students interested in and eligible for employment off campus in their field of study may get job search assistance from the CMC and must attend an Introduction

to Cooperative Education and Internship Workshop conducted by the CMC. Workshop schedules are posted at www.cmc.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 an F1 visa may be eligible for opportunities off campus (only if related to their field of study) through the Cooperative Education Program or the Internship Program.

Veterans' Educational Benefits

Veterans enrolling for the first time should obtain Veterans Affairs application forms from the One Stop Student Service Center, Room 106, McCormick Tribune Campus Center, 312.567.3810. The university's Veterans Affairs representative processes subsequent enrollment certifications. 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.

Taxation of Scholarships and Fellowships

U.S. Citizen or Resident Alien

A scholarship/fellowship payment received by a candidate for degree is generally not taxable income to the student if it is used for qualified expenses. Qualified expenses are defined by the Internal Revenue Service (IRS) and include tuition and required fees, and/or for books, supplies, and equipment required of all students in the course. These payments do not need to be reported to the IRS by the student or Illinois Institute of Technology (the University).

A scholarship/fellowship used for expenses other than qualified expenses is taxable income and includes payments that are used for living and incidental expenses such as room and board (housing), travel, research, clerical assistance, or equipment and other expenses that are not required for enrollment or attendance.

Although these payments are taxable income to the U.S. citizen or resident alien student, the IRS does not require the University to withhold tax on the payment. In addition, the University is not required to report these payments to the IRS. However, students are responsible for reporting these payments and remitting any tax due with their personal income tax returns.

Since the University cannot advise students regarding their personal tax matters, the student should consult with their personal tax advisor regarding the reporting of their scholarship/fellowship or stipend on their tax return.

International Student

The Internal Revenue Service (IRS) is the U.S. government agency that administers U.S. tax laws and collects taxes from individuals receiving payments in the United States. The U.S. tax system is based on a calendar year, January 1 through December 31.

The IRS requires that the University apply specific federal tax withholding and reporting rules to payments made to international students.

A scholarship/fellowship payment received by an international student who is a candidate for a degree is generally not taxable income to the student if it is used for qualified expenses. Qualified expenses are defined by the IRS and include tuition and required fees, and/or for books, supplies, and equipment required of all students in the course. These payments do not need to be reported to the IRS by the student or the University. A scholarship/fellowship used for expenses other than qualified expenses is taxable income and includes payments that are used for living and incidental expenses such as room and board (housing), travel, research, clerical assistance, or equipment and other expenses that are not required for enrollment or attendance. For these types of scholarships, international students with an F, J, M, or Q visa are subject to 14% federal tax withholding unless their country of residency has a tax treaty with the United States that excludes scholarships/fellowships from taxation. Payments made to international students in any other immigration status are subject to 30% withholding.

Since the University cannot advise students regarding their personal tax matters, the student should consult with their personal tax advisor regarding the reporting of their scholarship/fellowship on their tax return.

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

With the Department of Computer Science:

Master of Data Science

With the Stuart School of Business:

Master of Mathematical Finance

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 128-core computer 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.

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: Bielecki, Duan, Lubin

Secondary interests: Cialenco, Fasshauer, S. Li, X. Li, Nair, Rempfer, Tier

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, S. Li, X. Li, Tier

Secondary interests: Duan, Petrovic, 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, Pelsmajer, Reingold

Secondary interests: Hickernell, Kang, Petrovic, Weening

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, Cialenco, Duan, Hickernell, Kang, Petrovic, Tier

Secondary interests: Ellis, Kaul

Faculty

Adler, Andre, Associate Professor. B.S., State University of New York-Binghamton; M.S., Purdue University; Ph.D., University of Florida. Asymptotics in statistics, probability, and statistical inference.

Bielecki, Tomasz R., Professor. M.Sc., 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.

Choi, Sou-Cheng, Research Assistant Professor. B.Sc., M.Sc., National University of Singapore; Ph.D., Stanford University.

Cialenco, Igor, Associate Professor. B.S., Ph.D., Moldova State University; M.S., Ph.D., University of Southern California. Stochastic processes, stochastic partial differential equations(PDEs), statistical inference for stochastic PDEs, application of stochastic PDEs to mathematical finance, operator theory, spectral analysis of non-selfadjoint operators.

Duan, Jinqiao (Jeffrey), Professor. B.S., Wuhan University (China); M.S., University of Massachusetts-Amherst; Ph.D., Cornell University. Stochastic dynamical systems; stochastic partial differential equations; nonlinear dynamical systems; modeling, analysis, simulation and prediction of random, complex and multiscale phenomena in engineering and science (geophysical and environmental systems, etc).

Ellis, Robert B., Associate Professor. B.S., M.S., Virginia Tech; Ph.D., University of California-San Diego. Combinatorics, spectral, random and algebraic graph theory, probabilistic methods, coding theory, and combinatorial algorithms.

Erickson, John F., Senior Lecturer. B.S., M.S., University of Illinois-Chicago; M.S., Northeastern Illinois University; Ph.D., Illinois Institute of Technology.

Fasshauer, Gregory, Professor, Associate Chair, and Director of Undergraduate Studies, Department of Applied Mathematics. Diplom, Universitat Stuttgart (Germany); M.A., 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.

Hickernell, Fred J., Professor and Chairman. B.A., Pomona College; Ph.D., Massachusetts Institute of Technology. Computational mathematics, numerical approximation of integrals and functions, Monte Carlo and quasi-Monte Carlo methods, low discrepancy analysis, information-based complexity theory, design of laboratory and computer experiments, computational finance.

Kang, Lulu, Assistant Professor. B.S., Nanjing University (China); Ph.D., Georgia Institute of Technology. Non-parametric statistical modeling, Bayesian experimental design, computer experiments, engineering statistics.

Kaul, Hemanshu, Associate Professor. B.Sc., St. Stephen's College (India); M.Sc., Indian Institute of Technology (India); Ph.D., University of Illinois, Urbana-Champaign. Graph theory and combinatorics, discrete optimization and operations research, probabilistic models and methods in discrete mathematics.

Li, Shuwang, Associate Professor. B.E., Tongji University (China); M.S., Ph.D., University of Minnesota. Computational materials science and modeling of biosystems, numerical analysis, methods for interface problems in Fluids, Biology and Materials.

Li, Xiaofan, Professor, Director of Graduate Studies in the Department of Applied Mathematics, and Associate Vice Provost for Graduate Admission. B.A., Zhejiang University (China); M.A., 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.

Lubin, Arthur, Associate Professor. B.S., Michigan State University; M.A., Ph.D., University of Wisconsin. Commuting contractions in Hilbert space, spectral theory, models for analytic functions, linear system theory.

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

Nair, Sudhakar E., Professor of Mechanical and Aerospace Engineering and Applied Mathematics. B.Sc., Regional Engineering College (India); M.E., Indian Institute of Science; 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.

Faculty (continued)

Nieweglowski, Mariusz, Visiting Assistant Professor. M.S., Ph.D., Warsaw University of Technology (Poland). Stochastic analysis and financial mathematics.

Pelsmajer, Michael J., Associate Professor. B.A., Williams College; M.S., Ph.D., University of Illinois, Urbana-Champaign. Discrete Applied Mathematics: Graph theory, combinatorics, communication networks, algorithms and complexity.

Petrovic, Sonja., Assistant Professor. B.Sc. University of Tennessee at Chattanooga; Ph.D. University of Kentucky. Algebraic statistics (algebra, geometry, and combinatorics for statistical models), computational algebraic geometry, applications to social networks, and computational biology (phylogenetics).

Rempfer, Dietmar, Professor of Mechanical and Aerospace Engineering and Applied Mathematics, and Associate Dean, Armour College of Engineering. M.S., Ph.D., Universität Stuttgart (Germany). 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.

Tier, Charles, Senior Lecturer. Ph.D. Courant Institute, New York University. Asymptotic and singular perturbation methods, applied stochastic modeling, mathematical biology, queueing models, computational finance.

Weening, Fred, Senior Lecturer. B.S., Carnegie-Mellon University; Ph.D. University of California-San Diego. Complex analysis, combinatorics.

Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0

GRE score minimum:

M.A.S. and M.S.: 304 (quantitative + verbal) 2.5 (analytical writing)

Before 2011: 1100 (quantitative + verbal)

Ph.D.: 304 (quantitative + verbal) 3.0 (analytical writing)

Before 2011: 1100 (quantitative + verbal)

TOEFL minimum: 80/213/550 (internet/computer/paper based test scores)

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 100/250 (internet/computer-based test score). A professional statement of goals/objectives (2 pages) and a curriculum vitae must be submitted. Three 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 156 on the quantitative portion of the GRE and at least 3.0 on the analytical writing 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 advisor for newly admitted graduate students in the Master of Science and the Ph.D. programs, until an appropriate faculty member is selected as the advisor. Students are responsible for following all departmental procedures, as well as the general requirements of the Graduate College.

Master of Applied Mathematics

32 credit hours

The Master of Applied Mathematics program at IIT is a non-thesis professional master's degree program that provides graduates with mathematics training for technology-based jobs in business, industry, or government. Graduates develop state-of-the-art skills in modeling, analysis, and computation needed to solve real-world problems. The program requires students to learn writing and communication skills along with teamwork and project management skills. The program can typically be completed in 15 months, with three regular term semesters and one summer semester.

Required Courses

Applied Mathematics and Computational Science Core (9 hours)

MATH 475 Probability

OR

MATH 563 Mathematical Statistics

MATH 522 Mathematical Modeling

MATH 577 Computational Mathematics I

Business and Professional Core (6 hours)

SCI 511 Project Management

SCI 522 Public Engagement for Scientists

Capstone Professional Experience (9 hours)

MATH 523 Case Studies and Project Design in Applied Mathematics

OR

MATH 592 Internship in Applied Mathematics

MATH 594 Professional Master's Project

Elective Courses

Choose two from the following:

Advanced Computation

MATH 489 Partial Differential Equations

MATH 565 Monte Carlo Methods in Finance

MATH 578 Computational Mathematics II

MATH 581 Finite Element Method

MATH 589 Numerical Methods for Partial Differential Equations

CS 595 Topics in Computer Science

MSF 526 Computational Finance

Stochastic Modeling and Analysis

MATH 481 Introduction to Stochastic Processes

MATH 485 Introduction to Mathematical Finance

MATH 542 Stochastic Processes

MATH 548 Mathematical Finance I

MATH 582 Mathematical Finance II

Statistical and Data Analytics

MATH 563 Mathematical Statistics

MATH 564 Applied Statistics

MATH 565 Monte Carlo Methods in Finance

MATH 567 Advanced Design of Experiments

Discrete Mathematics and Optimization

MATH 535 Optimization I

MATH 553 Discrete Applied Mathematics I

MATH 554 Discrete Applied Mathematics II

Degree Requirements

All IIT Graduate College requirements must be satisfied. Specific departmental requirements follow.

Credit Requirements

The student must complete 30 credit hours and maintain a 3.0/4.0 GPA. There are 24 hours of required, core courses. Six hours of electives are selected in consultation with, and approval of, the Program Director are required. The program may include, at most, nine hours at the 400-level.

Capstone Professional Experience

The capstone consists of a six-hour course in case studies and project management or an internship in applied mathematics.

Master's Project

The project, which is three credit hours of MATH 594, is conducted under the supervision of a faculty member or an industrial partner.

Course Substitutions and Prerequisites

Course substitutions and needed prerequisite courses may be permitted, subject to the approval of the Program Director.

Master of Data Science

Collaborative Program with the Department of Computer Science

33 credit hours

This Professional Master's degree program consists of 33 credit hours of coursework, including a practicum, in data science. The program is designed primarily for those with previous degrees or experience in computer science, statistics, mathematics, natural sciences, or business, who are interested in preparing for a career as a data science professional in business and industry. Enrolled full-time, the program can be completed in a year, including one summer.

Admission Requirements

A 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 304 and an analytic writing score of at least 3.0, 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), a data structures course at the level of CS 331, experience with database programming at the level of CS 425, linear algebra at the level of MATH 332, and probability and statistics at the level of MATH 474. Information on these courses is available in this catalog.

Students with insufficient background in computer science and/or mathematics will be required to take the relevant prerequisite courses and earn at least a B grade in each. These prerequisite courses do not count toward the 33 credit hour requirement.

Program Requirements

Coursework includes 18 credit hours of required core courses and 6 credit hours of CSP/MATH 572 Data Science Practicum. At least 9 credit hours must be taken of 500-level CS or CSP courses and 9 credit hours of 500-level MATH courses, not including the CSP/MATH 572 Data Science Practicum. Students must also take one semester of CSP/MATH 570 Data Science Seminar.

Data Science Core Courses

COM 523 Communicating Science
CS 587 Software Project Management

CS 584 Machine Learning

OR

MATH 569 Statistical Learning

CS 525 Advanced Database Organization

OR

CS 554 Data-Intensive Computing

MATH 564 Applied Statistics

MATH 571 Data Preparation and Analysis

Data Science Electives

Computational Fundamentals

CS 425 Database Organization
CS 450 Operating System
CS 535 Design and Analysis of Algorithms
CS 546 Parallel and Distributed Processing
CS 553 Cloud Computing
CS 589 Software Testing and Analysis

Computer Science Applications

CS 512 Topics in Computer Vision
CS 529 Information Retrieval
CS 556 Cyber-Physical Systems: Languages and Systems
CS 557 Cyber-Physical Systems: Networking and Algorithms
CS 583 Probabilistic Graphical Models
CS 585 Natural Language Processing

Mathematics, Probability, and Statistics

MATH 532 Linear Algebra
MATH 540 Probability
MATH 542 Stochastic Processes
MATH 565 Monte Carlo Methods in Finance
MATH 567 Advanced Design of Experiments
MATH 574 Bayesian Computational Statistics

Mathematical and Scientific Computing

MATH 577 Computational Mathematics I
MATH 578 Computational Mathematics II
MATH 590 Meshfree Methods
PHYS 440 Computational Physics

Master of Mathematical Finance

Collaborative Program with the Stuart School of Business

33 credit hours

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 gives students the chance to benefit from the strength of both units. Students are required to complete a total of 11 semester courses, including eight core courses and three elective courses.

Core Courses

- MSF 505 Futures, OPT, and OTC Derivatives
- MSF 526 Computational Finance
- MSF 575 C++ with Financial Markets
- MATH 542 Stochastic Processes
- MATH 548 Mathematical Finance I
- MATH 565 Monte Carlo Methods in Finance
- MATH 582 Mathematical Finance II
- MATH 586 Theory and Practice of Fixed Income Modeling

Elective Courses from the Department of Applied Mathematics

- CS 522 Data Mining
- MATH 512 Partial Differential Equations
- MATH 522 Mathematical Modeling
- MATH 540 Probability
- MATH 543 Stochastic Analysis
- MATH 544 Stochastic Dynamics
- MATH 545 Stochastic Partial Differential Equations
- MATH 546 Introduction to Time Series
- MATH 566 Multivariate Analysis
- MATH 567 Advanced Design of Experiments
- MATH 569 Statistical Learning
- MATH 577 Computational Mathematics I
- MATH 578 Computational Mathematics II
- MATH 579 Complexity of Numerical Problems
- MATH 587 Theory and Practice of Modeling Risk and Credit Derivatives
- MATH 589 Numerical Methods for Partial Differential Equations
- MATH 590 Meshfree Methods

Elective Courses from the Stuart School

- MSF 524 Models for Derivatives
- MSF 525 Term Structure Modeling and Interest Rate Derivatives
- MSF 545 Structured Fixed Income Portfolios
- MSF 546 Quantitative Investment Strategies
- MSF 554 Market Risk Management
- MSF 555 Credit Risk Management
- MSF 564 Financial Theory
- MSF 565 International Finance Theory
- MSF 566 Time Series Analysis
- MSF 567 Bayesian Econometrics
- MSF 574 .NET and Database Management
- MSF 576 OOP and Algorithmic Trading Systems
- MSF 577 High Frequency Finance
- MSF 584 Equity and Equity Derivatives Trading
- MSF 585 FOREX and Fixed Income Strategies

Core Requirement

All Mathematical Finance students must complete the eight core classes unless they have obtained written permission from their academic advisor to substitute an alternative class for a core class.

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.

Electives

At least one elective must be taken in Finance and at least one elective must be taken in Math from the elective options listed above.

Free Electives

One graduate level elective may be taken from outside the courses prescribed above, provided that it is consistent with the MMF program objectives and has been approved by the Program Director prior to the student's registration.

Students may also transfer up to two classes from a graduate program at another accredited university if the student has not used the classes to satisfy the requirements for a degree at the previous university. Additional classes may be transferred with the permission of the Program Director.

Prerequisite Courses

Some students may be required to take prerequisite courses in mathematics, statistics, or computer programming before being admitted to a graduate course.

Master of Science in Applied Mathematics

32 credit hours
Comprehensive exam

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

Required Credit Hours

Required courses 12 hours
Research/thesis 5-8 hours
Elective courses 12-20 hours

Required Courses

The colloquium/seminar course MATH 593 (must take it at least twice with satisfactory grade), 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 540 Probability

AND one of the following:

MATH 543 Stochastic Analysis
MATH 544 Stochastic Dynamics
MATH 545 Stochastic Partial Differential Equations

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.

Comprehensive Examination

The comprehensive examination requirement is fulfilled by a master's thesis (5 to 8 credit hours of MATH 591), under the supervision of a faculty member, or by passing written tests in two of the four core areas of study.

Doctor of Philosophy in Applied Mathematics

72 credit hours beyond the bachelor's degree

Qualifying exam

Comprehensive exam

Dissertation and Defense

Required Credit Hours (if entering with a bachelor's degree)

Required courses 18 hours

Research/dissertation 24-32 hours

Elective courses 34-42 hours

Required Credit Hours (if entering with a master's degree)

Required courses 18 hours

Research/dissertation 24-32 hours

Elective courses: 2-10 hours

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 72 credit hours (approximately 52 for students entering with a master's degree).

The qualifying examination requirement is fulfilled by passing written tests in three of the four core areas of study listed under the M.S. degree. The areas are chosen by the student and the qualifying exam must be completed within the first five semesters of study. The written tests will be offered twice every year, one in the

early Fall (September) and the other in early Spring (January or February). The tests are given in each area separately and students can take the tests in one, two, or three areas each time. 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 advisor. The program may include at most three MATH courses at the 400-level. The program requires the student take the colloquium/seminar course MATH 593 at least six times with satisfactory grade. 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.

Course Descriptions

MATH 400

Real Analysis

Real numbers, continuous functions; differentiation and Riemann integration. Functions defined by series.

Prerequisite(s): [(MATH 251)]
(3-0-3)

MATH 402

Complex Analysis

Analytic functions, conformal mapping, contour integration, series expansions, singularities and residues, and applications. Intended as a first course in the subject for students in the physical sciences and engineering.

Prerequisite(s): [(MATH 251)]
(3-0-3)

MATH 405

Introduction to Iteration & 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.

Prerequisite(s): [(MATH 251, MATH 252, and MATH 332) OR (MATH 251, MATH 252, and MATH 333)]
(3-0-3)

MATH 410

Number Theory

Divisibility, congruencies, distribution of prime numbers, functions of number theory, diophantine equations, applications to encryption methods.

Prerequisite(s): [(MATH 230)]
(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. Prerequisite: Permission of instructor.

(3-0-3)

MATH 425

Statistical Methods

Concepts and methods of gathering, describing and analyzing data including basic statistical reasoning, basic probability, sampling, hypothesis testing, confidence intervals, correlation, regression, forecasting, and nonparametric statistics. No knowledge of calculus is assumed. This course is useful for students in education or the social sciences. This course does not count for graduation in any mathematics programs. Credit not given for both MATH 425 and MATH 476. Course does not satisfy graduation requirements for Applied Mathematics majors.

(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, introduction to multivariate analysis. Same as CHE 426. Credit not given for both Math 426 and CHE 426. Course does not satisfy graduation requirements for Applied Mathematics majors. Requires sophomore standing.

(3-0-3)

MATH 430

Applied Algebra

Relations; modular arithmetic; group theory: symmetry, permutation, cyclic, and abelian groups; group structure: subgroups, cosets, homomorphisms, classifications theorems; rings and fields. Applications to crystallography, cryptography, and check-digit schemes.

Prerequisite(s): [(MATH 230) OR (MATH 332)]
(3-0-3)

MATH 431

Applied Algebra II

Ring homomorphisms; factorization and reducibility in polynomial rings; integral domains; vector spaces; fields and their extensions. As time permits, application to one or more of the following: Frieze and crystallographic groups, Caley digraphs, and coding theory.

Prerequisite(s): [(MATH 430)]
(3-0-3)

MATH 435

Linear Optimization

Introduction to both theoretical and algorithmic aspects of linear optimization: geometry of linear programs, simplex method, anticycling, duality theory and dual simplex method, sensitivity analysis, large scale optimization via Dantzig-Wolfe decomposition and Benders decomposition, interior point methods, network flow problems, integer programming. Credit may not be granted for both MATH 435 and MATH 535.

Prerequisite(s): [(MATH 332)]
(3-0-3)

MATH 453

Combinatorics

Permutations and combinations; pigeonhole principle; inclusion-exclusion principle; recurrence relations and generating functions; enumeration under group action.

Prerequisite(s): [(MATH 230)]
(3-0-3)

MATH 454

Graph Theory & 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(s): [(MATH 230 and MATH 251) OR (MATH 230 and MATH 252)]
(3-0-3)

MATH 461

Fourier Series & 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.

Prerequisite(s): [(MATH 251 and MATH 252)]
(3-0-3)

MATH 474

Probability & Statistics

Elementary probability theory including discrete and continuous distributions, sampling, estimation, confidence intervals, hypothesis testing, and linear regression. Credit not granted for both MATH 474 and MATH 475. Course does not satisfy graduation requirements for Applied Mathematics majors.

Prerequisite(s): [(MATH 251)]
(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. Credit not granted for both MATH 474 and MATH 475.

Prerequisite(s): [(MATH 251)]
(3-0-3)

MATH 476

Statistics

Estimation theory; hypothesis tests; confidence intervals; goodness-of-fit tests; correlation and linear regression; analysis of variance; nonparametric methods.

Prerequisite(s): [(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. Credit may not be granted for both MATH 477 and MATH 577.

Prerequisite(s): [(MATH 350)]
(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 and spectral methods. Credit may not be granted for both MATH 478 and MATH 578.

Prerequisite(s): [(MATH 350)]
(3-0-3)

MATH 481

Introduction to Stochastic Processes

This is an introductory, undergraduate 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 risk management applications for finance and insurance. The course covers basic classes of stochastic processes: Markov chains and martingales in discrete time; Brownian motion; and Poisson process. It also presents some aspects of stochastic calculus.

Prerequisite(s): [(MATH 332 and MATH 475) OR (MATH 333 and MATH 475)]
(3-0-3)

MATH 483

Design & Analysis of Experiments

Review of elementary probability and statistics; analysis of variance for design of experiments; estimation of parameters; confidence intervals for various linear combinations of the parameters; selection of sample sizes; various plots of residuals; block designs; Latin squares; one, two, and $2k$ factorial designs; nested and cross factor designs; regression; nonparametric techniques.

Prerequisite(s): [(MATH 476)]
(3-0-3)

MATH 484

Regression & Forecasting

Simple linear regression; multiple linear regression; least squares estimates of parameters; hypothesis testing and confidence intervals in linear regression models; testing of models, data analysis, and appropriateness of models; linear time series models; moving average, autoregressive and/or ARIMA models; estimation, data analysis, and forecasting with time series models; forecasting errors and confidence intervals. Credit may not be granted for both MATH 484 and MATH 564.

Prerequisite(s): [(MATH 474) OR (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 while the major ideas and concepts underlying modern mathematical finance and financial engineering are explained and illustrated. The course covers the binomial model for stock prices and touches on continuous time models and the Black-Scholes formula.

Prerequisite(s): [(MATH 475)]
(3-0-3)

MATH 486

Mathematical Modeling I

The course provides a systematic approach to modeling and analysis of physical processes. For specific applications, relevant differential equations are derived from basic principles – for example, from conservation laws and constitutive equations. Dimensional analysis and scaling are introduced to prepare a model for analysis. Analytic solution techniques, such as integral transforms and similarity variable techniques, or approximate methods, such as asymptotic and perturbation methods, are presented and applied to the models. A broad range of applications from areas such as physics, engineering, biology, and chemistry are studied. Credit may not be granted for both MATH 486 and MATH 522.

Prerequisite(s): [(MATH 461)]
(3-0-3)

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(s): [(MATH 252)]
(3-0-3)

MATH 488

Ordinary Differential Equations & Dynamical Systems

Boundary-value problems and Sturm-Liouville theory; linear system theory via eigenvalues and eigenvectors; Floquet theory; nonlinear systems: critical points, linearization, stability concepts, index theory, phase portrait analysis, limit cycles, and stable and unstable manifolds; bifurcation; and chaotic dynamics.

Prerequisite(s): [(MATH 251 and 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 function, maximum principles. The wave equation: characteristics, general solution. The heat equation: use of integral transforms.

Prerequisite(s): [(MATH 461)]
(3-0-3)

MATH 491**Reading & Research**

Independent reading and research.
(Credit: Variable)

MATH 497**Special Problems**

Special problems.
(Credit: Variable)

MATH 500**Applied Analysis I**

Metric and Normed Spaces; Continuous Functions; Contraction Mapping Theorem; Topological Spaces; Banach Spaces; Hilbert Spaces; Eigenfunction Expansion.
Prerequisite(s): [(MATH 400)]
(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.
Prerequisite(s): [(MATH 500)]
(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.
Prerequisite(s): [(MATH 461) OR (MATH 489)]
(3-0-3)

MATH 515**Ordinary Differential Equations & 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.
Prerequisite(s): [(MATH 252)]
(3-0-3)

MATH 519**Complex Analysis**

Analytic functions, contour integration, singularities, series, conformal mapping, analytic continuation, multivalued functions.
Prerequisite(s): [(MATH 402)]
(3-0-3)

MATH 522**Mathematical Modeling**

The course provides a systematic approach to modeling and analysis of physical processes. For specific applications, relevant differential equations are derived from basic principles – for example, from conservation laws and constitutive equations. Dimensional analysis and scaling are introduced to prepare a model for analysis. Analytic solution techniques, such as integral transforms and similarity variable techniques, or approximate methods, such as asymptotic and perturbation methods, are presented and applied to the models. A broad range of applications from areas such as physics, engineering, biology, and chemistry are studied. Credit may not be granted for both MATH 486 and MATH 522.
Prerequisite(s): [(MATH 461)]
(3-0-3)

MATH 523**Case Studies & Project Design in Applied Mathematics**

The goal of the course is for students to learn how to use applied mathematics methods and skills to analyze real-world problems and to communicate their results in a non-academic setting. Students will work in groups of 2 or 3 to study and analyze problems and then provide useful information to a potential client. The time distribution is flexible and includes discussions of problems, presentation of needed background material and the required reports, and presentations by the teams. Several small projects will be examined and reported on.
Prerequisite(s): [(CHEM 511 and MATH 522)]
(6-0-6)

MATH 525**Statistical Models & Methods**

Concepts and methods of gathering, describing and analyzing data including statistical reasoning, basic probability, sampling, hypothesis testing, confidence intervals, correlation, regression, forecasting, and nonparametric statistics. No knowledge of calculus is assumed. This course is useful for graduate students in education or the social sciences. This course does not count for graduation in any mathematics program. Credit given only for one of the following: MATH 425, MATH 476, or MATH 525.
(3-0-3)

MATH 530**Algebra**

Axiomatic treatment of groups, rings and fields, ideals and homomorphisms; field extensions, modules over rings.
Prerequisite(s): [(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).
Prerequisite(s): [(MATH 332)]
(3-0-3)

MATH 535

Optimization I

Introduction to both theoretical and algorithmic aspects of linear optimization: geometry of linear programs, simplex method, anticycling, duality theory and dual simplex method, sensitivity analysis, large scale optimization via Dantzig-Wolfe decomposition and Benders decomposition, interior point methods, network flow problems, integer programming. Credit may not be given for both MATH 435 and MATH 535.

Prerequisite(s): [(MATH 332)]
(3-0-3)

MATH 540

Probability

Random events and variables, probability distributions, sequences of random variables, limit theorems, conditional expectations, and martingales.

Prerequisite(s): [(MATH 400)] AND [(MATH 475)]
(3-0-3)

MATH 542

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 field 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 financial engineering. Credit may not be granted for Math 481 and Math 542.

Prerequisite(s): [(MATH 332) OR (MATH 333)]
(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(s): [(MATH 540)]
(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(s): [(MATH 540)]
(3-0-3)

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, 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 the following: 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; and applications to science, engineering, and other areas.

Prerequisite(s): [(MATH 540) OR (MATH 543) OR (MATH 544)]
(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(s): [(ECE 511) OR (MATH 475)]
(3-0-3)

MATH 548

Mathematical Finance I

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 are explained and illustrated. Credit may not be granted for Math 485 and Math 548.

Prerequisite(s): [(MATH 474) OR (MATH 475)]
(3-0-3)

MATH 550

Topology

Topological spaces, continuous mappings and homeomorphisms, metric spaces and metrizability, connectedness and compactness, homotopy theory.

Prerequisite(s): [(MATH 556)]
(3-0-3)

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. Credit will not be granted for both Math 454 and Math 553.

Prerequisite(s): [(MATH 453)]
(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(s): [(MATH 453) OR (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.

Prerequisite(s): [(MATH 332 and MATH 400)]

(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(s): [(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 Lovasz Local Lemma. Many examples from classical results and recent research in combinatorics will be included throughout, including from Ramsey Theory, random graphs, coding theory and number theory.

(3-0-3)

MATH 563**Mathematical Statistics**

Theory of sampling distributions; interval and point estimation, sufficient statistics, order statistics, hypothesis testing, correlation and linear regression; analysis of variance; non-parametric methods. Credit given only for one of MATH 425, MATH 476, MATH 525, or MATH 563.

Prerequisite(s): [(MATH 475) OR (MATH 540)]

(3-0-3)

MATH 564**Applied Statistics**

Simple linear regression; multiple linear regression; least squares estimates of parameters; hypothesis testing and confidence intervals in linear regression models; testing of models, data analysis, and appropriateness of models; linear time series models; moving average, autoregressive and/or ARIMA models; estimation, data analysis, and forecasting with time series models; forecasting errors and confidence intervals. Credit may not be granted for both MATH 484 and MATH 564.

Prerequisite(s): [(MATH 474) OR (MATH 476) OR (MATH 563)]

(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 programming techniques and computer clusters have made these methods widespread in the finance industry.

Prerequisite(s): [(MATH 474)]

(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 T-square, covariance, principal components, factor analysis, discrimination, clustering.

Prerequisite(s): [(MATH 532, MATH 563, and MATH 564)]

(3-0-3)

MATH 567**Advanced Design of Experiments**

Various type of designs for laboratory and computer experiments, including fractional factorial designs, optimal designs and space filling designs.

Prerequisite(s): [(MATH 474) OR (MATH 476)]

(3-0-3)

MATH 568**Topics in Statistics**

Categorical data analysis, contingency tables, log-linear models, nonparametric methods, sampling techniques.

Prerequisite(s): [(MATH 563)]

(3-0-3)

MATH 569**Statistical Learning**

The wealth of observational and experimental data available provides great opportunities for us to learn more about our world. This course teaches modern statistical methods for learning from data, such as regression, classification, kernel methods, and support vector machines.

Prerequisite(s): [(MATH 350)] AND [(MATH 474) OR (MATH 475)]

(3-0-3)

MATH 570**Data Science Seminar**

Various research topics on data science are presented in this seminar. Permission is required from the instructor or department. Open only to Data Science majors.

(1-0-0)

MATH 571**Data Preparation & Analysis**

This course surveys industrial and scientific applications of data analytics with case studies including exploration of ethical issues. Students will learn how to prepare data for analysis, perform exploratory data analysis, and develop meaningful data visualizations. They will work with a variety of real world data sets and learn how to prepare data sets for analysis by cleaning and reformatting. Students will also learn to apply a variety of different data exploration techniques including summary statistics and visualization methods. Open only to Data Science majors.

Prerequisite(s): [(CSP 570*) OR (MATH 570*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

MATH 572**Data Science Practicum**

In this project-oriented course, students will work in small groups to solve real-world data analysis problems and communicate their results. Innovation and clarity of presentation will be key elements of evaluation. Students will have an option to do this as an independent data analytics internship with an industry partner. Open only to Data Science majors.

Prerequisite(s): [(CSP 571) OR (MATH 571)] AND [(SCI 522)]
(3-3-6)

MATH 573**Reliable Mathematical Software**

Many mathematical problems cannot be solved analytically or by hand in a reasonable amount of time; so, turn to mathematical software to solve these problems. Popular examples of general-purpose mathematical software include Mathematica, MATLAB, the NAG Library, and R. Researchers often find themselves writing mathematical software to demonstrate their new ideas or using mathematical software written by others to solve their applications. This course covers the ingredients that go into producing mathematical software that is efficient, robust, and trustworthy. Students will write their own packages or parts of packages to practice the principles of reliable mathematical software.

(1-0-0)

MATH 574**Bayesian Computational Statistics**

Rigorous introduction to the theory of Bayesian statistical inference and data analysis including prior and posterior distributions, Bayesian estimation and testing, Bayesian computation theories and methods, and implementation of Bayesian computation methods using popular statistical software.

(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. Credit may not be granted for both Math 577 and Math 477.

Prerequisite: An undergraduate numerical course, such as MATH 350 or instructor permission.
Prerequisite(s): [(MATH 350)]
(3-0-3)

MATH 578**Computational Mathematics II**

Polynomial interpolation; 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 and spectral methods. Credit may not be granted for both MATH 578 and MATH 478. Prerequisite: An undergraduate numerical course, such as MATH350 or instructor's consent.

Prerequisite(s): [(MATH 350)]
(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(s): [(MATH 350)]
(3-0-3)

MATH 581**Finite Element Method**

Various elements, error estimates, discontinuous Galerkin methods, methods for solving system of linear equations including multigrid. Applications.

Prerequisite(s): [(MATH 400)]
(3-0-3)

MATH 582**Mathematical Finance II**

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(s): [(MATH 481) OR (MATH 542)] AND [(MATH 485) OR (MATH 548)]
(3-0-3)

MATH 586**Theory & 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 understanding 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(s): [(MATH 485 and MATH 582*) OR (MATH 543 and MATH 582*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

MATH 587**Theory & Practice of Modeling Risk & Credit Derivatives**

This is an advanced course in the theory and practice of credit risk and credit derivatives. Students will get acquainted with structural and reduced form approaches to mathematical modeling of credit risk. Various aspects of valuation and hedging of defaultable claims will be presented. In addition, valuation and hedging of vanilla credit derivatives, such as credit default swaps, as well as vanilla credit basket derivatives, such as collateralized credit obligations, will be discussed.

Prerequisite(s): [(MATH 582)]
(3-0-3)

MATH 589**Numerical Methods for Partial Differential Equations**

This course introduces numerical methods, especially the finite difference method for solving different types of partial differential equations. The main numerical issues such as convergence and stability will be discussed. It also includes introduction to the finite volume method, finite element method and spectral method. Prerequisite: An undergraduate numerical course such as MATH 350 and MATH 489 or consent of instructor.

Prerequisite(s): [(MATH 350 and MATH 489)]
(3-0-3)

MATH 590**Meshfree Methods**

Fundamentals of multivariate meshfree radial basis function and moving least squares methods; applications to multivariate interpolation and least squares approximation problems; applications to the numerical solution of partial differential equations; implementation in Matlab.

(3-0-3)

MATH 591**Research & Thesis M.S.**

Prerequisite: Instructor permission required.
(Credit: Variable)

MATH 592**Internship in Applied Mathematics**

The course is for students in the Master of Applied Mathematics program who have an approved summer internship at an outside organization. This course can be used in place of Math 523 subject to the approval of the director of the program.

(0-0-6)

MATH 593**Seminar in Applied Mathematics**

Current research topics presented in the department colloquia and seminars.

(1-0-0)

MATH 594**Professional Master's Project**

The course is part of the capstone experience for students in the Master of Applied Mathematics program. Students will work in groups of 2 or 3 to study and analyze a real-world problem.

(Credit: Variable)

MATH 597**Reading & Special Projects**

(Credit: Variable)

(Credit: Variable)

MATH 599**TA Training**

This course provides the foundation of how to teach mathematics in the context of introductory undergraduate courses. The course is designed to encourage participation and cooperation among the graduate students, to help them prepare for a career in academia, and to help convey the many components of effective teaching.

(1-0-0)

MATH 601**Advanced Topics in Combinatorics**

Course content is variable and reflects current research in combinatorics.

Prerequisite(s): [(MATH 554)]
(3-0-3)

MATH 602**Advanced Topics in Graph Theory**

Course content is variable and reflects current research in graph theory.

Prerequisite(s): [(MATH 554)]
(3-0-3)

MATH 603**Advanced Topics in Computational Mathematics**

Course content is variable and reflects current research in computational mathematics.

Prerequisite(s): [(MATH 578)]
(3-0-3)

MATH 604**Advanced Topics in Applied Analysis**

Course content is variable and reflects current research in applied analysis.

Prerequisite(s): [(MATH 501)]
(3-0-3)

MATH 605**Advanced Topics in Stochastics**

Course content is variable and reflects current research in stochastic.

Prerequisite(s): [(MATH 544)]
(3-0-3)

MATH 691**Research & Thesis Ph.D.**

(Credit: Variable)

(Credit: Variable)

College of Architecture

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Dean:

Wiel Arets

Associate Dean of Academic Affairs:

Robert Krawczyk

Associate Dean of Research:

Vedran Mimica

Associate Dean of Curriculum and Director of Classes:

Eva Kultermann

Director of Academic Affairs:

Cynthia Torres

Director of Admissions and Recruitment Management:

Jaucinta Echols

Director of Doctoral Program:

Michaelangelo Sabatino

Director of History and Theory:

Sean Keller

Director of Master of Science in Architecture:

Vedran Mimica

Director of Master of Landscape Architecture Program:

Marshall Brown

Director of Studios:

Frank Flury

Director for Buildings and Operations:

Richard Nelson

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.

Accreditation

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 Accrediting Board (NAAB), which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes three types of degrees: the Bachelor of Architecture, the Master of Architecture, and the Doctor of Architecture. A program may be granted a 6-year, 3-year, or 2-year term of accreditation, depending on the extent of its conformance with established educational standards.

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

The College of Architecture has two NAAB accredited degrees: the Bachelor of Architecture and the Master of Architecture Professional Degree Programs. Both hold 6-year terms of accreditation with the NAAB.

The Landscape Architectural Accreditation Board (LAAB) evaluates professional landscape architecture programs in the United States to determine whether they meet objective standards of academic quality and properly prepare students for professional work.

The Master of Landscape Architecture (M.L.A.) degree program holds a 6-year term of accreditation with the LAAB.

Degrees Offered

Master of Architecture (M. Arch.), Professional Degree
Master of Landscape Architecture (M.L.A.),
Professional Degree
Master of Science in Architecture (M.S.Arch.),
Post-Professional Degree
Dual Master of Architecture/Master of Landscape
Architecture

Master of Integrated Building Delivery
Dual Master of Architecture/Master of Integrated
Building Delivery
Doctor of Philosophy in Architecture (Ph.D.)
Doctor of Philosophy with specialization in:
History and Theory of Architecture
Doctor of Philosophy with specialization in:
Technologies of the Built Environment

Research Facilities

The College of Architecture is housed in three buildings designed by Mies van der Rohe: S.R. Crown Hall, 3410 S. State St., and the Minerals and Metals Building. With more than 112,000 sq. feet dedicated exclusively to the College, along with seminar and classrooms utilizing many IIT campus facilities, students have some of the finest instructional spaces in the United States.

A branch of the Paul V. Galvin Library, the Graham Resource Center (GRC) is the main library for College of Architecture (CoA) students and faculty. Housed in Crown Hall, the GRC houses over 16,000 books, a number of architecture specific databases and 55 journal subscriptions. The GRC is charged with meeting all library-related needs of the CoA and responsibilities include: acquiring, preserving, and serving materials in myriad media to CoA students, faculty, and staff; maintaining additional resources, including the Crown Hall darkroom, the CoA Archives, the Graham Resource Center Web Page, and an Audio-Visual equipment collection; providing reference and research assistance to local, national, and international clients about architecture in general and IIT and Mies van der Rohe in particular; and providing bibliographic instruction to all GRC and Architecture researchers and users.

The Architecture Materials Lab has 14,000 square feet of shop facilities. The lab contains tools and machinery for working with wood, metal, and plastics and includes a large paint booth. The facility houses four Universal Laser Systems 60W Laser Cutters, a Bridgeport Series I Vertical CNC Machine, a 3D Printer, and a Precix Series 9100 CNC Router for digital fabrication.

The College houses two computer labs, with a third instruction lab in Siegel Hall, with over 70 PCs outfitted with the latest Architectural Digital Design and Fabrication software. All labs and requisite software are listed here: http://www.iit.edu/ots/computer_labs.shtml. The lab PCs are updated every third year to support curriculum initiatives and technology advances, such as BIM (Building Information Modeling), and serve as digital imaging and rendering instruction spaces for the College. When not in use for class, the labs are open to students and offer 24 hour access for several weeks at the end of the semester. The two labs support myriad printing and output media including four plotters for student use. In addition, the Office of Technology Services printing system allows students to print remotely to any printer on campus, including the aforementioned plotters. The university campus is a wireless zone serving the IIT community.

Research Areas

Faculty and doctoral candidates conduct research on a wide range of important topics related to the theory and 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; urban agriculture; the research, planning, and design of large-scale projects such as stadiums, 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; biophilic design; advanced critical analysis and architectural history/theory; 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.

Cloud Studio

“Cloud Studio” is an innovative College-wide course in which students from all degree programs work together on research and design topics drawn from the College’s yearly themes. The designated yearly themes will shape the program of visiting teachers and lecturers, so that the “Cloud Studio” will offer a chance for students to be taught directly by some of the world’s leading architects. By combining advanced professional students (B.Arch.,

M.Arch., and M.L.A.) with those in the post-professional programs (M.S. and Ph.D.), the “Cloud Studio” also provides a chance for students to experience other modes of studying and working on the built environment, and the opportunity for some to define themselves by teaching others based on their professional and academic backgrounds.

Faculty

Arets, Wiel, Professor, Dean, and John and Jeanne Rowe Chair. M.Arch., Technical University of Eindhoven (Netherlands).

Brock, Thomas, Studio Associate Professor and Director of Professional Practice. B.Arch. University of Cincinnati; M. Arch., University of Pennsylvania. Architectural design, construction technologies, and digital media.

Brown, Marshall, Associate Professor. B.A. Washington University-St. Louis; M.Arch., M.A.U.D., Harvard University. Architectural design and theory, urbanism.

Brown, Timothy, Studio Associate Professor and Director of the College of Architecture International Affairs. B.S.Arch., Clemson University; M.Arch., University of Illinois-Chicago. Architectural design and theory.

Conger-Austin, Susan, Studio Associate Professor and Director of Foreign Relations. B.A., Stanford University; M.Arch., Princeton University. Architectural design and theory.

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

DeSalvo, John, Studio Associate Professor and Director of Graduate Admission. B.S., University of Illinois, Urbana-Champaign; B.Arch., M.Arch., Cornell University. Architecture design and freehand rendering, energy saving design, and detailing.

Elnimeiri, Mahjoub, Professor. B.S., University of Khartoum (Sudan); M.S., University of London, Imperial College (England); Ph.D., Northwestern University. Structural engineering and sustainability.

Endres, Paul, Assistant Professor and Director of Technology. B.S., University of Illinois, Urbana-Champaign; M.A., M.S., University of California-Berkeley. Structural engineering, structural integration.

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

Flury, Frank, Associate Professor. M.Arch., Diploma, University of Karlsruhe (Germany). Architectural design, design/build.

Humer, Colleen M., Studio Assistant Professor. B.F.A., B.Arch., University of British Columbia (Canada); M.A., University of Toronto (Canada). Architectural design, architectural history and theory.

Jacobs, Thomas, Studio Assistant Professor.

Johnson, Leslie M., Studio Assistant Professor. B.Arch., Illinois Institute of Technology; M.Arch., Bartlett School of the Built Environment, University College London (England). Architectural design and theory, dwellings.

Kearns, Thomas, Studio Associate Professor and Director of Design Communication. B.Arch., Iowa State University. Architectural design and theory, digital technologies.

Keller, Sean, Associate Professor and Director of History/Theory/Culture. B.A., M.Arch., Princeton University; Ph.D. Harvard University. History and theory of architecture.

Kibler, Steve, Studio Associate Professor. B.S., M.Arch., University of Illinois, Urbana-Champaign. Steel structures, concrete structures, and design/build.

Krawczyk, Robert, Professor and Associate Dean for Academic Affairs, College of Architecture. B.Arch., University of Illinois-Chicago. Computer-aided design and advanced digital applications.

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

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

Land, Peter, Professor of City and Regional Planning. A.A. Dipl., 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.

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

Miller, Jonathan, Studio Associate Professor. B.A., Yale University; M.F.A., New York University. Architectural design and theory; film studies.

Mimica, Vedran, Professor, Associate Dean for Research, and Director of M.S. Program, College of Architecture. M.Arch., University of Zagreb (Croatia). Architectural research and urbanism.

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

Nelson, Richard, Studio Associate Professor and Director of Buildings and Operations, College of Architecture. B.A., M. Arch., Washington University-St. Louis. Architectural design and building technology.

Peluso, Alphonso, Studio Associate Professor and Director of Digital Curriculum. B.Arch., Illinois Institute of Technology. Digital design.

Pettigrew, Paul, Studio Associate Professor. B.S., University of Illinois, Urbana-Champaign; M.Arch., Massachusetts Institute of Technology. Architectural design, furniture design/build, introduction to architecture.

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

Ronan, John, Professor, Associate Dean of Curriculum, and Director of Elective Studios. B.S., University of Michigan; M.Arch., Harvard University Graduate School of Design. Architectural design and material investigation.

Sabatino, Michaelangelo, Professor and Director of the Ph.D. Program. Laurea in Architecture, University of Venice; Ph.D., University of Toronto. History and theory of Architecture.

Schachman, Andrew, Studio Associate Professor and Director of the Paris Program. B.A., University of Chicago; M.Arch., University of Illinois-Chicago. Architectural design.

Sierralta, Karla, Studio Associate Professor.

Takeuchi, Arthur, Associate Professor. B.Arch., M.S.Arch., Illinois Institute of Technology. Architectural design.

Tinucci, Andrew, Studio Assistant Professor. B.Arch., University of Arizona; B.S., University of Illinois, Urbana-Champaign. Architectural design and theory, urbanism.

Wetzel, Catherine, Associate Professor and Associate Dean for Graduate Academic Affairs. B.Arch., University of Cincinnati; M.Arch., University of Pennsylvania. Architectural design and visual training.

Wood, Antony, Research Professor and Executive Director for the Council for Tall Buildings and Urban Habitat. B.A., Diploma in Architecture, PGCHE. University of Nottingham; PG.Dip.Arch.Prac., De Montford University-Leicester. Architectural design and sustainability.

Admission Requirements

Completed application form
 Portfolio
 Three letters of recommendation
 Statement of intent
 Official transcripts
 GRE score minimum: 292 combined, 2.5 analytical writing
 TOEFL minimum: 80/550 (internet/paper-based test scores)
 Application Fee of \$60

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 (8.5 by 11 inches or smaller), three letters of recommendation from individuals able to appraise the applicant's achievement and potential, a statement of intent describing academic and professional objectives as well as why they would like to study at IIT, and GRE scores, which are less than five years old.

International applicants from non-English speaking countries are required to submit TOEFL scores of 550/80

(paper-based test score scale/internet-based) or above. Admitted international students with TOEFL scores between 550/80 and 600/90 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 affidavit of financial support confirming adequate funding for their entire term of study and a copy of their passport. Visa documents cannot be issued unless both the financial affidavit and passport are on file with the College of Architecture.

Although we encourage early submission, completed applications and all supporting documents must be received by the deadline for each program. Late applicants will be reviewed only if space is available.

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

The Master of Architecture professional degree serves those students seeking a consummate professional education. The degree is accredited by the National Architectural Accrediting Board (NAAB), and is a necessary component for licensure in the field.

The IIT College of Architecture's graduate professional Architecture degree program emphasized the integration of architectural design, theory, and technology. Through rigorous work and critical thought, the college promotes innovation and underscores refinement with the objective of developing outstanding proficiency in the practice of architecture.

The College draws strength from its legacy of Mies van der Rohe, as well as from its own contributions to modern theory and practice. Our argument is that the poetics of space are inseparable from the practical and significant understanding of materials and fabrication. The strength of the curriculum lies in rigorously unfolding the implications of this position.

Our location in Chicago is central to our understanding of architecture as an urban art, which is greatly enriched by the vibrant culture of our city and the influence of its progressive and global architectural practices.

Our mission is to teach design excellence and technical expertise, and to foster an understanding of the role of the architect in society as an ethical, insightful, and informed leader. We believe that society sustains and enriches itself through thoughtful planning and careful work, and we regard the architect as the central figure who is best able to synthesize the natural and man-made in the creation of a more humane built environment.

The curriculum addresses principles of design concepts, materials, construction, systems, planning, professional practice, history and visual judgment, which are fundamental for development of the creative process. The curriculum is progressive with required core coursework offering foundation knowledge, skills and vocabulary, while upper-level study seeks a broader understanding of architecture by combining theoretical exploration with practical considerations.

Master of Architecture with Advanced Standing

Candidates who hold a B.A. or B.S. in Architecture (a pre-professional program from an NAAB recognized school from the U.S.) or international students holding a professional degree from outside the U.S.; and who have completed the equivalent of the first year's required courses may qualify for up to one year of advanced standing in the professional degree program. Admission with Advanced Standing may allow the candidate to complete the Master of Architecture degree in as few as two years (four semesters), depending on prior preparation. Can-

didates may be asked to provide additional evidence on their previous coursework, including projects and course syllabi, to determine eligibility for Advanced Standing. Candidates will be notified upon admission as to their qualification for Advanced Standing. International students with a Bachelor of Architecture degree (or equivalent) who wish to pursue a NAAB accredited program to be eligible for licensure in the United States should apply to the Master of Architecture with Advanced Standing.

Curriculum and Admission Requirements

The Master of Architecture professional degree program requires a Bachelor's degree in any discipline from an accredited university.

For holders of a bachelors degree outside of the field of architecture, who satisfy the prerequisites for admission, the course of study will be three years (six semesters) in length and 96 to 102 credit hours, depending upon a placement exam and/or a portfolio review. For candidates who hold a B.A. or B.S. in Architecture (a pre-professional program from an NAAB recognized school if from the U.S.) or international students with a Bachelor of Architecture degree (or equivalent), who satisfy the prerequisites for admission, the course of study may be reduced to a minimum of two years (four semesters) in length and 60 to 66 credit hours, as required of graduate students by the University, and based on the number of credits received for Advanced Standing. Candidates will be notified of their program requirements at the time of admission. The total number of credit hours, which will be required for graduation, will be established by each student's individual program of study.

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 college level physics course equivalent to IIT's PHYS 200;
2. An understanding of basic mathematical principles and analytical procedures, including algebra, geometry, and trigonometry, as demonstrated through the successful completion of college-level mathematics equivalent to IIT's 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;
4. A basic understanding of design, as demonstrated by the successful completion of one college-level design course or by portfolio submissions;
5. An equivalent of 20 credit hours of liberal arts and humanities.

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.

Degree Requirements

As required by the University, graduate students must maintain a 3.0, or 'B', grade point average in their program of study. The College of Architecture also requires this as part of the Master of Architecture degree requirements. Within the College, particular emphasis is placed on the studio as the forum where aspects of the curriculum are synthesized. Candidates must pass each studio course before continuing to the next studio in the sequence. Students may receive a single 'C' in a studio, if maintaining the required 'B' average. However, if a student receives a second 'C' in studio coursework, they will be subject to dismissal from the program. Students may remediate this situation by repeating the coursework and achieving a higher letter grade, or enrolling in a remedial studio. The additional credits required for the additional studio cannot be counted toward their program of study.

In addition to the curricular requirements for the degree, there are several milestones that have been integrated throughout the coursework to ensure a student's successful completion and comprehension of the concepts and material. Each student's progress will be evaluated by an independent panel of faculty prior to their continuation, and eventual completion, of the program.

There are a wide variety of electives available not only in the College of Architecture, but also in IIT's 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. Master of Architecture students wishing to accomplish a Master's Thesis as part of the post-professional Master of Science in Architecture program may petition for dual enrollment.

Architecture

M.Arch. Curriculum

1st Year

Fall(Elements)		Credits
ARCH 500	History of Architecture	3
ARCH 505	Urban Ecology	3
ARCH 506	Design Communications I: Units & Order	3
ARCH 541	Architecture Studio I: Elements	6
Total Hours		15

2nd Year

Fall(Neighborhood)		Credits
ARCH 485	Structures I: Concepts	3
ARCH 508	Design Communications III	3
ARCH 513	Mechanical and Electrical Building Systems for Architects I	3
ARCH 520	Principles of Urban Planning & Design	3
ARCH 543	Architecture Studio III: Neighborhood	6
Total Hours		18

3rd Year

Fall(Metropolis)		Credits
ARCH 502/3	Advanced Topics in History & Theory I/II	3
ARCH 545	Architecture Cloud Studio V: Metropolis	6
ARCH 560/1/2/3/5	Professional Practice	3
	Architecture Elective	3
	Architecture Elective	3
Total Hours		18

1st Year

Spring(House)		Credits
ARCH 486	Structures II: Design of Wood & Steel	3
ARCH 501	Contemporary Architecture	3
ARCH 507	Design Communications II: Systems & Assemblages	3
ARCH 542	Architecture Studio II: House	6
	Architectural Elective	3
Total Hours		18

2nd Year

Spring(Institution)		Credits
ARCH 502/3	Advanced Topics in History & Theory I/II	3
ARCH 514	Mechanical and Electrical Building Systems for Architects II	3
ARCH 544	Architecture Studio IV: Institution	6
ARCH 568	Architectural Practice	3
	Materials Elective	3
Total Hours		18

3rd Year

Spring(Metropolis)		Credits
ARCH 546	Architecture Cloud Studio VI: Metropolis	6
	Architecture Elective	3
	Architecture Elective	3
	Architecture Elective	3
Total Hours		15

Total Credit Hours **102**

M.Arch. Curriculum with Advanced Standing

1st Year Fall(Neighborhood)		Credits
ARCH 485	Structures I: Concepts	3
ARCH 508	Design Communications III	3
ARCH 513	Mechanical and Electrical Building Systems for Architects I	3
ARCH 520	Principles of Urban Planning & Design	3
ARCH 543	Architecture Studio III: Neighborhood	6
Total Hours		18

1st Year Spring(Institution)		Credits
ARCH 486	Structural Analysis	3
ARCH 502/3	Advanced Topics in History & Theory I/II	3
ARCH 514	Mechanical and Electrical Building Systems for Architects II	3
ARCH 544	Architecture Studio IV: Institution	6
ARCH 568	Architectural Practice	3
Total Hours		18

2nd Year Fall(Metropolis)		Credits
ARCH 502/3	Advanced Topics in History & Theory I/II	3
ARCH 545	Architecture Cloud Studio V: Metropolis	6
ARCH 560/1/2/3/5	Professional Practice	3
	Architecture Elective	3
Total Hours		15

2nd Year Spring(Metropolis)		Credits
ARCH 546	Architecture Cloud Studio VI: Metropolis	6
	Architecture Elective	3
	Architecture Elective	3
	Architecture Elective	3
Total Hours		15

Total Credit Hours **66**

Master of Science in Architecture - Post-Professional Degree

The Master of Science in Architecture is a three semester program (including one summer semester) that allows students holding NAAB-accredited B.Arch. and M.Arch. degrees (or equivalent international degrees) to earn a master's degree with a research focus, by continuing their studies. For some students the program may also lead to further studies and research in the Ph.D. in Architecture program.

The Master of Science in Architecture program seeks to be synthetic and inter-disciplinary in its approach, and endeavors to sharpen critical thinking through collaborative and experimental working processes. The intensive three-semester program is structured around two design-based research studios, an individual or collective thesis project, history and theory seminars, and two master's classes. The college's colloquia, lectures, and exhibitions expand upon and augment the curriculum. The master classes will form the core of the "Cloud Studio" in the College.

Admission and Curriculum Requirements

Candidates for the post-professional Master of Science in Architecture must hold an accredited Bachelor of Architecture (B.Arch) or Master of Architecture (M.Arch) as a professional degree from an NAAB accredited institution if earned within the U.S. International applicants must hold a Bachelor of Architecture or Master of Architecture degree or equivalent and be eligible for licensure in their home country.

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 advisor. The program of study for each student is developed individually with the thesis advisor. Study begins with investigation and analysis for the thesis under the direction of the advisor. 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.

Master of Science in Architecture Curriculum

Fall		Credits
ARCH 588	Thesis Preparation Seminar	3
ARCH 590	Specialized Research & Thesis Development	6
Elective	Architecture Related	3
Elective	Architecture Related	3
Total Hours		15

Spring		Credits
ARCH 591	Research and Thesis	6
Elective	Architecture Related	3
Elective	Architecture Related	3
Elective	Architecture Related	3
Total Hours		15

Summer/Fall		Credits
ARCH 591	Research and Thesis	2
Total Hours		2

Total Credit Hours **32**

Master of Integrated Building Delivery – Post-Professional Degree

The Master of Integrated Building Delivery program focuses upon providing comprehensive delivery strategies to promote a quality built environment. The program will educate architects to more actively participate in, guide, and/or undertake the full range of entrepreneurial and innovative activities comprising design, develop and build initiatives. Architecture has generally involved the conceptual basis of project initiation as well as the documentation and management of implementing methodology. Some architects, in response to the broad definition of the profession, must have the abilities and leadership skills to empower the individual toward a position of competency and responsibility in the broader and complex processes of design and construction. The

Master of Integrated Building Delivery program aims to provide this knowledge and skill set to those who have already assimilated, or are in the process of acquiring, the more traditional scope of an architectural education. The program is interdisciplinary by design and each course will be taught by an expert in the particular field of study. It is therefore encouraged that electives be pursued from allied colleges within the University including Stuart School of Business, Chicago-Kent College of Law, and Armour College of Engineering. The Master of Integrated Building Delivery is a post-professional degree program and may be completed in as few as two semesters.

Admission and Curriculum Requirements

Candidates for the post-professional degree program must hold an accredited Bachelor of Architecture (B.Arch) or Master of Architecture (M.Arch) as a professional degree from an NAAB accredited institution if earned within the U.S. International applicants must hold a professional Bachelor of Architecture or Master of Architecture degree or equivalent and be eligible for licensure in their home country.

The Master of Integrated Building Delivery program of study requires a minimum of 30 credit hours. The program is course based with the opportunity for independent investigation in the Comprehensive Development Project and the Project Sector Studies. In

order to allow working professionals to attend, courses will be scheduled for evening and weekend hours. The Comprehensive Development Project or Practicum provides two options for the acquisition and assimilation of the breadth of knowledge required to bring projects to fruition. The Comprehensive Development Project is a capstone effort which will demonstrate project concept, planning resolution, land acquisition strategies, estimating, scheduling, financial pro-forma, and value capture intents. The Practicum entails employment at a vetted office, engaged in the actual process of project assembly.

M.IBD Curriculum

Fall		Credits
ARCH 560	Integrated Building Delivery Practice/BIM	3
ARCH 561	Entrepreneurship & Innovation in Architecture	3
ARCH 562	Planning Law & Land Policy	3
ARCH 563	Introduction to Real Estate Finance Fundamentals	3
ARCH 566	Entrepreneurial Design: Sector Studies/Case Studies	3
Total Hours		15

Spring		Credits
ARCH 564	Comprehensive Opportunity Assessment & Entrepreneurship Development Project/Practicum	6
ARCH 565	Construction & Project Management	3
Elective	Topic Related	3
Elective	Topic Related	3
Total Hours		15

Total Credit Hours 30

Dual Master of Architecture/Master of Integrated Building Delivery

The intent of the dual degree program is to respond to the interests of those students who recognize the intrigue of expanding their goals from designing the built environment, to effecting or otherwise participating in the realization of the built environment. The content and the intentions of the component curriculums remain intact and undiminished.

Architecture has generally involved the conceptual basis of project initiation as well as the documentation and

management implementing methodology. Some architects, in turn, must have the abilities and the leadership skills to empower the profession toward a position of competency and responsibility in the broader and complex processes of design and construction. By integrating the NAAB accredited Master of Architecture (M.Arch.) and the Master of Integrated Building Delivery (M.IBD), the dual degree aims to provide this knowledge and skill set to those who wish to have the delivery option inform their studies throughout their architectural education.

Admission and Curriculum Requirements

The dual M.Arch./M.IBD program requires a bachelor's degree in any discipline from an accredited university. In order to be admitted to the dual degree, applicants must complete all of the admission requirements for the M.Arch. program. In addition, a professional statement specifically addressing the interest in the Dual M.Arch./M.IBD. program is required.

Candidates may apply for the dual degree during their initial application. An application to the Dual M.Arch./M.IBD. degree does not guarantee admission to both programs. If an application is denied for the M.Arch. portion of the degree, candidates will not be eligible for the M.IBD. degree program unless they fulfill the post-professional degree requirements. Continuing students in the M.Arch. program may apply for the Dual M.Arch./M.IBD. program prior to their final semester in the M.Arch. program.

Two required courses within the M.IBD. program are directly repeated within the M.Arch. program (ARCH 560 and ARCH 565). Another M.Arch. requirement, a Professional Practice Elective, is fulfilled by the student's choice of ARCH 561, ARCH 562, or ARCH 563 from the M.IBD. program. This overlap of 9 credit hours is applied to a reduction of required courses for the dual degree. Furthermore, the M.IBD. program requires two electives, in a related course of study. These two courses will also apply to the M.Arch. curriculum. A summation of requisite credit hours for each degree program would entail 102 credits for the M.Arch., and 30 for the M.IBD. With the credited overlay, the dual degree program would be awarded upon completion of 117 credit hours.

Dual M.Arch./M.IBD. Curriculum

1st Year Fall		Credits
ARCH 485	Structures I: Concepts	3
ARCH 500	History of Architecture	3
ARCH 506	Design Communications I: Units & Order	3
ARCH 541	Architecture Studio I: Elements	6
Total Hours		15

2nd Year Fall		Credits
ARCH 403	Mechanical & Electrical Building Systems for Architects I	3
ARCH	Visual Training Elective	3
ARCH 502	Advanced Topics in History & Theory I	3
ARCH 505	Urban Ecology	3
ARCH 543	Architecture Studio III: Neighborhood	6
Total Hours		18

3rd Year Fall		Credits
ARCH 520	Principles of Urban Planning & Design	3
ARCH 523	Master's Project Preparation: Research Analysis & Programming	3
ARCH 545	Architecture Cloud Studio V: Metropolis	6
ARCH	Professional Practice Elective	3
561/2/3		
Elective	Dual Elective	3
Total Hours		18

4th Year Fall		Credits
ARCH 560	Integrated Building Delivery Practice/BIM	3
ARCH	Professional Practice Elective*	3
561/2/3		
ARCH	Professional Practice Elective*	3
561/2/3		
Elective	Dual Elective	3
Elective	Architecture Elective	3
Total Hours		15

Total Credit Hours 117

1st Year Spring		Credits
ARCH 486	Structures II: Design of Wood & Steel	3
ARCH 501	Contemporary Architecture	3
ARCH 507	Design Communications II: Systems & Assemblages	3
ARCH 508	Design Communications III	3
ARCH 542	Architecture Studio II: House	6
Total Hours		18

2nd Year Spring		Credits
ARCH 404	Mechanical & Electrical Building Systems for Architects II	3
ARCH 503	Advanced Topics in History & Theory II	3
ARCH 509	Topics in Advanced Technology	3
ARCH 544	Architecture Studio IV: Institution	6
ARCH 565	Construction & Project Management	3
Total Hours		18

3rd Year Spring		Credits
ARCH 564	Comprehensive Opportunity Assessment & Entrepreneurship Development Project/Practicum	6
ARCH 566	Entrepreneurial Design: Sector Studies/Case Studies	3
ARCH 593	Master's Project	6
Total Hours		15

*One of these courses will be used as a M.Arch.required ARCH 561/2/3 Professional Practice Elective, the other two will be required for the M.IBD. program.

Master of Landscape Architecture

More than ever, the world needs more informed, more innovative, more critically involved landscape architects. Globally, population growth, changing climate, and continued depletion of natural resources question historical planning and design models. Landscape architects have emerged among design professionals to lead in the reclamation, organization, and understanding of our cities to meet these 21st century challenges. Among American cities, Chicago presents unique opportunities to test and celebrate the potential of urban environments to transform these conditions of crisis to promise, neglect to value, banality to poetry.

Chicago is geographically positioned within the Great Lakes Basin, where twenty percent of the world's fresh water supply is both a vital natural resource and an

economic catalyst for the mega-region. While Chicago enjoys the legacy of a world-class park system sponsored by the 1893 Columbian Exposition, the world-renowned Chicago Botanic Garden, and the Prairie School Landscape aesthetic, it is steadily being transformed by a set of contemporary interests. Millennium Park, Chicago Green Roof and Sustainability Initiatives, Green Streets, the Bloomingdale Trail, and the regeneration of the Chicago River, characterize the emergence of Chicago's 21st century landscape.

Landscape students, during their final year, will participate in the College's "Cloud Studio", contributing their unique skills and perspectives on the urban landscape.

Additional Admission Requirements

To be admitted without conditions to the Master of Landscape Architecture program, an applicant is required to have prior college-level coursework in freehand drawing, biology, and earth science (geology, physical geography, or hydrology, etc.). Candidates lacking these

prerequisites may be admitted on the condition that they complete the required coursework before enrolling. Candidates will be notified upon admission of their program of study, which is determined by prior academic training and professional experience, as well as portfolio content.

Master of Landscape Architecture Curriculum

1st Year Fall		Credits
LA 501	Nature of Ecology	3
LA 525	Representing and Modeling the Landscape	3
LA 541	Studio I: Dynamics and Processes of Place	6
LA 565	Ecology & Materials Workshop I: Plants and Planting	3
Total Hours		15

2nd Year Fall		Credits
LA 515	Firms, Parks, Developers	3
LA 527	Advanced Modeling & Fabrication	3
LA 543	Studio III: Comprehensive Landscape Design	6
LA 567	Ecology and Materials Workshop III: Horticulture & Design	3
Total Hours		15

3rd Year Fall		Credits
LA 516	Historic Landscape Preservation	3
LA 545	Studio V: Advanced Landscape Design Investigations	6
Elective	Related to Landscape Research	3
Elective	Related to Architecture	3
Total Hours		15

1st Year Spring		Credits
LA 502	Landscape Architectural History: From Antiquity to Olmsted	3
LA 526	Digital Media	3
LA 542	Studio II: Site and City	6
LA 566	Ecology and Materials Workshop II: Earthworks and Infrastructures	3
Total Hours		15

2nd Year Spring		Credits
LA 503	Advanced Contemporary Theory: Case Studies	3
LA 514	Professional Practice in Landscape Architecture	3
LA 544	Studio IV: Site, City, & Region	6
LA 568	Ecology & Materials Workshop IV: Manufacturing the Urban Environment	3
Total Hours		15

3rd Year Spring		Credits
LA 546	Studio VI: Advanced Landscape Design Investigations	6
Elective	Landscape Architecture Elective	3
Elective	Related to Landscape Research	3
Elective	Related to Architecture	3
Total Hours		15

Total Credit Hours 90

Electives

Media: GIS, Flash, Animation, Parametric (Revit)
 History and Theory: Specific designers, periods, themes
 Current electives: Urban Planning
 Research: As per individual student and faculty interests

Architecture

M.Arch/MLA Dual Degree Curriculum

1st Year		
Fall		Credits
ARCH 500	History of Architecture	3
ARCH 505	Urban Ecology	3
ARCH 541	Architecture Studio I: Elements	6
ARCH 506	Design Communications I: Units & Order	3
	OR	
LA 525	Representing & Modeling the Landscape	3
Total Hours		15

2nd Year		
Fall		Credits
ARCH 403	Mechanical & Electrical Building Systems for Architects I	3
ARCH 486	Structures II: Design of Wood & Steel	3
ARCH 543	Architecture Studio III: Neighborhood	6
LA 565	Ecology & Materials Workshop I: Plants & Planting	3
Total Hours		15

3rd Year		
Fall		Credits
ARCH 502	Advanced Topics in History & Theory I	3
LA 543	Comprehensive Landscape Design	6
LA 567	Ecology & Materials Workshop III: Horticulture & Design	3
LA 501	Nature of Ecology	3
	OR	
Elective	LA Elective	3
Total Hours		15

4th Year		
Fall		Credits
ARCH 520	Principles of Urban Planning & Design	3
ARCH 523	Master's Project Preparation: Research Analysis & Programming	3
LA 545	Community Based Building Project	6
LA 514	Professional Practice	3
	OR	
ARCH 561/2/3	Professional Practice Elective	3
Elective	Architecture Elective	3
Total Hours		18

1st Year		
Spring		Credits
ARCH 485	Structures I: Concepts	3
ARCH 508	Design Communications III	3
ARCH 542	Architecture Studio II: House	6
LA 502	Landscape Architecture History	3
LA 566	Ecology & Materials Workshop II: Earthworks & Infrastructures	3
Total Hours		18

2nd Year		
Spring		Credits
ARCH 404	Mechanical & Electrical Building Systems for Architects II	3
ARCH 501	Contemporary Architecture	3
ARCH 544	Architecture Studio IV: Institution	6
LA 568	Ecology & Materials Workshop IV: Manufacturing the Urban Environment	3
Elective	LA Elective	3
Total Hours		18

3rd Year		
Spring		Credits
ARCH 509	Topics in Advanced Technology	3
ARCH 565	Construction & Project Management	3
LA 503	Advanced Contemporary Theory: Case Studies	3
LA 544	Site, City, or Region	6
Elective	LA Elective	3
Total Hours		18

4th Year		
Spring		Credits
ARCH 593	Master's Project	6
ARCH 560	Integrated Building Delivery Practice/BIM	3
Elective	LA Elective	3
Elective	Architecture Elective	3
Total Hours		15

Total Credit Hours **132**

Doctor of Philosophy in Architecture

The Doctor of Philosophy (Ph.D.) in Architecture program is for those individuals who desire to pursue careers in academia and/or in research-based professional practice. As the most advanced academic degree, the Ph.D. recognizes both the highest level of expertise and the production of significant novel work. The program demands a deep understanding of architecture's history and its contemporary intellectual terrain, a command of advanced research methodologies, and a commitment to critical inquiry that extends its frontiers.

The program begins with advanced coursework and culminates in a dissertation that is the result of extensive, original, and rigorous research and thought. The Ph.D. program grows out of the school's collective commitment to progressive research that is grounded in the realities of the workplace and devoted to contesting existing values and ideologies. Doctoral students will participate in the experiments of design studios and will later help guide these efforts in mentoring roles, helping to shape the debate within the College through their involvement in the College's "Cloud Studio."

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 either the Master of Architecture or the Master of Science in 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 IIT's Graduate College, plus a minimum cumulative grade point average of 3.5 on a 4.0 scale; a TOEFL score of at least 80/550; and at least three letters of recommendation, from immediate supervising professors. 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 52 credit hours usually completed in three-and-a-half to four years beyond the M.Arch. degree, which will include a minimum of 26 credit hours of course-work. 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, history/theory, and advanced computer applications. Work for the Ph.D. must be completed within six years after admission to doctoral candidacy.

Doctor of Philosophy with Specialization in History and Theory of Architecture

52 credit hours beyond the Master's degree
(Master's degree required)
Written qualifying examination
Comprehensive examination
Dissertation and oral defense
Reading knowledge of two foreign languages (generally German, French, or Italian)

architectural thought might take higher level courses in the the social sciences or humanities. Electives include the Special Projects or Directed Readings course (597). The College of Architecture will also accept the following courses from other IIT departments: CAE 597, CAE 691, ID 598, ID 691, MMAE 597, MMAE 691, PHIL 597.

Required Courses

ARCH 500 History of Architecture
ARCH 501 Contemporary Architecture
ARCH 502 Advanced Topics in History & Theory I
ARCH 503 Advanced Topics in History & Theory II
ARCH 601 Doctoral Methodology Pre-Seminar
ARCH 602 Doctoral Methodology II

All students will enter the program with a Master's degree, hence the minimum credit hours of Ph.D. study is 52. The first doctoral methodology course (601) is taken in the first semester of the first year; the second doctoral methodology course (602) is directed to the preparation of the comprehensive exam proposal. Electives will be tailored to the student's particular field of study. For instance, a student working on the social dimension of

Doctor of Philosophy with Specialization in Technologies of the Built Environment

52 credit hours beyond the Master's degree

Written qualifying examination

Comprehensive examination

Dissertation and oral defense

Architecture is a discipline encompassing both theory and practice. Engineering is a science applied to many industries of design and the construction trades, including energy systems, materials, structural efficiencies, acoustics, lighting, etc. Thus the professional reach of the two fields overlap in many ways. This joint specialization between the College of Architecture and the Department of Civil, Architectural, and Environmental Engineering provides a new pathway for qualified architecture and engineering students, with suitable backgrounds, to pursue doctoral research in various fields of building technologies, which spans subjects including building physics, architecture, structural engineering, design, and others.

The program requires a minimum of 52 credit hours, usually completed in three-and-a-half to four years beyond the M.Arch. degree, which will include 12 credit hours of core courses. Another 6 credit hours will be chosen from a list of courses, depending on the student's dissertation research interests. Students must also complete at least 24 credit hours of dissertation research courses (ARCH 691 or CAE 691). The remaining coursework should be taken within the student's field of concentration and/or to supplement their research interests. Courses within ARCH, CAEE, MMAE, and a number of other departments are allowed but are subject to advisor approval.

Required Courses

CAE 513 Building Science

ARCH 601 Doctoral Methodology Pre-Seminar

Elective Courses (minimum of two)

CAE 502 Acoustics & Lighting

CAE 521 Building Illumination Design

CAE 524 Building Enclosure Design

CAE 553 Measurement & Instrumentation in Architectural Engineering

ENVE 576 Indoor Air Pollution

ARCH 485 Structures I: Concepts

AND

ARCH 486 Structures II: Design of Wood & Steel

ARCH 487 Eco Structures

ARCH 488 Long-Span & Special Structures

ARCH 508 Design Communications III

ARCH 509 Topics in Advanced Technology

ARCH 551 Design of Energy-Efficient Buildings I

AND

ARCH 552 Design of Energy-Efficient Buildings II

ARCH 602 Doctoral Methodology II

Course Descriptions

Architecture

ARCH 500

History of Architecture

A comprehensive and critical reading of architectural ideas and built form from classical times until the late 19th century. With a focus on primary readings and building documentation, the course surveys the embodiment of ideas within the panorama of changing styles, techniques, and attitudes, highlighting the critical debates of each epoch. It places an emphasis on the great complexity of social, political, intellectual, and material forces affecting architectural thought and design. Critical reading and writing skills will be emphasized. Open only to Architecture majors.

(3-0-3)

ARCH 501

Contemporary Architecture

This course investigates the state of contemporary architecture as represented by significant practices, buildings, theories, and criticisms. Themes to be considered include globalization, the role of digital design media, the ethics and aesthetics of sustainability, contemporary urbanism, new approaches to materials and structure, and recent interests in ornament and pattern-making. Current conditions will be related historically to postwar reactions to modernism and contextually to the social and technological shifts of recent decades. With a focus on primary readings and building documentation, the course places an emphasis on the great complexity of social, political, intellectual, and technological forces affecting design. Critical reading and writing skills will be emphasized. Open only to Architecture majors.

(3-0-3)

ARCH 502

Advanced Topics in History & Theory I

Intended to build on the knowledge and abilities gained in the foundational architectural history and theory courses. This seminar focuses on advanced topics in history, theory, and criticism. Students select from varying and diverse topics such as urbanism, sustainability, design methodology, aesthetics, ethics and law, history of technology, and architecture in relation to other arts. Seminar may also offer intense focus on particular architects, periods, regions, or movements. Critical reading and writing skills will be emphasized. In addition, the advanced seminar will teach research skills, will expect the students to formulate and pursue original research topics, and will expect oral presentations of these projects. These abilities will be evaluated through in-class presentations and research papers. Open only to Architecture majors.

(3-0-3)

ARCH 503

Advanced Topics in History & Theory II

Intended to build on the knowledge and abilities gained in the foundational architectural history and theory courses. This seminar focuses on advanced topics in history, theory, and criticism. Students select from varying and diverse topics such as urbanism, sustainability, design methodology, aesthetics, ethics and law, history of technology, and architecture in relation to other arts. Seminar may also offer intense focus on particular architects, periods, regions, or movements. Critical reading and writing skills will be emphasized. In addition, the advanced seminar will teach research skills, will expect the students to formulate and pursue original research topics, and will expect oral presentations of these projects. These abilities will be evaluated through in-class presentations and research papers. Open only to Architecture majors.

(Credit: Variable)

ARCH 505

Urban Ecology

Students will develop a sensitivity to the environment in which architecture is created. Emphasis will be placed on an in-depth exposure to the integration of natural features of site, sustainable components of both natural and man-made systems, and the synergy of ecological design. Open only to Architecture majors.

(3-0-3)

ARCH 506

Design Communications I: Units & Order

A comparative study of physical and digital media from the immediacy of the hand to the logical rigor of algorithmic design. Organizational systems and mapping strategies explored as craft is developed across a broad toolkit. Instruction in object-oriented thinking begins an introduction to computer science. Open only to Architecture majors.

(2-2-3)

ARCH 507

Design Communications II: Systems & Assemblages

The full design communication process, from contextual and programmatic analysis to the digital fabrication of a system of parts, will be introduced through a series of related studies. Computationally associative design methodologies will be utilized and continue the computer science introduction. Open only to Architecture majors.

Prerequisite(s): [(ARCH 506)]

(2-2-3)

ARCH 508

Design Communications III

Introduction to geospatial mapping, data modeling, and data visualization processes for research, analytics, and generative design. Basic data structures, algorithms, and design patterns advance students ability to construct digital tools and communicate complexity. Open only to Architecture majors.

Prerequisite(s): [(ARCH 506)]

(2-3-3)

ARCH 509

Topics in Advanced Technology

This research seminar examines advances in the technologies that affect the practice of architecture. The course examines leading technologies, 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. Students may select between varying and diverse topics offered by the faculty that may include building envelopes, architectural materials, building and environmental systems, advanced structural design, energy and sustainability, architectural acoustics and lighting, fabrication, and computer-aided design technologies. Open only to Architecture majors.

(3-0-3)

ARCH 513

Mechanical & Electrical Building Systems for Architects I

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.

(3-0-3)

ARCH 514

Mechanical & Electrical Building Systems for Architects 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. Prerequisite(s): [(ARCH 513)]

(3-0-3)

ARCH 520

Principles of Urban Planning & Design

An immersion in the history, discourse, and culture of cities in the modern era with an emphasis on Chicago and a focus on the needs and influences surrounding urban growth, development, and culture. Readings, lectures, case studies, film screenings, field trips, and discussions will provide a basic set of conceptual and theoretical resources for understanding the origins and development of cities. Although the more disciplinary concerns of urban design will be covered in the concurrent Arch 545 studio, this course will also develop a context for understanding the role of design in shaping the urban environment. Open only to Architecture majors.

(3-0-3)

ARCH 523

Master's Project Preparation: Research Analysis & Programming

Identification and development of the proposal for the master's project. Development of the project will include a comprehensive listing of all necessary program elements, research, analysis and selection of site, a statement of design parameters, project objectives, or similar project characteristics. Projects will be selected from eight areas of focus: sustainable cities, building delivery practices, community-based planning, research/history/theory, research/advanced technologies, housing and urban design, high-rise typology, and cultural institutions. Open only to Architecture majors.

(3-0-3)

ARCH 541

Architecture Studio I: Elements

Introduction of fundamental architectural elements (walls, doors, windows, stairs, rooms) through research, precedent study, and related design assignments. Establishment of quality criteria and core communication skills (verbal, graphic, and written) allow studio members to detect and avoid chance and arbitrariness in order to arrive at rational clarity and intellectual order. Studio projects focus on deployment of fundamental architectural elements into a whole and unified small structure. Open only to Architecture majors.

(0-12-6)

ARCH 542

Architecture Studio II: House

The second semester of the Master of Architecture focuses on the development of the fundamental aspects of building (space, structure, and materials) which are explored through designing a small house. Students expand their notions of scale and context through the investigation of current issues, historical and contemporary precedents, and the careful analysis and documentation of a specific site within a neighborhood of the city. Through a series of assignments, the studio is guided step by step through an iterative design process that culminates in imagining the home of the future. Open only to Architecture majors.

Prerequisite(s): [(ARCH 541)]

(0-12-6)

ARCH 543

Architecture Studio III: Neighborhood

Students move beyond the single building and elements that make up the home to consider the spaces between buildings, infrastructural elements, and neighborhoods. More complex sites and programs are introduced through the study of mixed-use buildings with hybrid structures and projects comprised of multiple building elements. Research of neighborhood typologies culminate in an urban design study that becomes the basis for individual building designs. The introduction of sustainable design concepts and material selection increase the students understanding of the building as a whole and are precursor to the comprehensive building design studio. Finally, students explore the architect's role in the making of a neighborhood and end with a project considering the neighborhood of the future. Open only to Architecture majors.

Prerequisite(s): [(ARCH 542)]

(0-12-6)

ARCH 544

Architecture Studio IV: Institution

This studio is the last of the four milestones of the curriculum consisting sequentially of Element, House, Neighborhood, and Institution. As a bridge between the concerns of the neighborhood and the metropolitan scale issues to be encountered in the subsequent Cloud Studios, this studio will deal with problems, programs, and contexts that are unique to institutional architecture within the city and will challenge students to create forward-looking strategies for renewed civic and cultural development. Because this studio is the only required comprehensive studio for the Master of Architecture degree program, all students must demonstrate that they are capable of producing a single building project demonstrating the synthesis of ecological planning, programming and code analysis, structure, and building systems. Students will research and produce a building program based on the themes introduced in the studio sections consisting of all necessary code research, context documentation and analysis, building theme research, and logistics research. Project will vary by studio section. Open only to Architecture majors.

Prerequisite(s): [(ARCH 543)]

(0-12-6)

ARCH 545

Architecture Cloud Studio V: Metropolis

The cloud studio is a research-based design studio focused on investigating the complex forces that shape the built environment and proposing new strategies for urban development. The aim of the studio is to build a commentary and transformative agenda toward the future metropolis and to drive urban and architectural design solutions with the most advanced technologies and critical thought. The studio production is oriented toward the development of new strategies and future urban models with the aim of advancing the knowledge of relationships between urban thinking and materiality, technology, energy, ecology, emerging media, and socio-political and cultural concerns. Strong emphasis is put toward engagement with external parties and agencies to connect the academic environment with the professional practice and to promote cross-disciplinary collaboration. Students will be able to select from a variety of studio topics. Vertical studio integrating advanced BArch, MArch, MS, and PHD students. Open only to Architecture majors.

Prerequisite(s): [(ARCH 544)]

(0-12-6)

ARCH 546

Architecture Cloud Studio VI: Metropolis

The design-based research studio is a continuation of the ARCH 545 research based design studio. It is focused on the development of the specific proposals based on the critical findings of ARCH 545. The aim of the studio is to develop formal solutions which address the complexities of modern metropolis and advance disciplinary knowledge at large. The studio production is oriented toward the development of projects in a variety of scales from large-scale master plans, urban designs, and landscape designs to new urban typologies and singular buildings, all of which can address a variety of the issues pertinent to the modern metropolis. The studios are formed in few thematic clusters which complement each other or serve as dialectical opposites. Each studio explores variety of techniques from parametric design, digital fabrication, model making, and advanced geospatial software to cultural and theoretical discourses. Vertical studio integrating advanced BArch, MArch, MLA, MS, and PHD students. Students will be able to select from varied studio topics. Open only to Architecture majors. Open only to Architecture majors.

Prerequisite(s): [(ARCH 545)]
(0-12-6)

ARCH 551

Design of Energy-Efficient Buildings I

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. Open only to Architecture majors.
(3-0-3)

ARCH 552

Design of Energy-Efficient Buildings 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. Open only to Architecture majors.
(3-0-3)

ARCH 553

High-Rise Building Technology I

The course consists of presentations by specialists in the various technologies of high rise buildings including planning, financing, code reinforcement, materials, architecture, engineering, project management, construction, building management services, safety, and maintenance. Open only to Architecture majors.
(3-0-3)

ARCH 554

High-Rise Building Technology II

The course consists of presentations by specialists in the various technologies of high rise buildings including planning, financing, code reinforcement, materials, architecture, engineering, project management, construction, building management services, safety, and maintenance. Open only to Architecture majors.
(3-0-3)

ARCH 560

Integrated Building Delivery Practice/BIM

Architecture has always been a complex interdisciplinary business, where the management of allied professions and industry affiliates is critical to the success of any endeavor of significant scale. The introduction of BIM (Building Information Modeling) is an advance in project delivery tools which should be viewed as a multi-dimensional expansion of the mechanisms of management and accommodation of an ever-broadening range of participants in the organization of a project, allowing the development of a new delivery protocol, IBPD (Integrated Building Project Delivery). BIM is currently recognized as consolidating the basis for a range of functions including drawing, modeling, document management, clash detection, interdisciplinary coordination, estimating, scheduling, constructability review, production modularization, fabrication protocols, and for the analysis of myriad physical and prescriptive demands such as energy consumption, daylighting, code compliance, egress, circulation, and operation scenarios. The breadth of information embedded in a BIM model will require the emergence of facilitating professionals to an extent previously unknown in the practice and the industry. This course explores the state of the profession and the anticipated ramifications. Open only to Architecture majors.
(3-0-3)

ARCH 561

Entrepreneurship & Innovation in Architecture

The course teaches future architects the practical aspects of entrepreneurial small business management, to develop a comprehensive opportunity assessment and to develop the skills necessary to improve the odds of success. The course will consider strategies to leverage limited resources for maximum effect. The course will also cover small organization and group behavior, performance, leadership, and motivation in small business settings and will focus on the owner/manager as the principal success factor in the context of a small organization. Emphasis is placed on the circumstances and opportunities of the professional practice of architecture: practice as profession, process, organization, business, and evolving models of practice are covered. The course also provides a series of concepts, frameworks, and heuristics that enable the entrepreneur to anticipate and deal with the challenges that accompany growth of an existing business. Cases, exercises, lectures, and speakers are used to focus on choosing opportunities, allocating resources, motivating employees, and maintaining control while not stifling innovation. A key component of the course is how to sustain entrepreneurial thinking in mid-sized ventures as they continue to grow. Open only to Architecture majors.
(3-0-3)

ARCH 562

Planning Law & Land Policy

Since the introduction of basic zoning laws to the numbers and complexity of ordinances attached to any land parcel have proliferated to include those addressing land use, development, density, environmental concerns both on and off site, aesthetic mandates, energy use, quality of life concerns, and infrastructure development, the growing understanding that comprehensive and integrated systems must be managed across property lines to effect sustainable planning and communities will accelerate the number of prescriptive and policy ordinances enforced at the development of a parcel. Many agencies have further created extra-legal linkages between approvals for land development and the provision of social and ideological benefits to the community. The impact on the profession of architecture of the panoply of planning options and governmental goals is the result that the navigation of the system of mandated design determinates is one of the initial and potentially most creative acts in the process of project delivery. Project designers must understand the ramifications and trade-offs inherent in the system, especially in any attempt to achieve the best use of any parcel of land and position the most appropriate built environment. Open only to Architecture majors.

(3-0-3)

ARCH 563

Introduction to Real Estate Finance Fundamentals

The Art of the Deal, with the emphasis on Art, is a term best positioning the financial structuring behind any project. The ability of the project team leader in integrated practice to understand and appreciate the motivations and opportunities inherent in the initiation of the project will be essential in guiding team decisions and maintaining a leadership position. The understanding of the financial underpinnings of a project is of paramount importance to those intending to actually engage the process of initiating and effecting a construction activity. The sources, costs, and sequence of funding, budgeting, cash flow, incentives options, and tax ramifications regarding a project are to be addressed as component knowledge to an understanding of integrated project management. Open only to Architecture majors.

(3-0-3)

ARCH 564

Comprehensive Opportunity Assessment & Entrepreneurship Development Project/Practicum

Two options are available to the student for the acquisition and assimilation of the breadth of knowledge required to bring project ideas to fruition. The Comprehensive Development Project is a capstone effort which will demonstrate project concept, planning resolution, land acquisition strategies, estimating, scheduling, financial pro-forma, and value capture intents. The practicum would entail employment at a vetted office engaged in the actual process of project assembly. A position requiring a minimum of 20 hours per week, prior review and approval of the work plan, and submittal of documentation of the work undertaken would be required for this scenario. The ultimate objective is to provide a roadmap of the interaction between the architect-entrepreneur, market opportunities, and integrated building delivery practices which facilitate the development of student skills necessary to compete in a rapidly changing socio-economic environment. This course is designed to help students learn and use tools and frameworks to create, implement, and update a strategic plan to shape the future and guide an entrepreneurial organization on its path to success. This course will entail collaboration with real world organizations including city agencies, community development corporations, IIT Department of Community Affairs, or private developers. Open only to Architecture majors.

(6-0-6)

ARCH 565

Construction & Project Management

The organization of deliverables from the multiple participants in a project plan, including estimating, quality control, value engineering, scheduling of work, conflict resolution, pay schedules, and project close-out and commissioning are essential to managing a building project. Many of these areas of endeavor are those most directly impacted by the developments addressed in Integrated Building Delivery Practice. This course will solidify the underpinnings and will amplify, where needed, the requisite understanding in these areas of the practice. The development of managerial skills requisite to the practice of this coordination and the basis of developing inter-professional relationships will be stressed throughout the incorporation of the technical methodologies. Open only to Architecture majors.

(3-0-3)

ARCH 566

Entrepreneurial Design: Sector Studies/Case Studies

This course will be advanced as an independent study format. Each student will work independently to research a project option, or building type, and document the particular attributes of that case study which require specialized address. Case studies might be a particular business niche, such as land sub-divisions, condo conversions, change of use conversions, or build-to-suit options. The studies might pursue particular building types, social initiatives, historic restoration strategies, or even unique construction typologies. Open only to Architecture majors.

(3-0-3)

ARCH 568

Architectural Practice

Lectures and practical problems dealing with specifications, specification writing, administration of construction, contracts, building law, and professional practice. Open only to Architecture majors.

(3-0-3)

ARCH 588

Thesis Preparation Seminar

The Master of Science in Architecture program positions its investigations in the liminal space between emerging forms of urbanization and existing concepts of architecture, landscape, and cities. Our goal is to develop new and better models for shaping socially, culturally, and ecologically sustainable environments. Thesis preparation seminars are conducted on thesis development with a thesis statement outlining an area of study or a problem that has consequences for contemporary architectural production at-large. Thesis development is parallel and complementary with the research-based design cloud studio ARCH 545 with Master of Science students focusing on the social and cultural aspect of research-based design developments. The seminar will focus on developing a bibliography, case studies of referential projects and built structures, and advanced research methods specifically tailored to the research interests of each student. Regular oral presentations will focus on development of thesis content, the use of media and rhetoric, and the didactic nature of disciplinary architectural communication. Open only to Architecture majors.

(3-0-3)

ARCH 589

Pre-Thesis Seminar

The Master of Science program seeks to be synthetic and inter-disciplinary in its approach. In contrast to an increasingly compartmentalized design profession divided into disparate realms of expertise, the program endeavors to sharpen critical thinking through collaborative and experimental working processes. Thesis development is parallel and complementary with the design-based research cloud studio ARCH 546. The focus is on design-based research work understood both as an intellectual problem of exploring the relationship between design and theory for knowledge production and as a practical problem of the way that design research can affect architectural practice. The seminar is focused on the general development of thesis work specifically generating an overall thesis structure and opening chapters. 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. Open only to Architecture majors. Open only to Architecture majors. (3-0-3)

ARCH 590

Specialized Research & 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. (Credit: Variable) Open only to Architecture majors. (Credit: Variable)

ARCH 591

Research & Thesis

The thesis research and development of ARCH 591 is premised on the view that design and research activities are inseparable and that knowledge production (theory) and formal production (practice) are methodologically linked. Marking the transition between the academic and professional worlds, the thesis work is an opportunity for each student to define an individual position with regard to a specific aspect of architectural practice. It is intended that the thesis project looks upon architectural and urban designs as formal and theoretical elaborations of the design-based research cloud studio ARCH 546 as well as the collective outcome of socio-political forces analyzed during thesis research. Thesis work leads towards the final acceptance of the presentation materials by the advisory committee. The text, reductions of the drawings, and representations using various media are bound together in a hard-cover volume, which is deposited in the Graham Resource Center and the Galvin Library. Credits: Variable; minimum total eight semester hours. Open only to Architecture majors. Open only to Architecture majors. (Credit: Variable)

ARCH 593

Master's Project

The Masters Project is the culmination of both the two-year and three-year Master of Architecture curricula – the synthesis of architectural study into an independent project. The Project is, most commonly, the design of a building or in-depth research about specific aspects of the built environment. 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. Successful Masters project proposals will be grouped into “Areas of Focus” studios. After final acceptance of the presentation materials by the faculty advisor and the “Area of Focus” teaching faculty, the text, reductions of the drawings, and model photographs are bound together, which are deposited in the GRC and the University’s library. Open only to Architecture majors.

Prerequisite(s): [(ARCH 523)]
(0-12-6)

ARCH 594

Research Problems

(Credit: Variable)

ARCH 596

ARCH IPRO

(0-0-3)

ARCH 597

Special Problems

Open only to Architecture majors.
(Credit: Variable)

ARCH 600

Continuance of Residence

(0-1-1)

ARCH 601

Doctoral Methodology Pre-Seminar

This course provides a foundation for doctoral students in the diversity of research paradigms in architecture. The first component is an introduction to 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. It is intended to provide substantial information on research methodologies not covered in undergraduate and graduate education. In this course students will write a series of papers that critically review the course readings and discussions. Open only to Architecture majors. (3-0-3)

ARCH 602

Doctoral Methodology II

This course will assist the student in preparing a doctoral proposal for the comprehensive examination and dissertation. Students will register for one credit hour if they are only seeking advice on how to structure the proposal or for three credit hours if they are preparing the structure and content of the proposal with their primary dissertation advisor. Open only to Architecture majors.

Prerequisite(s): [(ARCH 601)]
ERR!

ARCH 611

Seminar in Theory & Technology I

It will explore the history of modern architectural theory from the late seventeenth-century to 1975 with special regard to technology and its relationship to architectural culture. At times architectural theory forms a backdrop to architectural practice while seemingly taking little account of technological events. At other times technology and its material innovations change the very nature of architectural practice and its discourse. The course will consist of short lecture, presentations, and discussion. Open only to Architecture majors.

(3-0-3)

ARCH 612

Seminar in Theory & Technology II

It will form a continuation of ARCH 611 and consider the interface of theory and technology over the last thirty years. Students will take a more active role in tailoring their participation to advance their research in the dissertation and thesis topics they wish to pursue. Larger thematic issues of theory and technology will be considered within the richness of contemporary debates and competing interests. Students will present papers and a collective seminar document or publication will be produced.

(3-0-3)

ARCH 690

Research & Analysis Studio

Each research 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. Open only to Architecture majors.

(Credit: Variable)

ARCH 691

Doctoral Research

Open only to Architecture majors.

(Credit: Variable)

Architecture and Urbanism

Architecture and Urbanism

AURB 520

Principles of Urbanism & City Planning

Advanced study of infrastructure, networks, and systemic character that define the urban realm and urban issues with an examination and analysis of ecological, economic, social, and compositional frameworks. Students will explore historical and current discourse of urban conditions and planning. Open only to Architecture majors.

(3-0-3)

Landscape Architecture

LA 501

Nature of Ecology

An historical, theoretical, and scientific account of nature's role in the humanities and sciences as they relate to design. Emphasis is placed on the relationships between natural systems and the fitness of a landscape, the site and the organism, open and closed systems, causation and constraints, sustainability, and the complex interplay between humans and the designed environment. Open only to Architecture majors.

(3-0-3)

LA 502

Landscape Architectural History: From Antiquity to Olmsted

The chronological history of landscape design from antiquity to Olmsted, with emphasis on garden and park typologies. Open only to Architecture majors.

(3-0-3)

LA 503

Advanced Contemporary Theory: Case Studies

The study of 20th century landscape design with an emphasis on the Prairie School, modernism, organicism, and contemporary trends. The course is split between lecture and in-depth case studies of significant landscapes from the Chicago region and beyond. Collection information from the study projects' authors and weekend site visits will lead to models and representations (drawings, videos, etc.) that reveal otherwise latent aspects of each study project's organization, perceptual character, appearance, and performance. Open only to Architecture majors.

(3-0-3)

LA 514

Professional Practice of Landscape Architecture

An introduction to landscape architecture as a profession. Lectures, research assignments, and case studies will address issues including firm practice types, proposals and contracts, schedule and budget, project phases, project and client types, project team structure, the role of competitions, and professional development and licensure. Open only to Architecture majors.

(3-0-3)

LA 515

Firms, Parks, Developers

The players who orchestrate and manage landscapes, including planners, landscape architects, trusts, governmental agencies, and developers; and their economic, professional, political, and socio-cultural concerns and responsibilities. Open only to Architecture majors.

(3-0-3)

LA 516

Historic Landscape Preservation

Survey of historic landscape preservation theory, method, and practice, and their relationship to environmental and cultural considerations. Open only to Architecture majors.

(3-0-3)

LA 525

Representing & Modeling the Landscape

Using hand drawing and physical modeling to explore and interrogate landscape processes. Techniques and methods to explore, develop, and envision ideas particular to landscape design. Mapping, time, movement, body in space, line, contour, texture, flows of materials (hydro, litho, aero), and plant communities. Open only to Architecture majors.

(3-0-3)

LA 526

Digital Media

Using digital tools to clarify, conceptualize, represent, and communicate the forces and flows within designed and engineered environments. A fluidity between critical, visual, and quantifiable digital techniques will be cultivated and will ground the management of information across software platforms. Focus on Photoshop, Illustrator, and AutoCAD. Open only to Architecture majors.

Prerequisite(s): [(LA 525)]
(3-0-3)

LA 527

Advanced Modeling & Fabrication

Students learn advanced digital fabrication and modeling techniques necessary to understand complex three-dimensional surfaces, objects, and space, as well as dynamic processes. Modeling, rendering, scripting, and animation skills are used to conduct, generate, and communicate research. Open only to Architecture majors.

Prerequisite(s): [(LA 525 and LA 526)]
(3-0-3)

LA 541

Studio I: Dynamics & Processes of Place

Understanding the fundamental relationships of dynamic natural processes, with an emphasis on representing time, movement, space, light, natural rhythms, shifting boundaries and enclosures, and the physical materials of landscape. Within a "natural" setting, students use varied tools (including the body) to measure and record landscape-specific phenomena and conditions such as erosion, entropy, edges, and movement through dynamic spaces. Students develop insightful and appropriately precise methods of modeling and representing these phenomena. Open only to Architecture majors.

(0-12-6)

LA 542

Studio II: Site & City

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. Open only to Architecture majors.

(0-12-6)

LA 543

Studio III: Comprehensive Landscape Design

The integration of local ecologies, projected use, and the performance of ephemeral, semi-permanent, and permanent site interventions into cohesive and resilient design proposals for varied urban sites. Introduction to a wide range of site-specific and common design standards including ADA and Barrier-Free regulations. Open only to Architecture majors.

Prerequisite(s): [(LA 542)]
(0-12-6)

LA 544

Studio IV: Site, City, & Region

Continuing investigation of native woody species as a major element in the landscape and traditional plant configurations such as bosques and allies 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 planting design and plant list, as well as plant selection, and technical aspects including hardiness zones, and soil requirements. Open only to Architecture majors.

(0-12-6)

LA 545

Studio V: Advanced Landscape Design Investigations

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 physiographic conditions. Open only to Architecture majors.

(0-12-6)

LA 546

Studio VI: Advanced Landscape Design Investigations

Critical synthesis of complex environmental, regulatory, and cultural conditions with multi-faceted programs demanding a mastery of knowledge, skill, and technique appropriate for a graduating student. Open only to Architecture majors.

(0-12-6)

LA 565

Ecology & Materials Workshop I: Plants & Planting

The plants of the Western Great Lakes Basin, emphasizing both prominent native and commercially available species. Understanding and identifying species as found within typical plant communities. Familiarization with plant physiology as determined by climate, geology, topography, hydrology, soils, wildlife, and disturbances (natural and anthropogenic). Open only to Architecture majors.

(2-2-3)

LA 566

Ecology & Materials Workshop II: Earthworks & Infrastructures

The qualities and characteristics of "soft" and "hard" landscape materials with emphasis on a quantitative and interrelated understanding of landform (grading) and drainage design. Covers the influence of climate, geology, soils, hydrology, and disturbances on the design of a site's constituent elements including pathways and roads, infrastructure, plantings, and storm water management strategy. Open only to Architecture majors.

(2-2-3)

LA 567

Ecology & Materials Workshop III: Horticulture & Design

Advanced understanding of horticulture as a technical science. The relationship between ecological research and a designed and engineered site, and applications thereof. Open only to Architecture majors.

(2-2-3)

LA 568

Ecology & Materials Workshop IV: Manufacturing the Urban Environment

Techniques and technologies to analyze, construct, remediate and/or restore urban sites, including those that have been subjected to complex human disturbances, such as landfills and brownfields. Includes special needs construction practices such as structured soils, phytoremediation, green roofs and rooftop gardens. Overview of relevant sit-specific codes and environmentally oriented building programs such as LEED. Open only to Architecture majors.

(2-2-3)

LA 597

Special Problems

Special problems in landscape architecture. For students in the master program in landscape architecture only.

(Credit: Variable)

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Associate Chair for Biology

Tanya Bekyarova

Executive Associate Chair for Chemistry

M. Ishaque Khan

Associate Chair for Chemistry

Rong Wang

The Department of Biological and Chemical Sciences offers B.S., M.S., and Ph.D. degrees in the fields of chemistry, biology, 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 master's degrees and related certificate programs for part-time students, both on campus and through distance learning.

Degrees Offered

In Biology

Professional Science Master of Biology with specialization in:

Biochemistry
Cell and Molecular Biology
Microbiology

Master of Science in Biology

Master of Science in Biology with specialization in:

Biochemistry
Cell and Molecular Biology
Microbiology

Master of Science in Molecular Biochemistry and Biophysics

Doctor of Philosophy in Biology

Doctor of Philosophy in Molecular Biochemistry and Biophysics

In Chemistry

Master of Chemistry in Analytical Chemistry

Master of Chemistry in Materials Chemistry

Master of Chemistry

Master of Science in Chemistry

Doctor of Philosophy in Chemistry

Certificate Programs

In Chemistry

Analytical Method Development

Analytical Spectroscopy

Characterization of Inorganic and Organic Materials

Chromatography

Regulatory Science

Synthesis and Characterization of Inorganic Materials

Synthesis and Characterization of Organic Materials

Research Centers

International Center for Sensor Science
and Engineering (ICSSE)

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, materials chemistry, organic chemistry, polymer chemistry, surface chemistry, physical chemistry, and medicinal chemistry. 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. Collaborative programs are carried on with Fermi National Accelerator Laboratory, Argonne National Laboratory, and the Advanced Photon Source.

Faculty

Biology Faculty

Antipova, Olga, Research Assistant Professor. B.Sc., M.S., Nizhny Novgorod Technical University (Russia); Ph.D., Illinois Institute of Technology.

Bekyarova, Tanya I., Senior Lecturer and Associate Chair for Biology. M.S., University of Plovdiv (Bulgaria); Ph.D., Illinois Institute of Technology. Muscle contraction and regulation. Biology and Biophysics.

Chakravarthy, Srinivas, Research Assistant Professor. B.Sc., Osmania University (India); M.Sc., Kasturba Medical College (India); Ph.D. Colorado State University.

Dushay, Mitchell, Assistant Professor. B.A., Brown University; Ph.D., Brandeis University. *Drosophila* genetics, immunology, eukaryotic transcription. Cell and Molecular Biology.

Howard, Andrew, Associate Professor of Biology and Physics and Laboratory Safety Officer. B.A., Pomona College; Ph.D., University of California-San Diego. Methods development and macromolecular crystallography. Biochemistry, Molecular Biochemistry, and Biophysics.

Irving, Thomas C., Professor of Biology, Physics, and Biomedical Engineering and Executive Associate Chair for Biology. B.Sc., M.Sc., Ph.D., University of Guelph (Canada). Structure and biophysics of macromolecular systems, muscle structure and physiology, synchrotron radiation instrumentation. Biochemistry, Molecular Biochemistry, and Biophysics.

Krikorian, Charles, Senior Lecturer and Director of Master's Program. B.S., University of Illinois, Urbana-Champaign; Ph.D., Loyola University; J.D., DePaul University.

Mehta, Rajendra, Professor. B.S., M.S., Gujarat University (India); Ph.D., University of Nebraska. Efficacy and mechanism of action of chemopreventive agents in experimental carcinogenesis of breast, colon, lung, and prostate. Cell and Molecular Biology.

Menhart, Nicholas G., Associate Professor. B.Sc., Ph.D., University of Waterloo (Canada). Spectroscopic techniques for the study of multi-domain proteins. Biochemistry, Molecular Biochemistry, and Biophysics.

Orgel, Joseph, Associate Professor. B.Sc.(Hons.), Ph.D., Stirling University. Extracellular matrix function and structure, protein folding.

Pombert, Jeah-Francois, Assistant Professor. B.Sc., M.Sc., Ph.D., Universite Laval (Canada).

Spink, Kathryn M., Senior Lecturer and Chair of the Pre-Medical Advisory Committee. B.S., Michigan Technological University; Ph.D., Michigan State University. Molecular genetics of mammalian viruses. Cell and Molecular Biology, Microbiology.

Stark, Benjamin C., Professor, Associate Dean for Research, and Acting Chair. B.S., University of Michigan; M.Ph., Ph.D., Yale University. Biochemistry and molecular biology of bacterial respiration, fermentation, bioremediation. Microbiology, Biotechnology, Cell and Molecular Biology.

Webster, Dale A., 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. Biochemistry, Microbiology, Biotechnology.

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

Zhang, Chunbo, Research Assistant Professor. B.Agr., M.Agr., Zhejiang Fisheries College (China); Ph.D., University of Manitoba (Canada). Use of molecular genetics, biophysics, immunohistochemistry, pharmacology, and behavior to study olfactory transduction in the mouse and in fish. Cell and Molecular Biology.

Chemistry Faculty

Cage, Brant, Assistant Professor. B.S., University of West Florida; Ph.D., Florida State University. Synthesis and biophysical applications of magnetic materials, design and building sensitive instrumental techniques to characterize magnetic materials; theoretical analysis of novel materials with superior properties for particular needs, such as magnetic resonance imaging (MRI) enhancement, magnetic refrigeration, and standards for MRI.

Chong, Hyun-soon, 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.

Eisenberg, Walter C., Emeritus Professor. 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.

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

Guan, Xiyun (Richard), Associate Professor. B.S., China University of Geosciences; M.S., Chinese Academy of Geological Sciences; Ph.D., University of Kentucky. Bio-analytical and bio-physical chemistry with an emphasis on the development of biosensors for bio-terrorist/bio-defense chemicals, environmental pollutants, toxins, DNA and protein molecules.

Hock, Adam S., Assistant Professor. B.S., University of Delaware; Ph.D., Massachusetts Institute of Technology. Homogenous and heterogenous inorganic and organometallic synthesis and catalysis; rational and tunable methods for the preparation of light-harvesting and novel electronic materials; structure, bonding, and electronic properties of molecular and extended materials.

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

Khan, M. Ishaque, Professor and Executive Associate Chair for Chemistry. Ph.D., Indian Institute of Technology (India). Design, synthesis, and property studies of advanced materials. Current focus is on nanomaterials for applications in chemical sensing, energy storage, and biomedical usage, and nanostructured catalysts for detection and removal of toxic gases from industrial exhaust and flue gas streams, selective oxidation, (hydrocarbon's transformation into useful industrial feed-stocks), and hydro treating catalysis.

Mandal, Braja K., Professor. B.Sc., University of Calcutta (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.

Minh, David Do Le, Assistant Professor. B.A., University of California, Berkeley; M.S., Ph.D., University of California, San Diego. Computational chemical biology and structure-based drug design; theoretical chemistry, especially statistical mechanics; biophysical chemistry.

Nguyen, Diep, Industry Professor. B.S., Ph.D., McGill University. Characterization and study of structure-property relationships in industrial polymeric materials.

Rogachev, Andrey, Assistant Professor. M.S., Ph.D., Moscow State University (Russia). Chemistry at magnetic centers, theoretical point of view; luminescence and bioluminescence; chemistry and physics of curved polyaromatic systems (buckybowls and fullerenes); multi-reference approach to spectroscopic, magnetic, and catalytic properties of organic, organometallic, and bio-(in)organic systems.

Unni, Aditya K., Assistant Professor. B.A., St. Olaf College; Ph.D., University of Chicago. Synthesis of small molecule natural products with interesting structural characteristics and biological activities. Developing reactions, specifically in asymmetric catalysis, to access high value chemical building blocks for organic synthesis.

Wang, Rong, Associate Professor and Associate Chair of Chemistry. B.S., M.S., Jilin University (China); Ph.D., University of Tokyo (Japan). Scanning probe microscopy, bioconjugate chemistry, biocompatible materials, method of development for single cell characterization and manipulation, analysis of effects of microenvironments on protein/cell/tissue function and dynamics.

Zion, Benjamin, Lecturer. B.A., Lawrence University; Ph.D., University of Chicago. Reactions at surfaces. Current focus is on chemical education and course development with special attention to instrumentation.

Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0
TOEFL minimum: 550/213/80*

The Graduate Record Examination (GRE) is required for all applicants. The GRE minimum scores are:

Ph.D.: 310 (quantitative + verbal),
3.0 (analytical writing)

Masters Program: 300 (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 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, or Molecular Biochemistry and Biophysics) are expected to have a bachelor's 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/computer-based/internet-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 officially for the examination a maximum of two 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 master's 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's degree programs (MAS) are required to take and pass a comprehensive exam. Students may sit for the exam a limited number of times, depending upon the individual program.

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. Master's degree programs are designed so that

they may be completed by part-time students. Doctoral-level courses are usually available either in the evenings, on Saturdays, or on the internet. Each new graduate student is assigned a graduate student advisor and must obtain the approval of the advisor each semester before registering for any graduate classes.

Master of Biology

Minimum 30 credit hours
Comprehensive examination

The Professional Master of Biology is a course-only, professional master's 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 http://iit.edu/iit_online/ for more information.

Students must pass the written 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 a minimum of 30 credit hours of coursework as follows.

Cell and Molecular Biology

BIOL 401 Introductory Biochemistry **AND**
BIOL 402 Metabolic Biochemistry
OR
BIOL 504 Biochemistry
BIOL 515 Molecular Biology
BIOL 526 Developmental Biology
BIOL 544 Molecular Biology of Cells
AND 6-9 hours of approved electives

Microbiology

BIOL 401 Introductory Biochemistry **AND**
BIOL 402 Metabolic Biochemistry
OR
BIOL 504 Biochemistry
BIOL 515 Molecular Biology
BIOL 542 Advanced Microbiology
BIOL 544 Molecular Biology of Cells
AND 6-9 hours of approved electives

Biochemistry

BIOL 401 Introductory Biochemistry **AND**
BIOL 402 Metabolic Biochemistry
OR
BIOL 504 Biochemistry
BIOL 512 Advanced Biochemistry
BIOL 515 Molecular Biology
BIOL 544 Molecular Biology of Cells
AND 6-9 hours of approved electives

Biotechnology

BIOL 401 Introductory Biochemistry **AND**
BIOL 402 Metabolic Biochemistry
OR
BIOL 504 Biochemistry
BIOL 515 Molecular Biology
BIOL 544 Molecular Biology of Cells
BIOL 562 Current Topics in Functional Genomics
AND 6-9 hours of approved electives

Students in each area of specialization also take the following three courses:

CHEM 513 Statistics for Analytical Chemists **AND**
COM 421 Technical Communication
OR
COM 523 Communicating Science

COM 580 Topics in Communication **AND**
BIOL 511 Project Management: Business Principles
OR
INTM 511 Industrial Leadership
OR
BIOL 524 Science and Law: An Introduction to
Intellectual Property Law and Patents

Master of Science in Biology

32-34 credit hours

Comprehensive examination

Option 1: Thesis

Option 2: Library or Laboratory research project

A Master of Science student must complete 32-34 credit hours of approved graduate work in one of the areas of specialization detailed below. This will include 26-30 credit hours of coursework and one credit hour of BIOL 595 Colloquium. Two options are available to complete

the M.S. degree requirements: a thesis option and a nonthesis 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. This option is available on a competitive basis. 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 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); or BIOL 581 Capstone; or a laboratory research project in BIOL 522 (Research Techniques in the Biological Sciences I) plus BIOL 523 (Research Techniques in Biological Sciences II).

Master of Science in Biology

Required Courses (15 hours)

BIOL 501 Graduate Laboratory Techniques

BIOL 504 Biochemistry

BIOL 515 Molecular Biology

BIOL 533 Advanced Graduate Laboratory Techniques

BIOL 544 Molecular Biology of Cells

Additional Requirements (7 hours)

BIOL 581 Capstone **AND**

BIOL 595 Colloquium

AND One additional elective

OR

BIOL 522 Research Techniques in Biological Sciences I

AND

BIOL 523 Research Techniques in Biological Sciences II

OR

BIOL 591 Research

OR

CHEM 591 Research

Elective Courses (6 hours)

BIOL 410 Medical Microbiology

BIOL 426 Concepts of Cancer Biology

BIOL 430 Animal Physiology

BIOL 503 Virology

BIOL 514 Toxicology

BIOL 520 Laboratory Rotation

BIOL 526 Developmental Biology

BIOL 527 Immunology and Immunochemistry

BIOL 542 Advanced Microbiology

BIOL 545 Advanced Cell Biology

BIOL 550 Bioinformatics

BIOL 562 Current Topics in Functional Genomics

Master of Science in Biology with Specialization in Biochemistry

32 credit hours

Required Courses (19 hours)

BIOL 501 Graduate Laboratory Techniques
BIOL 504 Biochemistry
BIOL 512 Advanced Biochemistry
BIOL 515 Molecular Biology
BIOL 533 Advanced Graduate Laboratory Techniques
BIOL 544 Molecular Biology of Cells
BIOL 555 Macromolecular Structure

Additional Requirements (7 hours)

BIOL 595 Colloquium **AND**
BIOL 591 Research

OR

CHEM 591 Research

OR

BIOL 572 Literature in Biochemistry **AND** one
additional elective

OR

BIOL 522 Research Techniques in Biological Sciences I
AND

BIOL 523 Research Techniques in Biological Sciences II

Elective Courses (6 hours)

BIOL 410 Medical Microbiology
BIOL 426 Concepts of Cancer Biology
BIOL 430 Animal Physiology
BIOL 503 Virology
BIOL 514 Toxicology
BIOL 520 Laboratory Rotation
BIOL 526 Developmental Biology
BIOL 527 Immunology and Immunochemistry
BIOL 542 Advanced Microbiology
BIOL 545 Advanced Cell Biology
BIOL 550 Bioinformatics
BIOL 562 Current Topics in Functional Genomics

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.

Master of Science in Biology with Specialization in Cell and Molecular Biology

32-34 credit hours

Required Courses (19-21 hours)

BIOL 501 Graduate Laboratory Techniques
BIOL 504 Biochemistry
OR
BIOL 401 Introductory Biochemistry **AND**
BIOL 402 Metabolic Biochemistry
BIOL 515 Molecular Biology
BIOL 526 Developmental Biology
BIOL 533 Advanced Graduate Laboratory Techniques
BIOL 544 Molecular Biology of Cells
BIOL 545 Advanced Cell Biology

Additional Requirements (7 hours)

BIOL 595 Colloquium **AND**
BIOL 591 Research

OR

BIOL 576 Literature in Cell Biology **AND** one
additional elective

OR

BIOL 522 Research Techniques in Biological Sciences I
AND

BIOL 523 Research Techniques in Biological Sciences II

Elective Courses (6 hours)

BIOL 410 Medical Microbiology
BIOL 426 Concepts of Cancer Biology
BIOL 430 Animal Physiology
BIOL 503 Virology
BIOL 512 Advanced Biochemistry
BIOL 514 Toxicology
BIOL 520 Laboratory Rotation
BIOL 527 Immunology and Immunochemistry
BIOL 542 Advanced Microbiology
BIOL 550 Bioinformatics
BIOL 555 Macromolecular Structure
BIOL 562 Current Topics in Functional Genomics

Other requirements are identical to those described previously for all M.S. students in biology.

Master of Science in Biology with Specialization in Microbiology

32-34 credit hours

Required Courses (22-24 hours)

BIOL 501 Graduate Laboratory Techniques
 BIOL 503 Virology
 BIOL 504 Biochemistry **OR**
 BIOL 401 Introductory Biochemistry
AND
 BIOL 402 Metabolic Biochemistry
 BIOL 515 Molecular Biology
 BIOL 533 Advanced Graduate Laboratory Techniques
 BIOL 542 Advanced Microbiology
 BIOL 544 Molecular Biology of Cells
 BIOL 562 Current Topics in Functional Genomics

Additional Requirements (7 hours)

BIOL 595 Colloquium **AND**
 BIOL 591 Research
OR
 BIOL 578 Literature in Microbiology **AND** one
 additional elective
OR
 BIOL 522 Research Techniques in Biological Sciences I
AND
 BIOL 523 Research Techniques in Biological Sciences II

Elective Courses (3 hours)

BIOL 410 Medical Microbiology
 BIOL 426 Concepts of Cancer Biology
 BIOL 430 Animal Physiology
 BIOL 512 Advanced Biochemistry
 BIOL 514 Toxicology
 BIOL 520 Laboratory Rotation
 BIOL 526 Developmental Biology
 BIOL 527 Immunology and Immunochemistry
 BIOL 545 Advanced Cell Biology
 BIOL 550 Bioinformatics
 BIOL 555 Macromolecular Structure
 BIOL 562 Current Topics in Functional Genomics

Other requirements are identical to those described previously for all M.S. students in biology.

Doctor of Philosophy in Biology

72 credit hours

Written qualifying examination

Comprehensive examination

Dissertation and oral defense

A minimum of 72 credit hours is required for the Ph.D. degree in biology. Students should consult the Transfer Credit section in this bulletin 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 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 core courses listed below:

Required Courses

BIOL 504 Biochemistry

BIOL 515 Molecular Biology

BIOL 544 Molecular Biology of Cells

BIOL 595 Biology Colloquium (4 times)

Elective Courses

BIOL 410 Medical Microbiology

BIOL 426 Concepts of Cancer Biology

BIOL 430 Animal Physiology

BIOL 503 Virology

BIOL 514 Toxicology

BIOL 520 Laboratory Rotation

BIOL 526 Developmental Biology

BIOL 527 Immunology and Immunochemistry

BIOL 542 Advanced Microbiology

BIOL 545 Advanced Cell Biology

BIOL 550 Bioinformatics

BIOL 555 Macromolecular Structure

BIOL 562 Current Topics in Functional Genomics

BIOL 597 Special Problems

PHYS 410 Molecular Biophysics

All research for the dissertation must be carried out under the direct supervision of a faculty research advisor. The faculty research advisor will also act as the candidate's academic advisor. 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.

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 advisors 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

Option 1: Thesis

Option 2: Library or Laboratory research project

A master's student must complete 32 credit hours of approved graduate work, including a core of 22 credit hours, 1 hour of BIOL 595 (Colloquium), 3 credit hours of approved electives, and 6 credit hours of research toward the thesis (BIOL, CHEM, or PHYS 591); or BIOL 572 (Literature in Biochemistry) and one additional elective, or BIOL 522 (Research Techniques in the Biological Sciences), and 3 credit hours of BIOL 597 (Special Topics).

Required Courses (22 hours)

BIOL 501 Graduate Laboratory Techniques
BIOL 504 Biochemistry
BIOL 512 Advanced Biochemistry
BIOL 515 Molecular Biology
BIOL 533 Laboratory in Cell and Molecular Biology
BIOL 544 Molecular Biology of Cells
BIOL 555 Macromolecular Structure
PHYS 410 Molecular Biophysics

Additional Requirements (7 hours)

BIOL 595 Colloquium

BIOL 591 Research

OR

CHEM 591 Research

OR

PHYS 591 Research

OR

BIOL 572 Literature in Biochemistry **AND**
one additional elective

OR

BIOL 522 Research Techniques in Biological Sciences I
AND

BIOL 523 Research Techniques in Biological Sciences II

Elective Courses (3 hours)

BIOL 410 Medical Microbiology
BIOL 426 Concepts of Cancer Biology
BIOL 430 Animal Physiology
BIOL 503 Virology
BIOL 514 Toxicology
BIOL 520 Laboratory Rotation
BIOL 526 Developmental Biology
BIOL 527 Immunology and Immunochemistry
BIOL 542 Advanced Microbiology
BIOL 545 Advanced Cell Biology
BIOL 550 Bioinformatics
BIOL 562 Current Topics in Functional Genomics

The elective is chosen in consultation with an academic advisor. Research for the dissertation must be carried out under the direct supervision of a participating faculty member; the faculty research advisor also acts as the candidate's academic advisor.

Thesis Option

The thesis option is designed for individuals planning careers as experimental biologists, including those who may wish to pursue a Ph.D. This option is available on a competitive basis. Students choosing the thesis option

must complete six credit hours of thesis research (BIOL, CHEM, or PHYS 591). Students must also prepare a written thesis based on laboratory research.

Non-Thesis Option

The non-thesis option is intended as a 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 BIOL 572 (Literature in Bio-

chemistry), or BIOL 581 Capstone, or a laboratory based research project in BIOL 522 (Research Techniques in the Biological Sciences) plus BIOL 523 (Research Techniques in Biological Sciences II).

Doctor of Philosophy in Molecular Biochemistry and Biophysics

72 credit hours

Written qualifying examination

Comprehensive examination

Dissertation and oral defense

A minimum of 72 credit hours of instruction is required for the MBB Ph.D. Students should consult the section Transfer Credits on page 31 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 20 credit hours of core courses and at least five additional courses from the list of electives.

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 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). The program of study must include at least 36 credit hours in formal courses (exclusive of BIOL 591 and BIOL 691).

All students will be required to take the following courses, or have equivalent background:

Required Courses

BIOL 504 Biochemistry
BIOL 512 Advanced Biochemistry
BIOL 515 Molecular Biology
BIOL 544 Molecular Biology of Cells
BIOL 555 Macromolecular Structure
BIOL 584 Graduate Seminar in Biology
BIOL 595 Biology Colloquium
PHYS 410 Molecular Biophysics

MBB students, in consultation with their academic advisor, choose the remainder of their formal coursework from the following list of elective courses:

Elective Courses

BIOL 410 Medical Microbiology
BIOL 414 Genetics for Engineering Sciences
BIOL 426 Concepts of Cancer Biology
BIOL 430 Animal Physiology
BIOL 503 Virology
BIOL 514 Toxicology
BIOL 520 Laboratory Rotation
BIOL 526 Developmental Biology
BIOL 527 Immunology and Immunochemistry
BIOL 542 Advanced Microbiology
BIOL 545 Advanced Cell Biology
BIOL 550 Bioinformatics
BIOL 562 Current Topics in Functional Genomics
BIOL 597 Special Problems
CHEM 538 Physical Biochemistry

Other courses may be prescribed by the advisor/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 advisor who will also act as the candidate's academic advisor.

Chemistry

The department offers graduate programs leading to M.S. and Ph.D. degrees in chemistry. Each student's program is planned individually to meet individual needs, interests, and capabilities. 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 new graduate student is assigned a graduate student advisor and must obtain the approval of the advisor each semester before registering for any graduate classes.

Master of Chemistry in Analytical Chemistry

32 credit hours

Comprehensive examination

The professional master's program in analytical chemistry is a part-time program for working chemists seeking to strengthen their understanding of analytical chemistry. The specific goal of the program is to provide the student with a broad and in-depth understanding of state-of-the-art analytical techniques with a firm grounding in separation science, spectroscopy, method development, and sample preparation. In addition, students acquire professional skills in effective communication, statistics, and business principles. Candidates must possess a bachelor's degree (ideally in science or engineering) with at least one semester of calculus, one semester of calculus-based physical chemistry, one semester of analytical chemistry, and two semesters of organic chemistry. Candidates' advisors assist them in determining if any further prerequisites are necessary. A final comprehensive exam is required for graduation. This program is also available via the internet. Students should consult science.iit.edu/programs/graduate/master-chemistry-analytical-chemistry for more information.

Required Courses

CHEM 500 Advanced Analytical Chemistry
 CHEM 505 Spectroscopic Methods I
 CHEM 506 Sampling and Sample Preparation
 CHEM 508 Analytical Methods Development
 CHEM 509 Physical Methods of Characterization
 CHEM 512 Spectroscopic Methods II
 CHEM 513 Statistics for Analytical Chemists
 CHEM 515 Gas Chromatography - Theory and Practice
 CHEM 516 Liquid Chromatography - Theory and Practice

AND one of the following three courses:

CHEM 542 Polymer Characterization and Analysis
 CHEM 543 Analytical Chemistry in Pharmaceutical Laboratories
 CHEM 544 Colloids and Colloid Analysis

AND two of the following three courses:

CHEM 511 Project Management
 COM 523 Communicating Science
 INTM 511 Industrial Leadership
 SCI 511 Project Management
 SCI 522 Public Engagement for Scientists

Master of Chemistry in Materials Chemistry

31 credit hours

Comprehensive examination

The professional master's program in materials chemistry is a part-time program designed for scientists who wish to broaden their background in synthesis and characterization of materials and chemical systems and their properties. The program combines modern materials design and synthesis strategies with innovative characterization techniques, computational and simulation methods, environmental regulations, project management, technical communication, and intellectual property management. It is structured to provide students with opportunities to develop a broad and in-depth understanding of the state-of-the-art in materials synthesis and characterization, learn to design and manage projects, sharpen their intellectual property management techniques, learn how to operate under regulatory constraints, and to improve communication skills. Students have the option to concentrate in inorganic or organic materials, or polymers.

Candidates must have a bachelor's degree (ideally in science or engineering), with at least two semesters of organic chemistry and two semesters of calculus. The academic advisor assists 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.edu/csl/che/ for more information.

Required Courses

CHEM 454 Chemical Modeling and Simulation
CHEM 505 Spectroscopic Methods I
CHEM 509 Physical Methods of Characterization
CHEM 511 Project Management: Business Principles
CHEM 521 Structural Inorganic and Materials Chemistry
CHEM 522 Efficient Chemical and Materials Synthesis
CHEM 524 Synthesis and Intellectual Property Management
COM 523 Communicating Science

Elective Courses (choose 3)

CHEM 470 Introduction to Polymers
CHEM 513 Statistics for Analytical Chemists
CHEM 530 Organic Reaction Mechanisms
CHEM 531 Tactics in Organic Synthesis
CHEM 535 Polymer Synthesis
CHEM 542 Polymer Characterization and Analysis
PHYS 431 Nanoscience

Master of Chemistry

32 credit hours

Comprehensive examination

A minimum of 32 credit hours is required for the Master of Chemistry degree. A minimum of 20 credits of 500 level coursework is required with 15 credits required from the Chemistry disciplines. A maximum of 12 credits of 400 level coursework may be used to fulfill graduate study requirements. Students seeking the Master of Chemistry degree must pass a final oral comprehensive examination.

The Master of Chemistry 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, when 9 credits earned or in-progress.

Credit Hour Summary (32 credits)

CHEM 584 Graduate Seminar (must be taken once)

CHEM 585 Chemistry Colloquium (must be taken twice)

Core Courses: 12 credits

CHEM Electives: 17 credits

Required Courses

CHEM 584 Graduate Seminar (must be taken once)

CHEM 585 Chemistry Colloquium (must be taken twice)

Elective Courses: 17 Credits

Electives will be chosen in consultation with the student's advisor

A minimum of four core courses (12 credits) chosen from the following core areas (six disciplines):

Organic Chemistry

CHEM 455 Advanced Organic Chemistry

OR

CHEM 530 Organic Reaction Mechanisms

Analytical Chemistry

CHEM 500 Advanced Analytical Chemistry

OR

CHEM 505 Spectroscopic Methods I

Inorganic Chemistry

CHEM 520 Advanced Inorganic Chemistry

OR

CHEM 521 Structural Inorganic and Materials Chemistry

Physical Chemistry

CHEM 550 Chemical Bonding

Polymer Chemistry

CHEM 470 Introduction to Polymers

OR

CHEM 535 Polymer Synthesis

Biochemistry

BIOL 504 Biochemistry

Master of Science in Chemistry

32 credit hours

Comprehensive examination

Thesis and oral defense

A minimum of 32 credit hours is required for the Master of Science (M.S.) in Chemistry degree. A minimum of 20 credits of 500 level coursework is required with 15 credits required from the Chemistry disciplines. A maximum of 12 credits of 400 level coursework may be used to fulfill graduate study requirements. Students seeking the M.S. in Chemistry degree must pass the written comprehensive examination in their area of specialization (as determined by the student's academic advisor and by the declaration of a specialization by the student) by the end of the fourth semester in the master of science in chemistry degree program. The comprehensive examinations are given in the following areas:

- Analytical Chemistry
- Biochemistry
- Computational Chemistry
- Inorganic Chemistry
- Organic Chemistry
- Physical Chemistry
- Polymer Chemistry

The student must also write a thesis based on original research and defend it before his or her M.S. thesis committee, which includes registration in 6-8 credits of research coursework numbered 591. The thesis and oral defense should be completed before the end of their 3rd year of academic study.

The M.S. 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, when 9 credits are earned or in-progress.

Credit Hour Summary (32 credits)

CHEM 584 Graduate Seminar (must be taken once)

CHEM 585 Chemistry Colloquium (must be taken twice)

Core Courses: 12 credits

CHEM Electives: 9-11 credits

CHEM 591: 6-8 credits

Required Courses

CHEM 584 Graduate Seminar (must be taken once)

CHEM 585 Chemistry Colloquium (must be taken twice)

CHEM 591 6-8 credits

Elective Courses: 9-11 Credits

Electives will be chosen in consultation with the student's research advisor

A minimum of four core courses (12 credits) chosen from the following core areas (six disciplines):

Organic Chemistry

CHEM 455 Advanced Organic Chemistry

OR

CHEM 530 Organic Reaction Mechanisms

Analytical Chemistry

CHEM 500 Advanced Analytical Chemistry

OR

CHEM 505 Spectroscopic Methods I

Inorganic Chemistry

CHEM 520 Advanced Inorganic Chemistry

OR

CHEM 521 Structural Inorganic and Materials Chemistry

Physical Chemistry

CHEM 550 Chemical Bonding

Polymer Chemistry

CHEM 470 Introduction to Polymers

OR

CHEM 535 Polymer Synthesis

Biochemistry

BIOL 504 Biochemistry

Doctor of Philosophy in Chemistry

72 credit hours

Written qualifying examination

Comprehensive examination

Dissertation and oral defense

A minimum of 72 credit hours is required for the Ph.D. in chemistry. 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 in their area of specialization (as determined by the student's thesis advisor) by the end of their fourth semester in the Ph.D. program. Ph.D. qualifying examinations are given in the following areas:

- Analytical Chemistry
- Biochemistry
- Computational Chemistry
- Inorganic Chemistry
- Organic Chemistry
- Physical Chemistry
- Polymer Chemistry

The comprehensive examination will be taken and passed on each student's research progress and thesis proposal. A student must write a thesis proposal and present a research seminar on his or her thesis progress before their Ph.D. thesis committee, which includes registration in 24-36 credits of research coursework numbered 691. Students must pass the comprehensive exam before the end of their 3rd year. The final phase in the Ph.D. degree program is the successful oral defense of the dissertation and submission of a Ph.D. dissertation approved by the academic advisor and the thesis committee.

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).

Credit Hour Summary (72 credits)

CHEM 584 Graduate Seminar (must be taken once)

CHEM 585 Colloquium in Chemistry (must be taken twice)

CHEM 684 Graduate Seminar (must be taken once)

CHEM 685 Chemistry Colloquium (must be taken twice)

CHEM Core Courses: 12 credits

CHEM Electives: 18-30 credits

CHEM 691: 24-36 credits

Required Courses

CHEM 584 Graduate Seminar

CHEM 585 Chemistry Colloquium (must be taken twice)

CHEM 684 Graduate Seminar

CHEM 685 Chemistry Colloquium (must be taken twice)

Elective Courses: 18-30 Credits

Electives will be chosen in consultation with the student's research advisor

The required coursework includes a minimum of four core courses chosen from the following courses. Each of the four core courses must be chosen from six different chemistry disciplines including analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, physical chemistry and polymer chemistry.

Organic Chemistry

CHEM 455 Advanced Organic Chemistry

OR

CHEM 530 Organic Reaction Mechanisms

Analytical Chemistry

CHEM 500 Advanced Analytical Chemistry

OR

CHEM 505 Spectroscopic Methods I

Inorganic Chemistry

CHEM 520 Advanced Inorganic Chemistry

OR

CHEM 521 Structural Inorganic and Materials Chemistry

Physical Chemistry

CHEM 550 Chemical Bonding

Polymer Chemistry

CHEM 470 Introduction to Polymers

OR

CHEM 535 Polymer Synthesis

Biochemistry

BIOL 504 Biochemistry

Certificate Programs - In Chemistry

Analytical Method 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 515 Gas Chromatography - Theory and Practice
CHEM 516 Liquid Chromatography - Theory and Practice

AND two courses selected from the list of electives below.

Regulatory Science

Required Courses

CHEM 518 Understanding ICH Guidelines
CHEM 519 Good Manufacturing Practices

AND two courses selected from the list of electives below.

Electives for Analytical Method Development, Analytical Spectroscopy, Chromatography, and Regulatory Science

CHEM 500 Advanced Analytical Chemistry	CHEM 515 Gas Chromatography - Theory and Practice
CHEM 505 Spectroscopic Methods I	CHEM 516 Liquid Chromatography - Theory and Practice
CHEM 506 Sampling and Sample Preparation	CHEM 542 Polymer Characterization and Analysis
CHEM 508 Analytical Methods Development	CHEM 543 Analytical Chemistry in Pharmaceutical Sciences
CHEM 509 Physical Methods of Characterization	CHEM 544 Colloids and Colloid Analysis
CHEM 512 Spectroscopic Methods II	
CHEM 513 Statistics for Analytical Chemists	

Graduate Certificate Program in Materials Chemistry

The following three Graduate Certificate Programs are available:

Synthesis and Characterization of Inorganic Materials Synthesis and Characterization of Organic Materials Characterization of Inorganic and Organic Materials

To earn a certificate in materials chemistry a minimum of 12 credit hours of course work from the following two groups of courses is required. At least one course must be chosen from Group A and at least one course must be chosen from Group B. The remaining credit hours may be chosen from either group, depending upon the certificate program. Each of these courses, if completed with a B or higher, may be later applied toward the Master of Chemistry in Materials Chemistry degree if you apply and are accepted to the degree program.

Group A:

CHEM 505 Spectroscopic Methods I
CHEM 509 Physical Methods and Characterization
CHEM 542 Polymer Characterization and Analysis

Group B:

CHEM 521 Structural Inorganic and Materials Chemistry
CHEM 522 Efficient Chemical and Materials Synthesis
CHEM 530 Organic Reaction Mechanisms
CHEM 531 Tactics in Organic Synthesis
CHEM 535 Polymer Synthesis

Course Descriptions

Biology

BIOL 501

Graduate Laboratory Techniques

This course will provide training in biological laboratory techniques. This will include basic laboratory protocols, safety, record keeping, proper use of equipment, and fundamental techniques common to many sub-specializations. (0-3-2)

BIOL 503

Virology

This course will cover topics related to animal viruses including the life cycles 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(s): [(BIOL 445) OR (BIOL 515)]

(3-0-3)

BIOL 504

Biochemistry

Molecules of biological significance; reaction thermodynamics and kinetics; metabolism; cellular localization of biochemical function; proteins; nucleic acids; transcription; translation.

(4-0-4)

BIOL 511

Project Management: Business Principles

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. Open only to Biology or Molecular Biochemistry and Biophysics majors.

(2-0-2)

BIOL 512

Advanced Biochemistry

This course provides an advanced view of modern biochemistry building on studies done in BIOL 504 of metabolism, enzyme mechanisms, and kinetics, as well as theoretical aspects of various laboratory techniques used in biochemistry. Instructor permission required.

Prerequisite(s): [(BIOL 504)]

(3-0-3)

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.

Prerequisite(s): [(BIOL 401) OR (BIOL 430) OR (CHEM 237)]

(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(s): [(BIOL 401)]

(3-0-3)

BIOL 520

Laboratory Rotation

Independent study in the research laboratory of a faculty member.

(0-9-3)

BIOL 522

Research Techniques in the Biological Sciences I

Experimental techniques in biochemistry, cell Biology, biotechnology, and microbiology are offered as discreet modules. Students select appropriate modules to complement other laboratory courses. Thus a student who has completed, for example, BIOL 533, (Laboratory in Cell and Molecular Biology) would select two modules chosen from cell biology, biotechnology, or microbiology. A written report is required at the completion of each module. Instructor permission required.

(1-6-3)

BIOL 523

Research Techniques in Biological Sciences II

This course is a continuation of BIOL 522 where students have to complete the research project started in BIOL 522 and a write a report in the form of a scientific paper.

(0-3-3)

BIOL 524

Science & Law: An Introduction to Intellectual Property Law & Patents

This course focuses on the interaction of science and law, specifically intellectual property. Topics will include patents, the ethical and legal issues involved with gene patenting, inventorship and collaborations, trade secrets, and the legal system as it relates to intellectual property.

(0-1-2)

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 & Immunochemistry

Basic concepts of immunology, immunochemistry, both biological and molecular.

(3-0-3)

BIOL 533

Advanced Graduate Laboratory Techniques

This course covers a number of essential techniques in cell and molecular biology, biochemistry, and structural biology with emphases on both the methodologies and the experimental details. Laboratory procedures include cell culture skills and relevant laboratory procedures. This course is arranged modules from which students choose according to their areas of specialization.

Prerequisite(s): [(BIOL 501 with min. grade of B)]

(0-9-3)

BIOL 542**Advanced Microbiology**

This course surveys a variety of topics regarding the biology of microbes. These include cell structure, metabolism, physiology, strategies for obtaining energy, and how this relates to microbial ecology, genetics, and comparative genomics.

(3-0-3)

BIOL 544**Molecular Biology of Cells**

This is a graduate-level cell biology course. The course contains two parts: initial lectures cover cellular structure and function emphasizing the molecular components, organelles, and regulation of cellular processes; the second part covers special topics emphasizing experimental approaches and molecular mechanisms of cellular regulation.

(3-0-3)

BIOL 545**Advanced Cell Biology**

This course is a continuation of BIOL 544 and focuses on recent advances in the area of cell biology. The course covers, in depth, eukaryotic cellular processes, structure-function relationships, and cellular signaling networks in response to physiological and pathological stimuli. The course will also cover frontier topics in the area of cell biology. Emphasis will be on experimental approaches. Instructor permission required.

Prerequisite(s): [(BIOL 445 and BIOL 446) OR (BIOL 533 and BIOL 544)]

(3-0-3)

BIOL 550**Bioinformatics**

This course is tailored for life science graduates having little to no prior knowledge of Unix/Linux-like operating systems. Topics covered will include Linux/UNIX-like operating systems, the Bash shell, Perl programming, collecting and storing sequences in the lab, multiple sequence alignments, database searching for similar sequences, gene prediction, genome analysis, and phylogenetic prediction.

(3-0-3)

BIOL 555**Macromolecular Structure**

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. Instructor permission required.

(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(s): [(BIOL 515)]

(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. Instructor permission required.

(0-0-3)

BIOL 574**Literature in Biotechnology**

A topic from the current literature in biotechnology is selected by students for preparation of a paper. Instructor permission required.

(0-0-3)

BIOL 576**Literature in Cell & Molecular Biology**

A topic from the current literature in cell and molecular biology is selected by students for preparation of a paper. Instructor permission required.

(0-0-3)

BIOL 578**Literature in Microbiology**

A topic from the current literature in microbiology is selected by students for preparation of a paper. Instructor permission required.

(0-0-3)

BIOL 581**Capstone**

In this course, students will be provided with the opportunity to perform a research project that is the culmination of their Master's education. This course involves the research and preparation of a group project. Students will develop a formal work reflecting integration of the scientific knowledge and technical skills learned in the Master's programs through a project chosen by the group. The course will explore online collaboration tools to allow participation of online students. Each group will present its Capstone project at the end of the class. Instructor consent is required.

(3-0-3)

BIOL 584**Graduate Seminar in Biology**

To foster scientific communication skills, students are required to present seminars based on the scientific literature.

(1-0-1)

BIOL 591**Research & Thesis M.S.**

Instructor permission required.

(Credit: Variable)

BIOL 594**Research Problems**

Instructor permission required.

(Credit: Variable)

BIOL 595**Biology Colloquium**

Lectures by invited scientists in areas of biology generally not covered in the department.

(1-0-1)

BIOL 597**Special Problems**

Special problems in biology. Instructor permission required.

(Credit: Variable)

BIOL 600**Continuation of Residence**

(0-0-1)

BIOL 691**Research & Thesis PHD**

Research and Thesis for Ph. D. students.

(Credit: Variable)

Undergraduate Courses available to Graduate Students

Note: Students may take up to an approved number of the following courses.

BIOL 401
Introductory Biochemistry

BIOL 402
Introductory Biochemistry

BIOL 410
Medical Microbiology

BIOL 414
Genetics for Engineering Scientists

BIOL 426
Concepts of Cancer Biology

BIOL 430
Animal Physiology

BIOL 445
Cell Biology

PHYS 410
Molecular Biophysics

Chemistry

CHEM 500
Advanced Analytical Chemistry

An overview of analytical chemistry with discussions of complex ionic equilibria, electro analytical techniques including potentiometric, voltametric, coulometric and conductometric methods, ion chromatography, capillary electrophoresis and sensor technology.
(3-0-3)

CHEM 502
Gas Chromatography, Gas Chromatography Mass Spectrometry

Theory and practice of gas chromatography with emphasis in capillary gas chromatography and gas chromatography mass spectrometry.
(2-0-2)

CHEM 504
Electroanalytical Chemistry

Fundamentals including pulse and differential pulse techniques, electro-chemical detection for chromatography, flow injection analysis and remote chemical sensors.
(2-0-2)

CHEM 505
Spectroscopic Methods

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 & 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 & 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: Business Principles

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. Open only to Analytical Chemistry, Chemistry or Materials and Chemical Synthesis majors.
(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 515
Gas Chromatography – Theory & Practice

This course will cover theory and concepts of gas chromatographic analysis and its practical application in solving analytical problems. Topics include basic theory of chromatographic separation, separation dynamics, instrumentation, column selection, quantitative techniques, and practical applications.
(3-0-3)

CHEM 516
Liquid Chromatography – Theory & Practice

This course will cover the operating principles and applications of state-of-the-art LC/HPLC instrumentation and analysis. Topics include basic theory of liquid chromatography, instrumentation, optimization of LC separation, quantitative techniques, and the diverse range of analytical applications amenable to LC analysis.
Prerequisite(s): [(CHEM 515)]
(3-0-3)

CHEM 518**Understanding the International Conference on Harmonization Guidelines**

The International Conference on Harmonization (ICH) was revolutionized in the 1980's to provide a forum for the pharmaceutical industry to discuss regulatory requirements for registration of new chemical entity. These guidelines have been significantly influenced the content of FDA draft guidelines to develop the scientific information and manufacturing controls. Thus, proper understanding of these guidelines is essential in the drug development process. This course will be designed to focus exclusively on guidelines associated with the registration of small molecules. Completing this course, students will understand the expectations set forth in various FDA and ICH quality topics in order to implement these guidelines and/or engage the regulatory agencies in dialogue in order to provide justification of data or present clear scientific rationale.

(3-0-3)

CHEM 519**Good Manufacturing Practices**

This course provides an introduction to current good manufacturing practices (GMP) regulations and their implementation to different areas of the manufacturing process such as laboratory records, equipment, personnel, facilities, etc. The course will help students to recognize the regulatory actions and financial risks for non-compliance.

(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 & Materials 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 & 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 & 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 the technical presentations by the students in the classroom. Topics of discussion will include invention disclosures, intellectual property rights, proprietary materials, justification for patents, types of patents, the 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)

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(s): [(CHEM 455)]

(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 stereo chemical 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(s): [(CHEM 530)]

(3-0-3)

CHEM 535**Polymer Synthesis**

This course will cover the basics of polymer synthesis including traditional polymerization techniques, such as free-radical and ionic chain polymerizations, and step-growth polymerization. Newer methods of polymer synthesis, such as ring-opening metathesis and controlled free-radical polymerizations, will also be discussed. Students will be introduced to the methods of preparation of advanced polymer structures, such as block, star and brush copolymers, dendrimers, and hyperbranched polymers.

Prerequisite(s): [(CHEM 239)]

(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(s): [(CHEM 470)]

(1-6-3)

CHEM 538**Physical Biochemistry**

The principles and techniques of physical chemistry applied to proteins, nucleic acids, polysaccharides and lipids.

Prerequisite(s): [(CHEM 239 and CHEM 344)]

(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.

Prerequisite(s): [(CHEM 239)]

(3-0-3)

CHEM 542

Polymer Characterization & Analysis

This course will provide an overview of the common techniques for polymer characterization, studying structure-property relationships, and polymer morphology. The course will focus on thermal and mechanical characterization of polymers as well as polymer rheology. Examples and uses of major commercial polymers and advanced functional polymers will be introduced.
(3-0-3)

CHEM 543

Analytical Chemistry in Pharmaceutical Laboratories

This course is designed to compliment the current curriculum of the professional master degree in analytical chemistry. It is a review of the requirements a student may face as a professional chemist in a regulated industry. The course focus is on the requirements and common topics facing today's pharmaceutical industry. While individual agencies have specific regulations, the fundamental ideas of these regulations are largely consistent across the board. For example, an analytical chemist versed in Good Laboratory Practices (GLP) under FDA can quickly pick up the GLP's required by EPA.
(2-0-2)

CHEM 544

Colloids & Colloid Analysis

This course will begin a general overview of colloid science. This part of the course will introduce various types of colloids, touch on factors and conditions leading to their stability or instability, consider their evolution and will include a very limited discussion of the conditions under which they can form. The second part of the course will consist of a series of discussions of specific analytical techniques used to characterize colloidal systems, with particular emphasis on the physical characterization of the dispersed phase.
(2-0-2)

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 adsorbed 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 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 semiempirical molecular orbital methods.
Prerequisite(s): [(CHEM 344)]
(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.
Prerequisite(s): [(CHEM 550 and CHEM 553)]
(3-0-3)

CHEM 553

Introduction to Chemical Thermodynamics

Fundamental laws of thermodynamics; application to simple chemical systems.
Prerequisite(s): [(CHEM 344)]
(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. May be taken more than once and up to 12 credit hours.
(Credit: Variable)

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 PhD 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 time by M.S. students and four time by PhD. students.
(1-0-1)

CHEM 591

Research & Thesis

(Credit: Variable)
(Credit: Variable)

CHEM 594

Special Problems

Designed for non-thesis M.S. only. (Credit: Variable)
(Credit: Variable)

CHEM 596

Chemistry for Teachers-Elementary

Certification as chemistry teacher or approval of instructor. An in-service workshop for pre-college teachers emphasizing the phenomenological approach to the teaching of chemical science. (Credit: variable)
(Credit: Variable)

CHEM 597

Reading & 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)
(Credit: Variable)

CHEM 598

Chemistry for High School Teachers

Certification as teacher or approved of instructor. An in-service workshop for pre-college teachers emphasizing the phenomenological approach to teaching of chemical science at the high school level. (Credit: variable)
(Credit: Variable)

CHEM 600

Continuation of Residence

(0-0-1)

CHEM 610

Special Topics in Analytical Chemistry

Topics of current interest in analytical chemistry including advanced electro-chemistry, surface spectroscopy of electrode surfaces, separations, laboratory automation and new spectroscopic techniques.

(2-0-2)

CHEM 611

Special Topics in Analytical Chemistry

Topics of current interest in analytical chemistry including advanced electro-chemistry, surface spectroscopy of electrode surfaces, separations, laboratory automation and new spectroscopic techniques.

(2-0-2)

CHEM 620

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 physical methods in inorganic and materials chemistry and chemical applications of group theory.

(2-0-2)

CHEM 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 physical methods in inorganic and materials chemistry and chemical applications of group theory.

(2-0-2)

CHEM 630

Special Topics in Organic Chemistry

Topics of current interest in organic chemistry including photochemistry, fluorine chemistry, heterocyclic chemistry, pharmaceutical chemistry and electro optical organic chemistry.

Prerequisite(s): [(CHEM 455)]

(2-0-2)

CHEM 631

Special Topics in Organic Chemistry

Topics of current interest in organic chemistry including photochemistry, fluorine chemistry, heterocyclic chemistry, pharmaceutical chemistry and electro optical organic chemistry.

Prerequisite(s): [(CHEM 455)]

(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(s): [(CHEM 239 and CHEM 455)]

(3-0-3)

CHEM 650

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)

CHEM 651

Special Topics in Physical Chemistry

Topics of current interests 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)

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.

Prerequisite(s): [(CHEM 585)]

(1-0-1)

CHEM 691

Research & Thesis Ph.D.

(Credit: Variable) Instructor permission required.

(Credit: Variable)

Undergraduate Courses Available to Graduate Students

Note: Students may take up to an approved number of the following courses.

CHEM 415

Inorganic Chemistry

CHEM 416

Inorganic Chemistry

CHEM 451

Modern Techniques in Chemical Literature

CHEM 454

Chemical Modeling and Simulation

CHEM 455

Chemical Modeling and Simulation

CHEM 470

Introduction to Polymers

Department of Biomedical Engineering

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3255 S. Dearborn
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312.567.5100
312.567.5770 (fax)
www.iit.edu/~biomed

Chair: David Mogul

The Department of Biomedical Engineering confers a doctoral degree in biomedical engineering (Ph.D. in Biomedical Engineering). Currently, eight faculty members hold tenured positions, and one faculty member holds a tenure track position in the department. Several departments at IIT contribute courses and faculty to the

graduate program: Biological and Chemical Sciences; Physics; Chemical and Biological Engineering; Computer Science; Electrical and Computer Engineering; Mechanical, Materials, and Aerospace Engineering; the College 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.

Degrees Offered

Master of Engineering in Biomedical Engineering
Master of Science in Biomedical Engineering

Doctor of Philosophy in Biomedical Engineering

Research Areas

Cell and Tissue Engineering
Medical Imaging
Neural Engineering

Faculty

Arfanakis, Konstantinos, Professor and Director of the MRI Program in the Pritzker Institute. B.S., University of Athens (Greece); M.S., Ph.D., University of Wisconsin-Madison. Magnetic resonance imaging (MRI), MRI acquisition and post-processing, diffusion tensor MRI (DTI), functional MRI (fMRI).

Arzbaecher, Robert, Emeritus Professor. Ph.D., University of Illinois, Urbana-Champaign. Instrumentation, signal processing and control.

Brey, Eric M., Professor. B.S., M.Eng., University of Louisville; Ph.D., Rice University. Angiogenesis, biomaterials, tissue engineering.

Cinar, Ali, Professor of Chemical Engineering and Biomedical Engineering and Director of the Engineering Center for Diabetes Research and Education. B.S., Robert College (Turkey); M.S., Ph.D., Texas A & M University. Diabetes and control of artificial pancreas systems; modeling, supervision, and control of biological, biomedical, and chemical processes with agent-based systems, multivariate statistics and artificial intelligence applications; modeling of angiogenesis and tissue growth.

DePaola, Natacha, Professor and the Carol and Ed Kaplan Armour Dean of Engineering. B.S., Simon Bolivar University (Venezuela); M.S., Massachusetts Institute of Technology; Ph.D., Harvard Medical School - Massachusetts Institute of Technology.

Dhar, Promila, Senior Lecturer.

Haferkamp, Bonnie, Senior Lecturer. B.S., Iowa State University; M.S., Ph.D., Illinois Institute of Technology.

Irving, Thomas C., Professor of Biology, Physics, and Biomedical Engineering and Executive Associate Chair for Biology, Biological and Chemical Sciences. B.Sc., M.Sc., Ph.D., University of Guelph (Canada). Structure and biophysics of macromolecular systems, muscle structure and physiology, synchrotron radiation instrumentation. Biochemistry, Molecular Biochemistry, and Biophysics.

Kamper, Derek, Associate Professor. B.S., Dartmouth College; M.S., Ph.D., Ohio State University. Neural control, biomechanics and rehabilitative medicine.

Kang-Mieler, Jennifer J., Associate Professor. B.S., M.S., Ph.D., Northwestern University. Models of thrombotic retinal vessel occlusion, blood flow, electroretinography.

Mogul, David, Associate Professor and Chair. B.S., Cornell University; M.S., M.B.A., Ph.D., Northwestern University. Control of epilepsy, brain electrophysiology, brain stimulation, traumatic brain injury.

Papavasiliou, Georgia, Associate Professor. B.S., Ph.D., Illinois Institute of Technology. Computational modeling of polymerization systems, design of polymeric biomaterials for tissue engineering and drug delivery applications.

Tichauer, Kenneth, Assistant Professor.

Trommer, Barbara L., Research Professor. B.A., Queens College; M.D., Columbia College, College of Physicians and Surgeons. Epilepsy, autism, and treatment for neurological disorders.

Troyk, Philip R., Professor and Associate Dean, Armour College of Engineering. B.S., University of Illinois, Urbana-Champaign; M.S., Ph.D., University of Illinois-Chicago. Neural prostheses, medical device implants, neuroscience.

Turitto, Vincent, Pritzker Professor and Director of the Pritzker Institute of Biomedical Science and Engineering. B.ChE., Manhattan College; D.Eng.Sci., Columbia University. Blood flow and thrombosis, atherosclerosis, cellular biodynamics, biomaterials.

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 departmental faculty. Entering graduate students are assigned a temporary academic advisor who will provide initial guidance. As their research and other academic interests become defined, students select a permanent research advisor, who will also guide them through their academic studies.

Master of Engineering in Biomedical Engineering

30 credit hours

The overall objective of the Master of Engineering in Biomedical Engineering degree is to provide training relevant to professional employment in a BME-related field. The student must have a minimum 3.0/4.0 GPA in an engineering or science Bachelor's program to be admitted. Candidates should have prior technical coursework that will provide proficiency in areas that are relevant to the field of biomedical engineering.

Required Courses

BME 500 Introduction to Biomedical Engineering
BME 533 Biostatistics
BME 553 Quantitative Physiology

AND two Life Science and/or Advanced Mathematics courses.

AND five Engineering and/or Computer Science courses, of which at least two are BME courses.

Master of Science in Biomedical Engineering

32 credit hours

Thesis

The overall objective of the Master of Biomedical Engineering degree is to provide training relevant to professional employment in a BME-related field. A minimum total of 32 credit hours is required for this degree, of which at least 24 credit hours must come from coursework; 6-8 credits of research are required. This degree requires completion of a written dissertation and a subsequent oral defense of it before an approved Master thesis examination committee.

Admission Criteria: Because the M.S. degree requires the time and frequently the resources of a faculty mentor to be available, in order to adequately execute the research component of the degree, the BME Department will admit candidates who not only have the credentials suitable for this degree but for which a department faculty member consents to serve as the candidate's research mentor.

Required Courses

BME 500 Introduction to Biomedical Engineering
BME 533 Biostatistics
BME 553 Quantitative Physiology

AND two Life Science and/or Advanced Mathematics courses

AND three Engineering and/or Computer Science courses, of which at least two are BME courses

Doctor of Philosophy in Biomedical Engineering

Total credit hours 72

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 72 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 course requirements necessary for graduation.

The following blocks of courses list applicable graduate level courses for graduate students in BME. They do not represent a complete and comprehensive list of all relevant courses since course offerings across departments may change with time. Graduate students should consult with their advisors to plan their curriculum.

Biomedical Engineering Courses

- BME 500 Introduction to Biomedical Engineering
- BME 501 Communication Skills in Biomedical Engineering
- BME 503 Mathematics and Statistical Methods for Neuroscience I
- BME 504 Neurobiology
- BME 505 Mathematics and Statistical Methods for Neuroscience II
- BME 506 Computational Neuroscience II: Vision
- BME 507 Cognitive Neuroscience
- BME 508 Mathematics and Statistics for Neuroscience III
- BME 509 Vertebrate Neural Systems
- BME 518 Reaction Kinetics for Biomedical Engineering
- BME 521 Medical Imaging
- BME 522 Mathematical Methods in Biomedical Engineering
- BME 523 Cell Biomechanics: Principles and Biological Processes
- BME 524 Quantitative Aspects of Cell and Tissue Engineering
- BME 530 Inverse Problems in Biomedical Imaging
- BME 532 Medical Imaging Science
- BME 533 Biostatistics
- BME 535 Magnetic Resonance Imaging
- BME 537 Introduction to Molecular Imaging
- BME 538 Neuroimaging
- BME 540 Wave Physics & Applied Optics for Imaging Scientists
- BME 542 Advanced Concepts in Image Science
- BME 543 Bioinstrumentation & Electronics
- BME 551 Physiological Signal Processing & Control Theory
- BME 552 Control Systems for Biomedical Engineering
- BME 553 Quantitative Physiology
- BME 575 Neuromechanics of Human Movement
- BME 581 Fluid Mechanics for Biomedical Engineers
- BME 582 Advanced Mass Transport for Biomedical Engineers
- BME 585 Computational Models of the Human Cardiovascular System
- BME 595 Seminar in Biomedical Engineering
- BME 597 Special Problems
- BME 691 Research and Thesis for Ph.D. degree

Doctor of Philosophy in Biomedical Engineering - continued**Life Science Courses (representative)**

BIOL 403 Biochemistry Lecture
 BIOL 414 Genetics for Engineering Scientists
 BIOL 426 Concepts of Cancer Biology
 BIOL 430 Animal Physiology
 BIOL 445 Cell Biology
 BIOL 512 Advanced Biochemistry
 BIOL 515 Molecular Biology
 BIOL 527 Immunology and Immunochemistry
 BIOL 550 Bioinformatics

Approved Math/Applied Math Courses

MATH 461 Fourier Series and Boundary-Value Problems
 MATH 476 Statistics
 MATH 489 Partial 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 Finite Element Method

**Engineering or Physics Courses (representative)
(may count toward math requirement)**

CHE 535 Applications of Mathematics to Chemical Engineering
 CHE 536 Computational Techniques in Engineering
 MMAE 501 Engineering Analysis I
 MMAE 502 Engineering Analysis II
 MMAE 503 Advanced Engineering Analysis
 MMAE 517 Computational Fluid Mechanics
 PHYS 501 Methods of Theoretical Physics I
 PHYS 502 Methods of Theoretical Physics II

Selected Engineering Electives

CHE 555 Polymer Processing
 CHE 575 Polymer Rheology
 CHE 577 Bioprocess Engineering
 CHE 582 Interfacial and Colloidal Phenomena with Applications
 CHE 583 Pharmaceutical Engineering
 CHE 585 Drug Delivery
 CS 480 Artificial Intelligence Planning & Control
 CS 525 Advanced Database Organization
 CS 580 Topics in Machine Learning
 CS 583 Probabilistic Graphical Models
 ECE 511 Analysis of Random Signals
 ECE 565 Computer Vision and Image Processing
 ECE 566 Statistical Pattern Recognition
 ECE 567 Statistical Signal Processing
 MMAE 510 Fundamentals of Fluid Mechanics
 MMAE 512 Dynamics of Viscous Fluids
 MMAE 517 Computational Fluid Dynamics
 MMAE 579 Advanced Materials Processing

Course Descriptions

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 signals.

(3-0-3)

BME 501

Communication Skills in Biomedical Engineering

Students will be taught to critically analyze manuscripts in the biomedical engineering literature. They will write a critique of the manuscripts, discuss the manuscripts in class, and prepare power point presentations that will be presented and evaluated by the entire class.

(3-0-3)

BME 503

Mathematical & Statistical Methods for Neuroscience I

This quarter introduces mathematical ideas and techniques in a neuroscience context. Topics will include some coverage of matrices and complex variables; eigen value problems, spectral methods and Greens functions for differential equations; and some discussion of both deterministic and probabilistic modeling in the neurosciences. Instructor permission required.

(2-0-2)

BME 504

Neurobiology

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 vertebrate preparations. Laboratories will be attended only on one day a week but may run well beyond the canonical period. Instructor permission required.

(2-0-2)

BME 505

Mathematical & Statistical Methods for Neuroscience II

This quarter treats statistical methods important in understanding nervous system function. It includes basic concepts of mathematical probability; information theory, discrete Markov processes, and time series. Instructor permission required.

Prerequisite(s): [(BME 503)]

(2-0-2)

BME 506

Computational 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 systems theory, and algorithms derived from computer vision.

(3-0-3)

BME 507

Cognitive Neuroscience

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. Instructor permission required.

(2-0-2)

BME 508

Mathematics & Statistics for Neuroscience III

This course covers more advanced topics including perturbation and bifurcation methods for the study of dynamical systems, symmetry methods, and some group theory. A variety of applications to neuroscience will be described. Instructor permission required.

Prerequisite(s): [(BME 503 and BME 505)]

(2-0-2)

BME 509

Vertebrate Neural Systems

This lab-centered course teaches students the fundamental principles of mammalian neuroanatomy. Students learn the major structures and the basic circuitry of the CNS and PNS. Students become practiced at recognizing the nuclear organization and cellular architecture of many regions in animal brain models. This course is taught at the University of Chicago. Instructor permission required.

(3-0-3)

BME 510

Neurobiology of Disease I

This seminar course is devoted to basic clinical and pathological features and pathogenic mechanisms of neurological diseases. The first semester is devoted to a broad set of disorders ranging from developmental to acquired disorders of the central and peripheral nervous system. Weekly seminars are given by experts in the clinical and scientific aspects of the disease under discussion. For each lecture, students are given a brief description of clinical and pathological features of a given set of neurological diseases followed by a more detailed description of the current status of knowledge of several of the prototypic pathogenic mechanisms.

(2-0-2)

BME 511

Extracellular Matrices: Chemistry & Biology

Advanced topics dealing with the biology and chemistry of the extracellular matrix, cell-matrix interactions, and current methodologies for engineering these interfaces.

(2-0-2)

BME 512

Behavioral Neurosciences

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 work involvement with live animals.

(2-0-2)

BME 513

Methods of Computational Neuroscience: Single Neurons

Topics include, but are not limited to, Hodgkin-Huxley equations, cable theory, single neuron models, information theory, signal detection theory, reverse correlation, relating neural responses to behavior, and rate versus temporal codes. Instructor permission is required.

(3-0-3)

BME 516

Biotechnology for Engineers

This course will provide students opportunity to learn about the field of biotechnology and how to apply engineering principles to biological systems and living organisms for betterment of medicines as well as agricultural products. The course covers the introduction to biotechnology with information about cell and molecular biology, the role of enzyme and growth kinetics, media preparations for cell culture and various chromatographic techniques, and antibiotics and its role in secondary metabolic production. Biological effluent treatment and regulatory issues to obtain FDA will be taught. Instructor permission is required.

(3-0-3)

BME 518

Reaction Kinetics for Biomedical Engineering

This course is an introduction to the fundamentals of chemical kinetics. Analysis of rate data; single and multiple reaction schemes. Biomedical topics include biological systems, enzymatic pathways, enzyme and receptor-ligand kinetics, pharmacokinetics, heterogeneous reactions, microbial cell growth and product formation, and the design and analysis of biological reactors.

Corequisite(s): (BME 482)

Prerequisite(s): [(BME 301, BME 335, and MATH 252)]

(3-0-3)

BME 519

Cardiovascular Fluid Mechanics

Anatomy of the cardiovascular system. Scaling principles. Lumped parameter, one-dimensional linear and nonlinear wave propagation, and three-dimensional modeling techniques applied to simulate blood flow in the cardiovascular system. Steady and pulsatile flow in rigid and elastic tubes. Form and function of blood, blood vessels, and the heart from an engineering perspective. Sensing, feedback, and control of the circulation. Includes a student project.

(3-0-3)

BME 521

Medical Imaging

Study of modern technology for medical imaging. Theory and operation of CAT, SPECT, PET, MRI, X-ray and echo imaging modalities.

(3-0-3)

BME 522

Mathematical Methods in Biomedical Engineering

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 mathematics of diffusion, pharmacokinetic models, biological fluid mechanics, and biosignal representations and analysis. The use of MATLAB will be emphasized for numerically solving problems of practical relevance. Open only to Biomedical Engineering majors.

(3-0-3)

BME 523

Cell Biomechanics: Principles & Biological Processes

This course will provide students an opportunity to learn about mechanical forces that develop in the human body and how they can influence cell functions in a range of biological processes from embryogenesis, wound healing, and regenerative medicine to pathological conditions such as cancer invasion. Examples of research methods for investigating cell biomechanics in various biological systems will be discussed. Permission of instructor is required.

(3-0-3)

BME 524

Quantitative Aspects of Cell and Tissue Engineering

This course is designed to cover fundamentals of cell and tissue engineering from a quantitative perspective. Topics addressed include elements of tissue development, cell growth and differentiation, cell adhesion, migration, molecular and cellular transport in tissues and polymeric hydrogels for tissue engineering and drug delivery applications.

(3-0-3)

BME 530

Inverse Problems in Biomedical Imaging

This course will introduce graduate students to the mathematical theory of inverse problems. Concept 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. Instructor permission required. Open only to Biological Engineering majors.

(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. Instructor permission required.

(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 is an introduction to the Physics and technology of magnetic resonance imaging (MRI). the topics that are covered include: basic MR physics, source of signal, signal acquisition, pulse sequences, hardware, artifacts, spectroscopy, and advanced imaging techniques. Instructor permission required.

(3-0-3)

BME 537

Introduction to Molecular Imaging

This course provides an overview of molecular imaging, a subcategory of medical imaging that focuses on noninvasively imaging molecular pathways in living organisms. Topics include imaging systems, contrast agents, reporter genes and proteins, tracer kinetic modeling. Preclinical and clinical applications will also be discussed with an emphasis on cancer and the central nervous system.

(3-0-3)

BME 538

Neuroimaging

This course describes the use of different imaging 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 magneto encephalography (MEG) and studying brain function with MEG. The second part of the 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. Instructor permission required.

(3-0-3)

BME 539

Advanced Medical Imaging

This course introduces advanced clinical imaging modalities, research imaging techniques, and concepts from image science and image perception. The first part of the course introduces the perception of image data by human observers and the visualization of brain structure and function. It includes an introduction to magnetic resonance imaging (MRI) and a survey of neurological imaging via functional MRI (fMRI). The second part of the course covers image science, clinical imaging applications, and novel research imaging techniques. It includes an introduction to radiation detection and image quality evaluation, a survey of clinical cases, and an overview of new imaging methods.

(3-0-3)

BME 540

Wave Physics & Applied Optics for Imaging Scientists

This course will introduce students to fundamental concepts in wave physics and the analysis of optical wave fields. 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. Instructor permission required.

(3-0-3)

BME 542

Advanced Concepts in Image Science

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 decision theory, and objective assessment of image quality.

Prerequisite(s): [(BME 530 and BME 532)]

(3-0-3)

BME 543

Bioinstrumentation & 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 Processing & Control Theory

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, system descriptions and lumped vs. distributed parameters. Students will use Mat lab to test concepts presented in class.

(2-0-2)

BME 552

Control Systems for Biomedical Engineers

Control systems design and analysis in biomedical engineering. Time and frequency domain analysis, impulse vs. step response, open vs. closed loop response, stability, adaptive control, system modeling. Emphasis is on understanding physiological control systems and the engineering of external control of biological systems.

(3-0-3)

BME 553

Quantitative Physiology

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)

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.

(3-0-3)

BME 581

Fluid Mechanics 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. A basic Fluid Dynamics Course is recommended. Instructor permission required.

Prerequisite(s): [(BME 500)]

(3-0-3)

BME 582**Advanced Mass Transport for Biomedical Engineers**

This course is primarily focused on the development of theoretical and mathematical principles necessary for the delineation of mass transport processes in biological & medical systems. The content includes heterogeneous reactions that occur at or in the vicinity of cells or vascular structures under applied laminar flow and transport across cell membranes and within tissues.

(3-0-3)

BME 585**Computational Models of the Human Cardiovascular System**

This course will focus on the use of computational fluid dynamics for the modeling and analysis of the human cardiovascular system. The course will cover both computational methods for fluid dynamics and biomedical aspects of the human cardiovascular system. Computer models for the simulation and analysis of hemodynamic phenomena will be developed. Requires an Introductory fluid dynamics

(3-0-3)

BME 591**Research & Thesis for Master of Science Degree**

Research and thesis for master of science degree students. Instructor permission required.

(Credit: Variable)

BME 594**Special Projects**

Special projects.

(Credit: Variable)

BME 595**Seminar in Biomedical Engineering**

Current research and development topics in biomedical engineering as presented by outside speakers, faculty and advanced students.

(3-0-3)

BME 597**Special Problems**

Special problems.

(Credit: Variable)

BME 691**Research & Thesis PHD**

Research and Thesis for PhD degree. (variable credit)

(Credit: Variable)

Stuart School of Business

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Marketing Analytics and Communications:
Krishna Erramilli

Master of Public Administration:
Roland Calia

Master of Mathematical Finance:
Tomasz Bielecki

Ph.D. in Management Science:
Siva K. Balasubramanian

Business at IIT

IIT Stuart School of Business provides intellectually rigorous business and management education at all levels, from baccalaureate to doctoral. All IIT Stuart programs are designed to educate tomorrow's global innovators through the unique concept of strategic competitiveness. Constructs including creativity, innovation, entrepreneurship, incisive decision-making, leadership, and sustainability are interwoven throughout coursework and professional development opportunities, offering students thorough preparation for the challenges of the Next Economy.

Established in 1969 with a gift from IIT alumnus and Chicago financier Harold Leonard Stuart, IIT Stuart offers a wide range of challenging business and management programs taught from a practical perspective, with an emphasis on analytic skills and the relation between business, management, and technology. AACSB-accredited programs include the M.B.A., Ph.D., five industry-responsive master's programs, and one bachelor of science in business program. IIT Stuart also offers a Master of Public Administration (M.P.A.) degree and one co-terminal B.S./M.P.A program.

Stuart faculty, in addition to their scholarly and teaching activities, 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. Many IIT Stuart students are also working professionals from Chicago's preeminent business, public, and finance communities.

Job placement and career advancement are very important at IIT Stuart. IIT Stuart Student Affairs enables students to find professional success through the Stuart Career Management Center, Stuart Academic Advising, Stuart's unique Advancing Career and Education (ACE) workplace immersion program, and the Professional Communication Advancement program. IIT Stuart is committed to creating well-rounded students who are not only armed with expert academic knowledge, but who also possess the interpersonal and communication skills that are critical to academic and professional success.

IIT Stuart operates on a semester academic calendar consisting of two semesters beginning in August and January and a summer session beginning in May. Because many Stuart students work full time, graduate classes are regularly offered on weekday evenings as well as being offered during the day.

Degrees Offered

Master of Business Administration (M.B.A.)
 Master of Science in Environmental Management and Sustainability
 Master of Science in Finance
 Master of Public Administration

Master of Science in Marketing Analytics and Communications
 Doctor of Philosophy in Management Science

With the Department of Applied Mathematics:
 Master of Mathematical Finance

Dual Degree Programs

M.B.A./M.S. in Environmental Management and Sustainability
 M.B.A./M.S. in Marketing Analytics and Communication
 M.B.A./M.S. in Finance
 M.B.A./Master of Public Administration

With the Institute of Design
 M.B.A./M.Des.

With the IIT Chicago-Kent College of Law
 M.B.A./J.D.
 M.S. in Environmental Management and Sustainability/J.D.
 M.S. in Finance/J.D.
 Master of Public Administration/J.D.

Graduate Certificate Programs

Business Analyst
 Compliance and Pollution Prevention
 Corporate Finance*
 Economic Development and Social Entrepreneurship
 Entrepreneurial Finance*
 Financial Economics*
 Financial Modeling*
 Financial Toolbox
 Fundamentals of Finance
 Innovation and Emerging Enterprises

Investments*
 Marketing Management
 Nonprofit and Mission-Driven Management
 Public Management
 Risk Management*
 Security, Safety, and Risk Management
 Sustainable Enterprise
 Trading*

* Post-graduate

Research at Stuart

Faculty at IIT Stuart School of Business engage in dynamic, collaborative research across disciplines. Focus areas include high frequency finance, sustainable enterprise, management science, and marketing analytics. IIT Stuart's research centers engage with industry partners on research projects and programming to meet the needs of the next economy. For more information about research at IIT Stuart School of Business, contact Siva Balasubramanian at sivakbalas@stuart.iit.edu.

IIT Entrepreneurship Academy

The IIT Entrepreneurship Academy (EA) provides distinctive and relevant education that emphasizes entrepreneurial thinking among students, alumni, and university stakeholders who interact with developing and existing businesses.

The Center for Strategic Competitiveness

The Center for Strategic Competitiveness develops global partnerships to enhance innovation and creativity, and is the foundation for IIT Stuart's strategically competitive curriculum. The Center's mission is to develop Strategic

competitiveness into an approach to business that will enhance the ability of individuals, organizations, and governmental units to respond proactively and innovatively to global market challenges in the next economy.

The Center for Financial Innovation

Financial innovation has been vigorously debated since the financial crisis of 2008. The Center for Financial Innovation (CFI) takes a comprehensive and objective look at the history of financial innovation, providing a central location for scholars, practitioners, media, and the general public to explore the many innovations that serve as the foundation for our global financial systems. The Center will provide data, video interviews, and an Encyclopedia of Financial Innovation through the Center's website.

Formerly named the Center for Financial Markets, and established in 1998 as the Center for Law and Financial Markets, the CFI has evolved from the vision of John A. (Jack) Wing, a financial and educational innovator. Jack Wing served as Chairman of Chicago Corp., of ABN AMRO Inc., Trustee of IIT, and the first Director of the Center for Law and Financial Markets.

Faculty

Anand, Smriti, Assistant Professor of Management. B.S., Ranchi University (India); M.B.A., Northwestern University; M.S., Ph.D., University of Illinois-Chicago.

Ashton, Weslynn, Assistant Professor of Environmental Management and Sustainability. B.S., Massachusetts Institute of Technology; Master of Environmental Science, Ph.D., Yale University.

Balasubramanian, Siva K., Harold L. Stuart Professor of Marketing, Associate Vice Provost for University Accreditation, and Associate Dean and Ph.D. Program Director for the Stuart School of Business. B.S., M.B.A., Osmania University; Ph.D., State University of New York at Buffalo. Managing innovations/new product diffusion, marketing communications and research methods, social media marketing.

Bariff, Martin L., Associate Professor of Information Systems. B.S., 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.

Bilson, John, Professor of Finance, Associate Dean, and Director of the Master's of Finance Program. B.Econ, M.Econ, Monash University-Melbourne, Australia; Ph.D., University of Chicago. International finance, quantitative investment strategies.

Bredine, Sanford, Senior Lecturer of Marketing Communication. B.A., Trinity College; M.B.A., University of Chicago. Marketing and marketing communications.

Cai, Li, Assistant Professor of Finance. B.S., Wuhan University (China); M.Sc., Warwick Business School (England); Ph.D., University of Massachusetts.

Calia, Roland, Senior Lecturer of Public Administration and MPA Program Director. B.A., University of Redlands; M.A., Claremont Graduate School; Ph.D., University of Chicago.

Chakravarti, Arjun, Assistant Professor of Management and Marketing. B.A., University of Colorado; M.B.A., Ph.D., University of Chicago.

Chaudoin, Gregory S., Instructor of Finance. B.S. University of Louisville; M.S., University of Illinois, Urbana-Champaign. Portfolio theory and risk analysis and management.

Cooper, Rick A., Assistant Professor of Finance. B.S., University of Chicago; M.B.A., Ph.D., Vanderbilt University.

Cooper, Tina K., Senior Lecturer, Chief of Staff, and Assistant Dean in the Stuart School of Business. B.F.A., Syracuse University; M.A., University at Albany-SUNY; M.B.A., DePaul University.

Cutler, Jennifer, Assistant Professor of Marketing. B.S., Brown University; Ph.D., Duke University Fuqua School of Business.

Durango-Cohen, Elizabeth, Associate Professor of Operations Management. B.S., Sonoma State University; M.S., Ph.D., University of California, Berkeley. Supply chain management, supply chains, inventory and production planning, and capacity and pricing.

Ehrlich, David G., Clinical Professor of Environmental Management and Public Administration. M.A., University of Michigan; M.P.P., Georgetown University; Ph.D., Wayne State University.

Erramilli, Krishna M., Professor of Marketing, Interim Associate Dean, and Director of Graduate Business Programs. M.S., M.B.A., University of Poona, (India); Ph.D., University of Arkansas. International marketing strategy, foreign market-entry strategy, competitive advantages of global firms and growth strategies in emerging markets.

Fang, Yiwei, Assistant Professor of Finance. B.S., Dalian University of Technology (China); M.S., Xi'an Jiaotong University (China); Ph.D., Rensselaer Polytechnic Institute.

Geisler, Eliezer, Distinguished Professor of Organizational Behavior. B.A., M.B.A., Tel Aviv University (Israel); Ph.D., Northwestern University. Organizational behavior, health care technology management, management of information and telecommunication technology, strategic management.

Goldhar, Joel D., Professor of Operations and Technology Management. 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.

Gorham, Michael J., Industry Professor of Finance and Director of the Center for Financial Markets. B.A., University of Notre Dame; M.S., University of Florida; M.S., Ph.D., University of Wisconsin.

Hamilton, Charles T., Clinical Associate Professor of Accounting. B.S., M.A.S., Ph.D., University of Illinois, Urbana-Champaign; Certified Public Accountant. Accounting education, the behavioral factors that influence audit judgment.

Hassan, M. Zia, Professor of Management Science and Dean Emeritus. B.Sc., University of Punjab (Pakistan); M.S., Ph.D., Illinois Institute of Technology. Effective organizations, strategic and quality issues in organizations.

Kahalas, Harvey, Harold L. Stuart Professor of Management and Economic Development, and Dean of Stuart School of Business. B.S., Boston University; M.B.A., University of Michigan; Ph.D., University of Massachusetts. Economic development, organizational competitiveness.

Kang, Sang Baum, Assistant Professor of Finance. B.A., Yonsei University (Korea); M.S., University of Wisconsin; M.S., Carnegie Mellon University; Ph.D., McGill University.

Khalili, Nasrin R., Associate Professor of 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, Knowles, Professor Emeritus of Management Science and Operations Management. B.S., Purdue University; M.B.A., University of Chicago; Ph.D., University of Chicago.

Ong, Michael K., Professor of Finance. B.S., University of the Philippines; M.A., M.S., Ph.D., 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.

Peters, Scott, Senior Lecturer of Public Administration. B.A., Macalester College; J.D., Washington University; Ph.D., University of Illinois-Chicago.

Ramanan, Ram, Industry Associate Professor of Environmental Management. B.Tech., India Institute of Technology (India); M.S., UICT Bombay University (India); M.B.A., University of Texas-Austin; Ph.D., University of Texas-Dallas.

Richardson, David W., Assistant Professor of Entrepreneurship and Marketing. B.A., Rice University; Ph.D., University of Texas-Dallas.

Rokop, Nik, Industry Professor of Entrepreneurship and Special Projects Assistant. B.S., Carnegie Mellon University; B.S., University of Pittsburgh; M.D.M., Illinois Institute of Technology.

Rybak, Michael J., Senior Lecturer of Finance. B.S., Illinois State University; M.B.A., DePaul University.

Sabbaghi, Navid, Assistant Professor of Management Science. B.A., B.S., University of California-Berkeley; M.S., Ph.D., Massachusetts Institute of Technology. Supply contracts and capacity pricing in supply chain management.

Sharma, Priyanka, Visiting Assistant Professor of Economics. B.A., M.A., University of Delhi (India); Ph.D., Texas A & M University.

Sun, Jiong, Assistant Professor of Management. B.Sc., Shanghai Jiao Tong University; M.Eng., National University of Singapore; M.S., Ph.D., Carnegie Mellon University. The interaction of technology, firms, markets, and the environment.

Tourk, Khairy A., Professor of International Business. 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.

Twombly, John R., Clinical Professor of Accounting and Finance and Director of Undergraduate Programs in the Stuart School of Business. B.S., University of Pennsylvania; M.B.A., Ph.D., University of Chicago; Certified Public Accountant. Financial and managerial accounting.

Van Vliet, Benjamin, Assistant Professor of Finance. B.A., Calvin College; M.S., Ph.D., Illinois Institute of Technology.

Wagman, Liad, Assistant Professor of Economics. B.A., B.S., University of North Carolina; M.S., Stanford University; M.A., Ph.D., Duke University.

Wang, Haizhi, Assistant Professor of Finance. B.S., Wuhan University (China); M.S., East China Normal University (China); Ph.D., Rensselaer Polytechnic Institute. Corporate Finance, financial institutions, entrepreneurial finance, mergers and acquisition, strategic alliances.

Weiss, Suzanne, Senior Lecturer of Business. B.A., University of Rochester; M.B.A., University of Chicago. Strategic marketing, marketing research, and new product development.

Wu, Tao, Assistant Professor of Finance. B.A., Columbia University; M.A., Ph.D., Wharton School. Asset pricing, investments, derivatives, fixed-income, international/ corporate finance.

Graduate Programs

Prospective students are urged to refer to the Stuart website, www.stuart.iit.edu, for the most current description of all programs.

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 complete 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 semester. 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), PTE (Pearson Test of English), or IELTS (International English Language Testing System) scores, unless they received an undergraduate or graduate degree from an accredited U.S. institution. English language proficiency assessment is required of all international students. Assessment results will determine which, if any, Professional Communication Advancement Courses will

be required in addition to the main academic program courses for graduation.

Admission to the Master of Public Administration degree requires an essay, two letters of recommendation, official transcripts and a summary of work experience if applicable. GRE or GMAT scores are not required, but may be submitted. The same requirements as for business programs apply for applicants from non-English speaking countries for TOEFL, PTE, or IELTS.

Applicants to the Ph.D. program in Management Science must have completed a masters degree with a graduate level business core, or a Masters in Finance or equivalent degree. For applicants who have a masters degree but have not completed the business core, some prerequisite courses will be required.

Refer to www.admission.iit.edu/graduate for complete details.

Master of Business Administration (M.B.A.)

The Master of Business Administration requires the successful completion of at least 48 semester credits (16 courses). Full-time students are expected to enroll for at least three courses per semester and can potentially complete their program in two-and-a-half years. Part-time students may enroll in as few as one course per semester and complete their program at a slower pace. The program schedule allows flexibility to students who wish to accelerate their studies. For example, full-time students may graduate in roughly 2 years by taking more courses each semester and attending school during the summers - but this requires careful planning.

Core Courses

BUS 510	Building an Innovative and Sustainable Business
BUS 550	Business Analytics for Competitive Advantage
BUS 590	Business Innovation in the Next Economy (Integrated Capstone Course)
MBA 501	Accounting for Strategic Decision-Making
MBA 502	Emerging Issues in the Global Business Environment
MBA 504	Spreadsheet Modeling
MBA 505	Contemporary Economic Analysis and Game Theory
MBA 506	Leading and Managing Knowledge-Intensive Organizations
MBA 509	Financial Management in a Globalized World
MBA 511	Creating, Communicating, and Delivering Customer Value
MBA 513	Operations and Technology Management

Concentrations

A concentration consists of a minimum of 6 credit hours in one of the following areas:

- Business Analytics
- Business and Society
- China Studies
- Corporate Finance
- Creativity and Innovation
- Emerging Markets
- Investment Management
- Management of Nonprofits
- Management of Public Sector
- Risk Management
- Strategy and Leadership
- Sustainability
- Technopreneurship
- Technology and Marketing

Master of Science in Environmental Management and Sustainability

To earn an M.S. in Environmental Management and Sustainability, students must successfully complete 33 credit hours (11 courses). Full-time students are expected to enroll for at least three courses per semester and can complete their degree in two years. Part-time students can enroll for as few as one course per semester and can take up to five years to complete their degree. The program schedule allows flexibility to students who wish to accelerate their studies. For example, full-time students could graduate in roughly a year by starting in Summer of Year 1 and completing their program in Summer of Year 2 - but this requires careful planning.

Required Courses (full semester)

BUS 510	Building an Innovative and Sustainable Business
BUS 550	Business Analytics for Competitive Advantage
BUS 590	Business Innovation in the Next Economy (Integrated Capstone Course)
EMS 501	Environmental Policy in a Competitive World
EMS 502	Contemporary and Emerging Laws Governing the Environment
EMS 503	Environmental Pollution Prevention and Control Strategies
EMS 504	Industrial Ecology and Systems Thinking
EMS 505	Environmental Finance

Elective Courses (choose three)

EMS 511	Solid and Hazardous Waste Management and Remediation
EMS 512	Environmental Risk Assessment and Management
EMS 513	Environmental Economics and Climate Change
EMS 518	Ethics and Corporate Social Responsibility
EMS 525	Environmental Performance Analytics
EMS 529	Social Entrepreneurship
EMS 531	Environmental Advocacy
EMS 532	Environmental and Energy Law Clinic
EMS 541	Managing Energy Technologies
EMS 542	Economics of Energy Systems

Master of Science in Finance

To earn a M.S. in Finance students must successfully complete 33 credit hours (11 courses). The typical program will consist of six core courses and five elective courses. However, students may request that they be allowed to substitute an elective course for a core course if they can demonstrate to the program director that they have already mastered the material in the core course.

Core Courses

MSF 501 Mathematics with Financial Applications
MSF 502 Statistical Analysis in Financial Markets
MSF 503 Financial Modeling
MSF 504 Valuation and Portfolio Management
MSF 505 Futures, Options, and OTC Derivatives
MSF 506 Financial Statement Analysis

Elective Courses

Elective classes are organized into concentrations. Students who complete two or more courses within a particular concentration will have the concentration recognized on official transcripts.

Alternative Investments

MSF 543 Alternative Investments
MSF 549 Commodities and Managed Futures

Corporate Finance

MSF 534 Corporate Finance
MSF 535 Investment Banking

Entrepreneurial Finance

MSF 595 Entrepreneurial Finance
MSF 598 The Venture Capital Process

Financial Econometrics

MSF 566 Time Series Analysis
MSF 567 Bayesian Econometrics

Financial Engineering

MSF 524 Models for Derivatives
MSF 525 Term Structure Modeling and Interest Rate Derivatives
MSF 526 Computational Finance

Financial Markets

MSF 591 Global Financial Markets
MSF 593 Market Microstructure

Financial Programming

MSF 574 .NET and Database Management
MSF 575 C++ with Financial Markets

High Frequency Finance

MSF 576 OOP and Algorithmic Trading Systems
MSF 577 High Frequency Finance

Investment Management

MSF 544 Equity Valuation
MSF 545 Structured Fixed Income Portfolios
MSF 546 Quantitative Investment Strategies

Risk Management

MSF 554 Market Risk Management
MSF 555 Credit Risk Management
MSC 622 Enterprise Risk Management (PhD level course)

Trading

MSF 584 Equity and Equity Derivatives Trading
MSF 585 FOREX and Fixed Income Strategies

Core Requirement

All M.S. Finance students must complete the six core classes unless they have obtained written permission from their academic advisor to substitute an alternative class for a core class.

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 program director. Qualified students may substitute courses from the Master of Mathematical Finance for elective courses in the M.S. Finance program.

Free Electives

Up to two graduate level electives may be taken from outside the courses prescribed above. These electives may be taken from other offerings at the Stuart School of Business, the Chicago-Kent College of Law, or Main Campus graduate programs, provided that: (1) they are consistent with the M.S. Finance program objectives; (2) they have been approved, prior to the student's registration, by the M.S. Finance Program Director or the student's academic advisor.

Students may also transfer up to two classes from a graduate program at another AACSB accredited university if the student has not used the classes to satisfy the requirements for a degree at the university. Additional classes may be transferred with the permission of the program director.

Prerequisite Courses

Some students may be required to take prerequisite courses in mathematics, statistics, or computer programming before being admitted to a graduate course. Undergraduate course offerings, which typically are listed with a primary numeral of four or below (i.e. FM 492) cannot be used as free electives in the M.S. Finance program.

Master of Mathematical Finance

Collaborative Program with IIT College of Science Applied Mathematics Department

33 credit hours

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 IIT Stuart School of Business (SSB) and the Applied Mathematics Department (AM) and as such, it gives students the chance to benefit from the strength of both units. Students are required to complete a total of 11 semester courses, including eight core courses and three elective courses.

Core Courses

MSF 505 Futures, Options, and OTC Derivatives
 MSF 526 Computational Finance
 MSF 575 C++ with Financial Markets
 MATH 542 Stochastic Processes
 MATH 548 Mathematical Finance I
 MATH 565 Monte Carlo Methods in Finance
 MATH 582 Mathematical Finance II
 MATH 586 Theory and Practice of Fixed Income Modeling

Elective Courses from the Department of Applied Mathematics

CS 522 Data Mining
 MATH 512 Partial Differential Equations
 MATH 522 Mathematical Modeling
 MATH 540 Probability
 MATH 543 Stochastic Analysis
 MATH 544 Stochastic Dynamics
 MATH 545 Stochastic Partial Differential Equations
 MATH 546 Introduction to Time Series
 MATH 566 Multivariate Analysis
 MATH 567 Advanced Design of Experiments
 MATH 569 Statistical Learning
 MATH 577 Computational Mathematics I
 MATH 578 Computational Mathematics II
 MATH 579 Complexity of Numerical Problems
 MATH 587 Theory and Practice of Modeling Risk and Credit Derivatives
 MATH 589 Numerical Methods for Partial Differential Equations
 MATH 590 Meshfree Methods

Elective Courses from the Stuart School

MSF 524 Models for Derivatives
 MSF 525 Term Structure Modeling and Interest Rate Derivatives
 MSF 545 Structured Fixed Income Portfolios
 MSF 546 Quantitative Investment Strategies
 MSF 554 Market Risk Management
 MSF 555 Credit Risk Management
 MSF 566 Time Series Analysis
 MSF 567 Bayesian Econometrics
 MSF 574 .NET and Database Management
 MSF 576 OOP and Algorithmic Trading Systems
 MSF 577 High Frequency Finance
 MSF 584 Equity and Equity Derivatives Trading
 MSF 585 FOREX and Fixed Income Strategies

Core Requirement

All Mathematical Finance students must complete the eight core classes unless they have obtained written permission from their program director to substitute an alternative class for a core class.

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 program director.

Electives

At least one elective must be taken in Finance and at least one elective must be taken in Math from the elective options listed above.

Free Electives

One graduate level elective may be taken from outside the courses prescribed above, provided that it is consistent with the MMF program objectives and has been approved by the Program Director prior to the student's registration.

Students may also transfer up to two classes from a graduate program at another accredited university if the student has not used the classes to satisfy the requirements for a degree at the previous university. Additional classes may be transferred with the permission of the Program Director.

Prerequisite Courses

Some students may be required to take prerequisite courses in mathematics, statistics, or computer programming before being admitted to a graduate course.

Master of Science in Marketing Analytics and Communication

The M.S. in Marketing Analytics and Communication (MAC) requires the successful completion of 33 credits (11 courses). Part-time students can enroll for as few as one course per semester and can take up to five years to complete their degree. Full-time students are expected to enroll for at least three courses per semester and can complete their degree in two years. The program schedule allows flexibility to students who wish to accelerate their studies. For example, full-time students could graduate in roughly a year by starting in Summer of Year 1 and completing their program in Summer Year 2 - but this requires careful planning.

Core Courses

BUS 510	Building an Innovative and Sustainable Business
BUS 550	Business Analytics for Competitive Advantage
BUS 590	Business Innovation in the Next Economy (Integrated Capstone Course)
MAC 501	Insights into the Next Economy Markets
MAC 502	Spreadsheet Modeling
MAC 503	Marketing Research and Engineering
MAC 504	Creating, Communicating, and Delivering Customer Value
MAC 505	Strategic Marketing Management

Concentrations A concentration consists of a minimum of 9 credit hours in each of the following areas:

Marketing Analytics Concentration (take all 3 courses):

MAC 521	Qualitative & Survey Research Methods in Business
MAC 522	Predictive Analytics
MAC 523	Social Media Marketing Analytics

Marketing Communication Concentration

MAC 511	Integrated Marketing Communication Strategy
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AND two of the following:

MAC 512	Customer Touch Points
MAC 513	Managing Sustainable Brands
MAC 514	Customer Relationship Management
MAC 515	Database & Direct Marketing
MAC 516	Social Media Marketing Strategy

Master of Public Administration

The M.P.A. degree requires a minimum of 33 credit hours (11 courses) of graduate work. The program of study requires completion of the following 8 core courses:

Required Courses

- PA 501 Essentials for Public Management in a Complex Society: Processes, Structures, and Values
- PA 502 Leading and Managing Knowledge-Intensive Organizations
- PA 509 Integrative Practicum for Effective Leadership in Public and Nonprofit Organizations
- PA 522 Effective Management of Human Resources in Environments of Scarce Resources
- PA 532 Managing Public Financial Resources in a Changing World
- PA 568 Strategic Competitiveness in the Public Sector
- PA 580 Policy Evaluation Analytics
- PA 581 Policy Design Analytics

In addition to the core courses, students choose 3 elective courses. Elective courses may be selected from courses in public administration or other fields such as architecture, business, city and regional planning, civil engineering, computer science, design, environmental engineering, humanities, psychology, social sciences, or law. Taking a course outside the M.P.A. program requires the permission of the student's advisor and the M.P.A. Program Director. 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 the M.P.A. Program Director.

M.P.A. with Nonprofit and Mission-Driven Management Specialization

This specialization is designed for professionals who want to become leaders and managers of nonprofit and other mission driven enterprises. It provides students with the skills needed to enter the nonprofit field, advance their current nonprofit career, or become a nonprofit or mission driven enterprise entrepreneur. Students take the

regular M.P.A. core curriculum and three electives from the nonprofit courses offered in the program. This program combines rigorous instruction with a practical orientation toward mission-driven organizational management.

M.P.A. with Security, Safety, and Risk Management Specialization

The Security, Safety, and Risk Management Specialization is intended for professionals who want to acquire cutting edge security strategies and leadership techniques to successfully manage public safety and public or private sector emergency preparedness programs. Students take

the regular M.P.A. core curriculum and three electives from the Security, Safety and Risk Management courses offered in the program. This program combines rigorous instruction with a practical orientation

M.P.A. with Economic Development and Social Entrepreneurship Specialization

The specialization in Economic Development and Social Entrepreneurship is designed for professionals who want to become Economic Development Leaders of Social Entrepreneurs. They will become managers and entrepreneurs who drive socially responsible economic change in a rapidly changing global environment. These professionals may work in the public sector specializing in developing cutting edge economic development strate-

gies and programs at the local, state, or federal level or they may want to be mission-driven entrepreneurs who organize, manage, or create ventures that utilize social capital to foster local or regional economic development. Students take the regular M.P.A. core curriculum and three electives from the Economic Development and Social Entrepreneurship courses offered in the program.

M.P.A. with Public Works Specialization

The Stuart M.P.A. program cooperates with the IIT Department of Civil, Architectural and Environmental Engineering (CAEE) in that department's offering of a Master of Public Works (MPW) degree. This program was initiated in 1982 by the Graduate Program in Public Administration in conjunction with the CAEE, the Chicago Metropolitan Chapter of the American Public Works Association (APWA), and the Education Foundation of the APWA.

CAEE students take a total of 11 courses:

Four core courses

- CAE 574 Economic Decision Analysis in Construction
- CAE 575 Systems Analysis in Construction
- PA 501 Essentials for Public Management in a Complex Society: Processes, Structures and Values (offered each semester)
- PA 551 Public Infrastructure Management (offered each spring)

AND four engineering electives

AND two public administration electives

AND one CAEE special problems

Bachelor of Science/Master of Public Administration (B.S./M.P.A.)

The B.S./M.P.A. co-terminal degree program allows students to complete both an undergraduate Business Administration (B.S.B.A.) or Political Science (B.S.P.S.) and a graduate Public Administration degree in five years. This approach enables students to gain greater knowledge in specialized areas while completing fewer credit hours, with better scheduling flexibility than completing the two degrees separately.

Application to and acceptance into the M.P.A. program is open to students who have attained at least junior standing in the B.S. program. Students must maintain a combined 3.0 GPA to be admitted to and remain in a co-terminal degree program.

The application for the B.S./M.P.A. co-terminal program is accessible through the myIIT portal. Under the Academics tab, locate the Graduate Admission-Student channel and then access the link for the co-terminal application.

Doctor of Philosophy in Management Science

IIT Stuart's Ph.D. in Management Science offers comprehensive coverage on the application of quantitative methods, analytical tools, and computer models to decision-making problems in business, finance, and operations management.

Program Goals

This program prepares students and working professionals for careers in academia as well as executive and management positions in business, government, and consulting sectors. The Ph.D. program emphasizes both analysis and synthesis. The required courses provide the tools to analyze business problems and to develop new systems or new solutions. Once students master these skills, their dissertation work involves structuring a problem, gathering data where appropriate, and solving it. The research methodologies of management science can be applied to any aspect of business. The program's goal is to facilitate the contribution of new knowledge to the field of business through applied research that addresses important problems in operations and finance.

Program Requirements

Applicants to the Ph.D. program must have completed a master's degree 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.

This program is selective and small with a high degree of interaction between faculty and students, and a mentor relationship with a faculty advisor. The Ph.D. committee carefully matches the interest of the student with the expertise of the faculty member. The program offers two concentrations, operations and finance.

In order to earn a Ph.D. in Management Science, students are required to complete a total of 64 credit hours beyond the master's degree, with 16 credits devoted to dissertation research work. Students are required to complete 12 courses in the first two years, including eight Ph.D. core courses and four advanced elective courses in the chosen area of concentration (Operations or Finance). In the third and fourth year of study, students enroll in four advisor-approved open electives, in addition to registering for dissertation credits to pursue and complete the doctoral dissertation.

Operations Concentration

Operations emphasizes the design and implementation of systems that improve the effectiveness and efficiency of organizations. Student learning focuses on effective optimization of a given firm's resources (people, technology, finance, and information) in order to secure competitive advantage. Effective operations are critical to any firm engaged in producing products or providing services.

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 graduate degree that is equivalent to the M.S.F. 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. Graduates of the Ph.D. program with a concentration in Finance have a wide choice of careers. In addition to a traditional academic career focused on teaching and research, graduates may also work in investment and commercial banking, trading, and risk management. Dissertation research in this area may include a wide range of topics such as risk modeling, financial time series analysis, and investment analysis.

Program Structure

In the first year, full-time students will complete the Ph.D. basic core (a six-course sequence of two courses each in Economics, Statistics, and Optimization areas), before taking the Qualifying exam.

- MSC 511 Economics I
- MSC 512 Statistics I
- MSC 513 Optimization I
- MSC 514 Economics II
- MSC 515 Statistics II
- MSC 516 Optimization II

Qualifying Exam: Students are required to take this exam after completing the six courses listed above. The qualifying exam may be taken only twice.

In the second year, full-time students will complete the Ph.D. advanced core and elective courses (a six course sequence consisting of two Ph.D. advanced core courses and four advanced electives as shown below).

Two Advanced Core Courses

- MSC 611 Philosophy of Management
- MSC 612 Research Methods

Four Advanced Electives from the Following

- MSC 621 Corporate Finance
- MSC 622 Enterprise Risk Management
- MSC 631 Theory of Finance I
- MSC 632 International Finance Theory
- MSC 641 Operations I
- MSC 642 Operations II

Doctor of Philosophy in Management Science - continued

Comprehensive Exam: After completing all required Ph.D. coursework, usually at the end of the second year of full-time study, 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. The comprehensive exam may be taken only twice.

In the third and fourth year of graduate study, students will take four advisor approved elective courses (or 12 credit hours) and enroll for 16 dissertation credit hours.

Program of Study

IIT Stuart requires that at least two semesters of study be completed on a full-time basis. The semesters need not be consecutive, but must occur within the six years prior to the awarding of the degree. After completion of coursework and qualifying/comprehensive exam requirements, the dissertation research may be done off campus if suitable arrangements for supervision are made.

When a student is ready to begin dissertation research work, the Dean of the Stuart School will appoint a mutually acceptable research advisor to supervise the student's research. The student will work with the advisor to constitute a dissertation committee (composed of at least four full time faculty members including the advisor, one of whom will be a representative from outside the student's field) before beginning work on a dissertation

project that must be an original investigation of high quality. Students are required to defend a dissertation proposal before the dissertation committee. After the dissertation project is completed, the student will appear before the dissertation committee to defend the dissertation project. Usually, the dissertation proposal defense and the dissertation defense are at least one year apart.

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 a requirement for the Ph.D. program.

Students entering the program may transfer up to two courses from a graduate program at another AACSB accredited university if the student has not used the courses to satisfy the requirements for a degree at the university. Additional courses may be transferred with the permission of the Program Director.

Some students may be required to take prerequisite courses in mathematics, statistics, or computer programming before being admitted to a graduate course. Undergraduate course offerings, which typically are listed with a primary numeral of four or below, cannot be used as free electives in the Ph.D. program.

Certificate Programs

Four graduate certificate programs are offered in public administration. 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 re-

quire 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.

Economic Development and Social Entrepreneurship

This certificate is designed for professionals who want to increase their knowledge and skills in economic development and social entrepreneurship but do not currently have the time to pursue an M.P.A. degree.

The student must take one M.P.A. core course.

Recommended core course

PA 568 Strategic Competitiveness in the Public Sector

Three of the following

- PA 533 Advanced Financial Management for Public and Nonprofit Organizations
- PA 539 Local Government Management
- PA 550 Social Entrepreneurship
- PA 551 Public Infrastructure Management
- PA 555 Introduction to Urban and Regional Planning
- PA 556 Public Management Strategies for the 21st Century
- PA 570 Social Capital and the Community
- PA 578 Planning, Policy-Making and the Built Environment

Additional courses could be taken in the Stuart Environmental Management and Sustainability Program, the Civil, Architectural, and Environmental Engineering Department, and other related programs as permitted by Program Director.

Nonprofit and Mission-Driven Management

This certificate is designed for professionals who want to increase their knowledge and skills in nonprofit and mission-driven management but do not currently have the time to pursue an M.P.A. degree.

The student must take one M.P.A. core course.

Recommended core course

PA 502 Leading and Managing Knowledge-Intensive Organizations

At least three of the following

- PA 505 The Law and the Nonprofit Sector
- PA 533 Advanced Financial Management for Public and Nonprofit Organizations
- PA 540 Public Sector Dispute Resolution
- PA 541 Performance Measurement in Nonprofit and Public Management
- PA 543 Public Policy, Nonprofits, and Philanthropy
- PA 556 Public Management Strategies for the 21st Century
- PA 565 The Nonprofit Sector
- PA 566 Nonprofits and the Public Sector
- PA 570 Social Capital and the Community
- PA 579 Ethics & Professional Responsibility in Public Service

Public Management

This certificate is designed for professionals who want to increase their knowledge and skills in public management but do not currently have the time to pursue an M.P.A. degree.

To complete the certificate, students will take 12 credit hours (4 courses). It is recommended that they take one M.P.A. core course.

Recommended core courses

- PA 501 Essentials for Public Management in a Complex Society: Processes, Structures, and Values
- PA 502 Leading and Managing Knowledge-Intensive Organizations
- PA 532 Managing Public Financial Resources in a Changing World

At least three of the following

- PA 511 Comparative Public Administration
- PA 516 Information Technology in Public Administration
- PA 522 Effective Management of Human Resources in Environments of Scarce Resources
- PA 533 Advanced Financial Management for Public and Nonprofit Sectors
- PA 539 Local Government Management
- PA 540 Public Sector Dispute Resolution
- PA 541 Performance Measurement in Nonprofit and Public Management
- PA 551 Public Infrastructure Management
- PA 556 Public Management Strategies for the 21st Century
- PA 562 Urban and Metropolitan Government
- PA 568 Strategic Competitiveness in the Public Sector
- PA 578 Planning, Policy Making and the Built Environment
- PA 579 Ethics & Professional Responsibility in Public Service
- PA 580 Policy Evaluation Analytics

Security, Safety, and Risk Management

This certificate is designed for professionals who want to increase their knowledge and skills in security, safety and risk management but do not currently have the time to pursue an M.P.A. degree.

The student will take one M.P.A. core course.

Recommended core course

- PA 502 Leading and Managing Knowledge-Intensive Organizations

Three of the following

- PA 536 Strategy and Structure: Homeland Security
- PA 537 Crisis Management and Homeland Security
- PA 538 Information Systems Security and Cyber-Crime
- PA 539 Local Government Management
- PA 553 Public Safety Administration
- PA 556 Public Management Strategies for the 21st Century
- PA 579 Ethics & Professional Responsibility in Public Service
- PA 588 Incident Response, Disaster Recovery, and Business Continuity

Dual Degree Programs

Several dual-degree programs are offered, including programs 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 advisors from both programs in which they are studying. Simultaneous enrollment is required for varying periods of time, depending on the program. Students should consult advisors 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 or GRE scores are required by the Stuart School of Business, but current LSAT scores may be substituted in some programs. Interested students should contact program advisors from either program for other specific requirements.

All graduate programs in business are subject to continuous improvements including dual-degree programs. Prospective students are urged to refer to the Stuart home page for the most current description of all programs and degree requirements.

M.B.A./M.P.A.

The Master of Business Administration/Master of Public Administration program is ideal for students who want to work in both public and private sector management, and/or who expect to move between business and govern-

ment positions in their careers. The curriculum consists of 12 M.B.A. and 9 M.P.A. courses, reducing degree requirements by 6 courses.

M.B.A./M.S. (Choose from M.S. EMS, M.S. Finance, M.S. MAC)

Combine your Master of Business Administration with one of our specialized M.S. degree programs in environmental management and sustainability, finance, or mar-

keting analytics and communication. Dual enrollment can reduce degree requirements by up to 6 courses.

M.B.A./J.D.

The Master of Business Administration/Juris Doctorate program offers a competitive advantage for legal professionals who need a solid understanding of busi-

ness practices, especially for corporate attorneys or legal/management consultants. Dual enrollment can reduce degree requirements by as many as 10 courses.

M.P.A./J.D.

The Master of Public Administration/Juris Doctorate degree is particularly valuable for administrators who need a greater understanding of legislation, rules, and

judicial decisions. Dual enrollment can reduce degree requirements by up to 5 courses.

M.S. Finance/J.D.

The Master of Science in Finance/Juris Doctorate degree is designed to prepare students for careers in the legal

profession with emphasis on finance. Dual enrollment can reduce degree requirements by up to 9 courses.

M.S. EMS/J.D.

The Master of Science in Environmental Management and Sustainability/Juris Doctorate degree is designed to prepare students for careers in the legal profession with

emphasis on environmental issues and sustainable business practices. Dual enrollment can reduce degree requirements by up to 9 courses.

M.B.A./M.Des.

The Master of Business Administration/Master of Design degree combines advanced methods for exploring new theories of design with an understanding of the business

applications of technology and analytic methods. Dual enrollment can reduce degree requirements by up to 9 courses.

Course Descriptions

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

Business

BUS 510

Building an Innovative & Sustainable Business

This is an introductory course on the fundamentals of doing business in an increasingly interconnected and hypercompetitive world where rapid information flows, environmental degradation, and societal challenges (e.g., poverty and ethics) can be viewed as both threats and opportunities facing for-profit enterprises. Students will learn that sustainable businesses are also innovative businesses and that sustainability often drives innovation. Students will not only be exposed to the basics of starting, growing, and running a profitable business but also learn how to do so in an environmentally and socially sustainable fashion. They will learn how companies create and capture value and how to analyze the business environment, industry, competitors, and customers. They will be introduced to corporate, business, and functional strategy and learn about different business functions (accounting, finance, operations, marketing, and information management). Students will be introduced to critical challenges of global sustainability and will explore through case studies how leading companies are implementing triple bottom line accounting, sustainable growth, and stakeholder value creation strategies. Finally, they will develop an innovative business idea to start a brand new company that has sustainable growth in its mission statement.

(3-0-3)

BUS 550

Business Analytics for Competitive Advantage

This course covers statistics, optimization, and simulation tools that are critical for managers in enabling their firms to have a competitive advantage. The course covers probability, sampling, estimation, hypothesis testing, linear regression, goodness-of-fit tests, linear optimization models, nonlinear optimization models, and managerial decision-making under uncertainty. The models address problems in finance, marketing, and operations and include applications such as media selection, capital budgeting, portfolio selection, advertising effectiveness, facility location, distribution planning, and production planning. The focus of the course is on using business analytics to build models and using software to aid in decision-making.

(3-0-3)

BUS 590

Business Innovation in the Next Economy

This is a forward-looking and experiential course that helps students understand how companies could successfully compete in the “next economy” through innovation and integrative problem-solving. It aims to integrate all of the key lessons from the M. B. A., M. S. EMS, and M. S. MAC programs to develop innovative solutions to solve real-world problems that actual companies face. The course is heavily project-based. Cross-disciplinary teams of students will act as management consultants to companies to identify and solve problems taking a holistic and integrative perspective. There will be lectures on various aspects of business strategy, sustainability, systems thinking, execution, innovation, and team effectiveness from faculty members and industry experts. Student teams will present their findings to fellow students, faculty members, and client companies. Prerequisite: Students should have successfully completed all of their respective program core courses.

(3-0-3)

Environmental Management and Sustainability

EMS 500

Fundamentals of Environmental Science

This is an introductory course designed to teach students without any background in environmental science the fundamentals of environmental science which is the prerequisite knowledge needed for the EMS core courses. It covers basics of environmental science, calculus, chemistry, and other relevant topics that represent a needed foundation for the other courses in the program. Students with prior education in environmental science or related subjects could be waived out of this course with approval from the program director.

(2-0-2)

EMS 501

Environmental Policy in a Competitive World

Environmental policies, the main tools that governments use to achieve environmental goals, cut across a wide swath of pollutants, industries, and stakeholders. Environmental policies affect the daily activities of every citizen and every business. Governments use environmental policy to protect their citizens' health, develop industries, preserve resources, increase national security, and more. This course introduces students to the major rationales for government intervention in environmental affairs, the academic theories on which these interventions are based, the variety of policy approaches that various levels of government often use to address environmental issues, the benefits and drawbacks of various approaches, the political processes involved in the environmental policy-making process, the tools that can be used to evaluate the effectiveness and tradeoffs of policy alternatives, and how these policies may affect government and business competitiveness. In addition, the course examines new directions in environmental policy, both policies gaining popularity and those not yet adopted.

(3-0-3)

EMS 502**Contemporary & Emerging Laws Governing the Environment**

This course introduces students to major federal laws that govern the environmental performance of regulated facilities, sites, and activities. The course describes why these laws were enacted, how they are implemented by regulatory agencies, and the practical measures regulated entities must employ to achieve compliance. These laws include the National Environmental Policy Act, the Clean Water Act, the Clean Air Act, the Endangered Species Act, the Resource Conservation and Recovery Act, and the Comprehensive Environmental Response, Compensation, and Recovery Act. The review of these major federal laws will be informed by international and state initiatives that also affect decision making on environmental matters. The course will include a series of case studies and skill development sessions to introduce students to the practical realities of environmental management in a complex regulatory context.

(3-0-3)

EMS 503**Environmental Pollution Prevention & Control Strategies**

Greening organizations benefit both firms and society as a whole by eliminating/reducing pollution, inventing new processes, and reducing risks. This course focuses on the design and development of environmental management strategies specific to industrial operations and economic development activities in order to make them more competitive and sustainable. Specifically discussed in this course are the techniques and tools for mapping and characterizing industrial operation and economic development activities, identifying sources and types of environmental pollution, and defining steps involved with designing pollution prevention/control strategies and their alternatives (i.e., changing inputs, increasing efficiency, promoting innovation, or adopting new technologies to either prevent emissions or treat residuals). The economics of the pollution prevention/control including cost valuation and cost-benefit analysis are covered in addition to discussing the limitations and risks.

Prerequisite(s): [(EMS 500)]

(3-0-3)

EMS 504**Industrial Ecology & Systems Thinking**

This course introduces the students to the philosophy of industrial ecology and how this systems-based approach can move society toward a more sustainable future. Industrial ecology is an interdisciplinary field involving technology (science and engineering), public policy and regulatory issues, and business administration. The major goal of this course is to promote creative and comprehensive problem solving as it might be applied to product, business, and systems models. The course introduces tools such as industrial metabolism, input-output analysis, life cycle assessment, and design for the environment. Individual and team projects are a significant part of the learning experience in this course.

Prerequisite(s): [(EMS 500)]

(3-0-3)

EMS 505**Environmental Finance**

The emerging field of environmental finance provides businesses an opportunity to approach environmental challenges in a financially sustainable and often profitable manner. The course will introduce students to fundamental concepts of microeconomics, macroeconomics, and accounting in order to prepare them for studying finance and other EMS courses. It will explore implications of environmental finance on the financial sector ranging from banking, insurance, investments, financial services, sustainable investing, and social enterprise. The role of hedging devices for pollution and energy and the role of corporate advocacy in environmental policy and standards will be addressed from a corporate competitive business strategy perspective. The interrelationship between financial and environmental performance will be discussed with a focus on corporate risk management and impact on stock and bond ratings. Format will comprise of introduction of basic concepts, discussion of select current publications from corporate and academic thought leaders, and cases or examples that provide hands-on experience.

Prerequisite(s): [(BUS 510)]

(3-0-3)

EMS 511**Solid & Hazardous Waste Management & Remediation**

The aim of this course is to teach the modern multi-faceted approach of the management of solid waste focusing on the generation and prevention (emphasis is on understanding what waste is, where it comes from, how/why it is generated, and how generation of waste can be reduced), re-use and recycling (once waste is generated, what can be done to make use of those waste components that are of economic interest), treatment (discuss the three most important treatment/disposal methods presently in use both in the less and the more developed world, landfills, incineration, and mechanical/biological treatment), and disposal of waste (examples include analysis and environmental impact assessment of land-filling and incineration). RCRA technical and regulatory points of views are covered, and discussed are evolution of RCRA legislation, components of RCRA, and its interrelationship to other environmental statutes CERCLA, SARA, and DNR hazardous waste permitting. Also discussed are the fundamentals of remedial actions, Brownfield's redevelopment, and renewable energy. The emphasis would be on the economic, social, and environmental costs of waste generation, recycling, treatment, and storage.

Prerequisite(s): [(EMS 503)]

(3-0-3)

EMS 512**Environmental Risk Assessment & Management**

The course provides an overview of the tools and techniques used to (1) assess environmental (human health), ecological, and occupational risks associated with exposure to environmental pollutants resulting from natural phenomena, economic development, and industrial growth, (2) examine current risk management and mitigation methods and strategies, and (3) design visionary risk management strategies grounded on a framework of operations in line with the principles of sustainable development.

Prerequisite(s): [(EMS 503)]

(3-0-3)

EMS 513

Environmental Economics & Climate Change

An overview of the modeling market process is provided focusing on externalities, environmental problems, and environmental quality. Economic solutions to environmental problems are discussed using a market approach which includes modeling emission charges, modeling a product charge, modeling per unit subsidy on pollution reduction, and modeling pollution permit trading systems and practice. The course examines institutional economic solutions to address environmental problems such as climate change, global warming, and water scarcity.

Prerequisite(s): [(EMS 505)]
(3-0-3)

EMS 518

Ethics & Corporate Social Responsibility

The corporate scandals and implosions of the past decade, climaxing in the recent global financial crisis and environmental disasters, have highlighted how critical ethical, environmental, and socially responsible decision making and leadership are to the long-term survival and success of both individual businesses and society. Concomitantly, the role of business is transforming from meeting a social contract to realizing tangible economic gains by creating shared value. In today's global environment, societal needs are defining markets, and key issues include poverty, hunger, water, sustainability, climate change, and MNC roles in developing economies. Ethical issues include bribery, fraud, and green washing all the way to a culture of corruption. Corporations and leaders have to manage corporate social responsibility not just as a moral obligation or risk/reputation management exercise but as an integration into their global strategy. This course will endeavor to teach students how these issues get integrated in business through strategy and structure and how to build new competencies in managing transparency, accountability, stakeholder engagement, ethics culture, and social innovation that are critical for business success in the next economy.

Prerequisite(s): [(BUS 510)]
(3-0-3)

EMS 525

Environmental Performance Analytics

With increasing focus on sustainability factors from marketplace (regulators, investors, financiers, and consumers), corporate sustainability reporting is shifting from voluntary to vital. Advances in enterprise systems are making it feasible for corporations to track, trend, and transform sustainability performance. Materiality of these seemingly non-economic impacts is the critical link between sustainability and business strategy. This course provides insight into how to determine which environmental metrics are material to them and relevant to their business through application of environmental performance analytics. Format will comprise of introduction of basic concepts, discussion of select current publications from corporate and academic thought leaders, and short cases or examples that provide hands-on experience. Students completing this course will develop a better understanding of the materiality of interrelationships between business and sustainability. In particular, they will equip themselves with the ability to apply data collection, analytics, and quantitative justification to promote select sustainability improvements that are consistent with corporate strategy. This will help them to be better prepared to take on greater responsibilities in a consulting or advisory role to the corporate sector.

Prerequisite(s): [(BUS 550)]
(3-0-3)

EMS 529

Social Entrepreneurship

This course gives students a practical introduction to the exciting and rapidly growing field of social entrepreneurship. The course will begin by introducing students to contemporary understandings of poverty, its causes, and traditional poverty alleviation strategies. It will then turn to key concepts regarding social ventures including entrepreneurship, organizational structure (for-profit, non-profit and hybrid), financing, marketing, and performance assessment (social and environmental impact). The course will also examine the challenges that are faced in creating and operating social enterprises in different parts of the world. The course includes guest lectures by other Stuart School of Business faculty and social entrepreneurs working in different areas (such as health, education, and environment). Students will gain hands-on experience by either developing a business plan for a social enterprise to address a specific real world problem or assisting an existing social venture in developing a business plan geared towards an expansion of its services; it is expected that the plans can be entered into a variety of social venture competitions. Through the course, students will learn how to do the following: (1) evaluate gaps and opportunities in a given context; (2) develop appropriate objectives and strategies for a social venture; (3) put together a business plan for a social enterprise; and (4) engage others and foster buy-in to their plans.

(3-0-3)

EMS 531

Environmental Advocacy

This course explores how individuals, firms, nonprofits, and others advocate in order to achieve environmental goals using a broad range of advocacy tools in the legislative, regulatory, administrative, political, judicial, and educational arenas. The course examines when, where, and how advocacy can be effective, strategies for framing policies, how to evaluate legal and ethical factors, and how to use traditional as well as grassroots, social networking, and other evolving new media methods to support an advocacy campaign.

Prerequisite(s): [(EMS 501)]
(3-0-3)

EMS 532

Environmental & Energy Law Clinic

This course provides students with the opportunity to experience the practical realities of being an environmental professional by working on actual cases under the supervision of a faculty member who is an experienced environmental attorney with a Chicago-based practice. The course includes weekly classroom sessions to build the skills environmental professionals must possess. Students apply these skills to cases in the Chicago area in which the faculty supervisor represents non-governmental organizations. The Clinic includes opportunities to participate in site visits, client interactions, a variety of professional meetings, and regulatory and enforcement proceedings. Students will engage in fact gathering, compliance analysis, client communication and case preparation activities, working alongside their faculty supervisor.

Prerequisite(s): [(EMS 502)]
(3-0-3)

EMS 541**Managing Energy Technologies**

A significant focus of this course will be on what environmental managers and business managers need to know regarding the technical aspects of energy management – energy efficiency and fossil and renewable energy technologies. The thrust of the course will be in understanding current and emerging technologies in this rapidly growing area of business and industry. However, students will not need to have technical or engineering background to do well in this course.

(3-0-3)

EMS 542**Economics of Energy Systems**

Students will see the big picture economics of energy management – cost of production/distribution, financing renewable investments, climate change, etc. Students will understand the economic, strategic, and management issues surrounding energy management and have an opportunity to learn new tools and techniques.

Prerequisite(s): [(EMS 500)]

(3-0-3)

EMS 595**Special Topics in Environmental Management & Sustainability**

This course covers contemporary or cutting edge topics in the EMS field offered on an irregular basis typically in a seminar style. Prerequisite: Instructor permission.

(3-0-3)

EMS 597**Independent Study in Environmental Management & Sustainability**

Students can conduct in-depth research, usually on an independent and solo basis, under the guidance of a full-time faculty member. Typically, a student signs up with a faculty member who is willing to supervise his/her independent research on a particular EMS-related topic. The student has to complete the independent study form, develop a one-page proposal outlining the purpose, process, and product (expected outcomes) of the independent research project, get the faculty member's approval, and submit it to the program director for approval. Prerequisite: Instructor and program director approval.

(0-0-3)

Management Science

MSC 511**Economics I**

This is the first of a two-semester sequence in advanced-level economics. It offers a rigorous treatment of modern microeconomics theory which includes consumer theory, theory of the firm, decision making under uncertainty, and game theory. The course examines various market settings such as competitive markets, oligopolies, and monopolies. Other topics considered include consumer preferences and production functions, choice under uncertainty, various measures of welfare and efficiency, equilibrium concepts, public goods, externalities, mechanism design, adverse selection, and moral hazard. Focus is on major topics of economic analysis and the tools used to study them. Some mathematics background, particularly calculus, is essential.

(3-0-3)

MSC 512**Statistics I**

This course provides a comprehensive introduction to the statistical approach of tackling research problems (random variables; transformations; popular distributions used in management science such as normal, Student T, Chi-square, and generalized lambda; sampling methods, parameter estimation, confidence intervals and joint confidence intervals; hypotheses testing, sample size and power, regression and correlation), and statistical modeling. It will focus on the mathematics of differential equations, stationary time series models, conditional heteroscedasticity, non-stationary time series, cointegration and non-linear models. Students will also learn techniques like maximum likelihood estimation, likelihood ratio tests, and generalized method of moments estimation. Students will be introduced to stochastic processes and applied probability, Bayesian statistics, computational inference, extreme value theory, survival analysis, design of control and cohort experimental studies, introduction to SAS statistical software, issues in data-screening/diagnostic testing, model specification and estimation issues and empirical analyses involving large databases.

(3-0-3)

MSC 513**Optimization I**

This course introduces optimization techniques with a focus on linear and integer optimization problems. Topics include: the simplex method and its variants, interior point algorithms, duality and sensitivity analysis, integer linear programming, cutting plane method, branch and bound method, Lagrangian relaxation methods, model formulation with integer variables, large scale optimization, and network flow problems.

(3-0-3)

MSC 514**Economics II**

This is the second course in the two course economics core sequence. It provides a basic introduction to game theory and explores its use in modern economics and business through examinations of classic and current papers. It covers the nature and existence of equilibrium in static and dynamic games, repeated games, and implications of asymmetric information including signaling, adverse selection and moral hazard and their application to modern business problems in finance, operation research and marketing. It also introduces students to models used in modern macroeconomics.

Prerequisite(s): [(MSC 511)]

(3-0-3)

MSC 515**Statistics II**

This course focuses on econometrics with a special emphasis on regression analysis. It begins with the classical linear regression model and variations based upon non-linearity, non-normality, heteroscedasticity and autocorrelation. The course also includes a discussion of cross-section data, systems of regression equations, dynamic regressions, and models with discrete dependent variables. The course emphasizes in-sample and post-sample forecasting and hypothesis testing. The course is heavily project-oriented and students will be expected to work with modern statistical packages like R, SAS, SPSS, and RATS. Projects will be drawn from financial and business applications.

Prerequisite(s): [(MSC 512)]

(3-0-3)

MSC 516

Optimization II

This course introduces dynamic programming and applications of dynamic programming to deterministic and stochastic decision problems. The course also introduces the theory and computation methods of nonlinear programming, convex analysis, and unconstrained methods; Kuhn-Tucker theory, saddle points and duality, quadratic linearly constrained and nonlinear constrained problems, and penalty and barrier methods.

Prerequisite(s): [(MSC 513)]
(3-0-3)

MSC 597

Special Problems

Subject matter will vary according to the research interest and background of both the student and the instructor. Research or study problems may be assigned from different areas within management science. Graduate course work in the problem subject matter.

(Credit: Variable)

MSC 611

Philosophy of Management

This course introduces doctoral students to the history and evolution of thinking in the management discipline. It focuses attention on theories of leadership and innovation, and showcase contributions of influential thought leaders in management. It also includes epistemological perspectives with substantial potential for enhancing business research. Finally, it will address fundamental approaches and criteria for successful theory development.

(3-0-3)

MSC 612

Research Methods

This course is a required course for all PhD students at the Stuart School of Business. It offers a comprehensive overview of the General Linear Model at both univariate and multivariate research levels. The course will review measurement issues (reliability, types of validity), multiple regression analysis, ANOVA, MANOVA, step-down analysis, factor analysis, structural equation models (exploratory and confirmatory factor analysis), discriminant analysis, redundancy analysis, canonical correlation analysis, repeated measures analysis, categorical data analysis, contingent valuation method, conjoint analysis, cluster analysis, multidimensional scaling, correspondence analysis, choice models, and relatively new areas such as multi-level analysis, meta-analysis, data warehousing, data mining, and neural networks. Additionally, nonlinear models will also be discussed.

Prerequisite(s): [(MSC 601, MSC 602, MSC 603, MSC 604, MSC 605, and MSC 606)]
(3-0-3)

MSC 621

Corporate Finance

This course describes how corporations use financial decisions to create shareholder value. Topics include net present value calculations, real options theory, equilibrium models of required rates of return, capital structure, and dividend policy. The course also covers the use of financial theories in organization structure through mechanisms like economic value added, enterprise risk management, and mergers and acquisitions. This course offers a more formal mathematical presentation of corporate finance than is found in similar courses in master level programs.

Prerequisite(s): [(MSC 601)]
(3-0-3)

MSC 622

Enterprise Risk Management

This course focuses on the 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 rate 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 scenarios analysis, and extreme and tail events modeling.

Prerequisite(s): [(MSC 602 and MSC 631)]
(3-0-3)

MSC 631

Theory of Finance I

This course is intended as an in depth review of the following areas of finance: (1) utility theory and expected utility valuation techniques; (2) the Markowitz portfolio problem and the CAPM model; (3) the APT theory and general linear arbitrage factor model; (4) single period consumption-based asset pricing models; (5) state preference theoretic approaches; (6) multi-period discrete time utility based models and associated mathematical techniques; (7) equilibrium and price bubbles in the preceding model (the ?Lucas? model); (8) basic binomial derivative pricing; and (9) Ito's Lemma, Black-Scholes, and related models.

(3-0-3)

MSC 632

International Finance Theory

International Finance Theory.

Prerequisite(s): [(MSC 605 and MSC 631)]
(3-0-3)

MSC 633

Theory of Finance II

This course is intended as an in depth review of the following areas of finance: (1) continuous time risk neutral pricing; (2) jump diffusion models; (3) continuous time utility optimization modeling (with dynamic programming); (4) consumption CAPM modeling; (5) non-time separable utility modeling; and (6) behavioral finance.

(3-0-3)

MSC 641

Operations I

This elective course will focus on special topics in the Operations area that are best aligned with the research interests of the instructor(s). More specifically, these may address the management of quality and related aspects such as the economics of quality (returns to investment in quality) and the management of customer satisfaction.

Prerequisite(s): [(MSC 601, MSC 602, and MSC 603)]
(3-0-3)

MSC 642

Operations II

This elective course will focus on special topics in the Operations area that are best aligned with the research interests of the instructor(s). More specifically, this course addresses supply chain management and related inventory management issues.

Prerequisite(s): [(MSC 601, MSC 602, and MSC 641)]
(3-0-3)

MSC 643**Investment & Market Entry Under Uncertainty**

How should firms decide whether and when to adopt new technology, develop a new product, enter a new market, or invest in new capital equipment? The literature in management science discusses approaches that recognize the value of waiting for better (but never complete) information and the value of investing early. The topic stresses the irreversibility of investment decisions and the ongoing uncertainty of the economic environment. Investment-related decisions include when to invest or wait for more information, what an optimal portfolio of technologies/equipment is, how to position the product, and how much capacity to invest in. The theory can be applied to a wide variety of business problems characterized by irreversible investment costs and stochastic environments such as new product development, timing of product introduction, market entry and deterrence, and new venture creation.

Prerequisite(s): [(MSC 511, MSC 512, MSC 513, MSC 514, MSC 515, and MSC 516)]
(3-0-3)

MSC 691**Research & Thesis PhD**

(Credit: Variable)

Marketing Analytics and Communications

MAC 501**Insights into the Next Economy Markets**

This course analyzes competitors, industries, and customers in the emerging global business environment. Understanding the demographics and psychographics of target audiences is essential to an effective marketing communication strategy. From data to information to insightful strategic marketing, this course covers what's important to know to make more effective marketing decisions. Social, cultural, psychological, and attitudinal factors are explored with particular attention to motivation, how attitudes are shaped and altered, how information is processed, and the role of learning in the formation of purchasing decisions. Theories and models of consumer behavior are examined to develop incisive insight into consumer behavior that can build strong brands. In addition to customer behavior, the course also covers tools and techniques to identify and analyze competitors and their strengths and weaknesses. Students will also learn a framework to analyze the relative attractiveness of industries and the techniques to analyze the threats and opportunities in the macro environment.

(3-0-3)

MAC 502**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.

(3-0-3)

MAC 503**Marketing Research & Engineering**

The course is roughly divided into thirds which track the standard market research process: define the problem and design a research plan; develop appropriate primary research tools (primarily survey design and implementation); and execute an analysis and presentation. Marketing engineering focuses on specific data-driven marketing tools, regression, cluster analysis, conjoint, etc., and their application to specific marketing problems (segmentation and targeting, new product design, and forecasting). The market research process will be taught backwards from analysis to data acquisition with the aim that students will have a working understanding of their analytical goals by the time they begin their projects and can therefore establish sensible research objectives with an eye to expected use for the data.

Prerequisite(s): [(MAC 501)]

(3-0-3)

MAC 504**Creating, Communicating, & Delivering Customer Value**

This course provides an introduction to the practice and strategy of marketing. Marketing activities are those processes and functions that enable managers and policy-makers to identify and serve the values and needs of a customer given the capacities of the company, activities of competitors, and inherent constraints in the business environment. Marketers typically refer to these concepts as the "four C's." Based on their understanding of the "four C's," students will then learn how to implement strategy by applying the levers of the marketing mix. These elements are known as the four P's (product, price, place/channels of distribution, and promotion). The treatment of marketing constraints and marketing mix will be motivated by essential foundations from economics, sociology, and consumer behavior. Over the course of the semester, students are expected to transition from thinking about these concepts in isolation to a dynamic, integrative framework. This process includes using the marketing strategy framework to assess business and policy problems from a "multiple objective" perspective: that is, the student will be asked to think about how marketing activities along with those of competitors and collaborators will affect the profitability, sustainability, social, and ethical standing of the firm. The synthesis of these concepts will be carried out through the use of case studies, problem sets, classroom lectures, discussions, and a field project. There will also be a midterm and final exam. The pedagogical style of the course emphasizes the students' role in applying the concepts discussed in the lectures to the situations at hand. The role of the instructor is to provide tools to structure thinking and to stimulate and facilitate analysis of the cases.

Prerequisite(s): [(BUS 510 and MAC 501)]

(3-0-3)

MAC 505

Strategic Marketing Management

In this course, we will emphasize both marketing strategy formulation and execution and the management of the marketing function. This includes the integration of marketing mix decisions, the longer-term effects of marketing mix decisions, and changes in the mix over time. For example: "Price" becomes "Price Policy", value-in-use, and price discrimination; "Product" becomes product line breadth and variety and product life cycle choices; "Place" becomes the design and control of single or multiple channels of distribution; and "Promotion" becomes communications, customer loyalty, and brand equity. The course will emphasize segmentation of the market, positioning the marketing mix to meet the needs of the market segment, sustaining an 'integrated' marketing mix over the product life cycle, and organizing the 'Strategic Business Unit' to implement the strategy. In addition to the development of a marketing strategy that 'positions' the product/service to the needs of one or more target markets (segmentation), the execution of a marketing strategy will require a marketing plan that includes the economic and financial analysis of the costs and potential profits of the strategy and an implementation plan including an organizational structure. This will often be an iterative process to find an optimal combination of costs and pricing and volume to maximize profits. This course will use readings, simulations, and cases for about half its content. The other half of the course will be a team consulting project for an external client.

Prerequisite(s): [(MAC 504)]
(3-0-3)

MAC 511

Integrated Marketing Communication Strategy

In this course, students learn how to identify and evaluate the full gamut of competitive strategic alternatives in both business-to-business and business-to-consumer marketing using a wide variety of analytic tools to develop and analyze consumer insights. Based on this 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, psychographic, and attitudinal characteristics and to analyze the style and appeal of messages within campaigns. Students also learn how to develop a balanced marketing communication plan utilizing the multitude of vehicles available to reach a target audience using the latest technological tools and media.

Prerequisite(s): [(MAC 504)]
(3-0-3)

MAC 512

Customer Touch Points

This course focuses the massive transformations based on new technologies that are occurring in today's communication environment and the wide variety of consumer contact points it generates. Students will develop an understanding of how the industry is organized and how marketing communications flow from the source company to the target audience. The course examines the major aspects of developing and evaluating media plans 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 product/service.

Prerequisite(s): [(MAC 511)]
(3-0-3)

MAC 513

Managing Sustainable Brands

This is a traditional brand management course applied to green or sustainable brands which are becoming more and more important in the global economy. The most valuable assets that a company has are the brands that it has developed and invested over time. Students will explore the components of a brand, its equity, and emotional benefits and gain an understanding of how to develop a meaningful brand relationship with the customer or prospect to optimize the brand or brand portfolio. The class will also explore the various aspects required to champion a new product or service from development to launch by optimizing the execution through all the marketing efforts of the firm. Students will address positioning, channel strategies, trade promotion, budgeting as a part of the planning process, new product development, packaging and merchandising, and the management of agency relationships. Like people, brands have unique personalities that differentiate them and drive their ability to grow or limit their ability to expand.

Prerequisite(s): [(MAC 511)]
(3-0-3)

MAC 514

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 to 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.

Prerequisite(s): [(MAC 511)]
(3-0-3)

MAC 515

Database & Direct Marketing

This course introduces students to the critical nature of information gathered in real time directly from important constituencies of third party sources. It explores the ability of data-based marketing to match consumers with products based on behaviors. Students learn to access and analyze database information as well as develop programs to elicit a direct and immediate response using a variety of direct-to-consumer/direct-to-business tools including electronic marketing.

Prerequisite(s): [(MAC 511)]
(3-0-3)

MAC 516**Social Media Marketing Strategy**

The area of online marketing continues to develop at a rapid pace. Social media (including tools like Facebook, Twitter, LinkedIn, blogs, websites, e-mail, etc.) is no longer a passing fad but an essential component of the marketing mix. As the platforms evolve and expand, so do the strategies required to leverage them properly. The increased demand for this specialized knowledge creates abundant opportunities for career development, heightened visibility, and market leadership. Companies that fail to capitalize on social media to attract quality people, penetrate new markets, and engage with customers on a meaningful level will most certainly be left out in the cold. This class will explore the core strategies used by companies today to leverage the marketing power of social media to grow their businesses. Students will learn what makes each platform unique and how they contribute to an overall social media campaign.

(3-0-3)

MAC 521**Qualitative & Survey Research Methods in Business**

This is an introductory course in qualitative and survey methods relevant to basic and applied research problems in businesses (with a focus on marketing). Although this is an introductory course, students should be prepared to engage seriously in how qualitative research is conceived, conducted, implemented, and interpreted in business contexts. The course does not emphasize statistical methods, and ability to quickly acquire working knowledge of basic statistics is assumed. The instructor will make an effort to work with students to cover essentials. Students will also require a good understanding of substantive business contexts. In short, while the course accomplishes several objectives, it will focus on the skills required to design and conduct research studies using qualitative and/or survey methods.

Prerequisite(s): [(BUS 550)]

(3-0-3)

MAC 522**Predictive Analytics**

The digital enterprise captures significantly more data about its customers, suppliers, and partners. The challenge, however, is to transform this vast data repository into actionable business intelligence. Both the structure and content of information from databases and data warehouses will be studied. Basic skills for designing and retrieving information from a database (e.g., MS Access) will be mastered. Data mining and predictive analytics can provide valuable business insights. A leading data mining tool, e.g., IBM/SPSS Modeler, will be used to investigate hypotheses and discover patterns in enterprise data repositories. Analysis tools include decision trees, neural networks, market basket analysis, time series, and discriminant analysis. Both data cleaning and analyses will be discussed and applied to sample data. Applications of data mining in a variety of industries will be discussed. Software exercises, case studies, and a major project will prepare the students to use these tools effectively during their careers.

Prerequisite(s): [(BUS 550)]

(3-0-3)

MAC 523**Social Media Marketing Analytics**

The pervasive adoption of internet technology has created an enormous opportunity to capture and analyze digital content exchanges from social media within and external to organizations. These analyses can provide valuable insights for improving the following: sales; customer service and loyalty; product quality, branding and development; employee satisfaction; and supply chain partner effectiveness. Data mining methods and analyses for websites, search engine results, and social media, e.g., Twitter, Facebook, and blogs, will be addressed. Text mining, GIS, speech analytics, and sentiment analyses will be studied. Both desktop and mobile device tools will be used to conduct these analyses.

Prerequisite(s): [(BUS 550)]

(3-0-3)

MAC 595**Special Topics in Marketing Analytics & Communication**

This course covers contemporary or cutting edge topics in the marketing analytics and communication field offered on an irregular basis typically in a seminar style. Instructor permission is required.

(3-0-3)

MAC 597**Independent Study in Marketing Analytics & Communication**

Students can conduct in-depth research, usually on an independent and solo basis, under the guidance of a full-time faculty member. Typically, a student signs up with a faculty member who is willing to supervise his/her independent research on a particular MAC-related topic. The student has to complete the independent study form, develop a one-page proposal outlining the purpose, process, and product (expected outcomes) of the independent research project, and submit it to the program director and instructor for approval.

(0-0-3)

MBA Business
MBA 501**Accounting for Strategic Decision-Making**

This course is an introduction to the basic financial and managerial accounting topics (GAAP, the major financial statements, accrual accounting, financial reporting alternatives, professional ethics, financial statement analysis, cost behavior, cost systems, short-and long-term decision-making with strategic considerations, and product costing) and a review of environmental accounting.

(3-0-3)

MBA 502**Emerging Issues in the Global Business Environment**

The course helps students understand the complexities of the globally-interconnected world of business they will be joining after graduation. It will set the background and context for their entire graduate business education. It will focus on emerging trends happening in six major components of the global business environment: political, economic, socio-cultural, technological, legal, and the natural environment. Special focus will be on ethical considerations in a cross-cultural setting. Students will be exposed to a mix of theories and managerial tools that will help them analyze the opportunities and threats within the global business environment and draw managerial insights.

(3-0-3)

MBA 504

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.

(3-0-3)

MBA 505

Contemporary Economic Analysis & Game Theory

This course applies economic principles to key decisions with organizations and solidifies intuition for understanding the business environments in which organizations operate. A key objective of the course is to develop tools useful in other Stuart courses. Economics is a key foundation for much of what is taught in finance, marketing, business strategy, environmental management, and virtually every other course in the graduate program. Economics is a way of thinking about problems, issues, and decisions that managers face in each of the functional areas of their organization. It stresses the importance of incentives in impacting human decision making and emphasizes the consideration of costs and benefits when making decisions. The course introduces and develops concepts in areas of microeconomics such as competition and market structure, incentive contracts, and pricing. Topics covered range from the most basic demand and supply models to principal-agent models and economics of information. The course will also touch on some of the primary macroeconomic topics (including GDP, inflation, and unemployment), topics in game theory (simultaneous and sequential games), and issues of ethics in economic policy-making pertaining to competitive and oligopolistic markets, pricing, and trade.

(3-0-3)

MBA 506

Leading & Managing Knowledge-Intensive Organizations

This course 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 design 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.

Prerequisite(s): [(BUS 510)]

(3-0-3)

MBA 509

Financial Management in a Globalized World

In this course, the student will learn the concepts and processes that underlie enlightened financial decision making in a global world. Students will explore how to raise debt and equity capital, how to think about what portion of earnings to retain and reinvest and whether to share some earnings with stockholders via dividend payments or repurchase of shares, how to value stocks and bonds, how to distinguish good from bad financial decision rules, how to decide which projects a firm should engage in, how to use futures, options and swaps to manage firm risk, how to ensure good corporate governance, why sustainability can be profitable while still protecting future generations, and how to manage the financial decisions required to effectively operate in a global setting.

Prerequisite(s): [(BUS 510 and MBA 501)]

(3-0-3)

MBA 511

Creating, Communicating, & Delivering Customer Value

This course provides an introduction to the practice and strategy of marketing. Marketing activities are those processes and functions that enable managers and policy-makers to identify and serve the values and needs of a customer given the capacities of the company, activities of competitors, and inherent constraints in the business environment. Marketers typically refer to these concepts as the "four C's." Based on their understanding of the "four C's," students will then learn how to implement strategy by applying the levers of the marketing mix. These elements are known as the four P's (product, price, place/channels of distribution, and promotion). The treatment of marketing constraints and marketing mix will be motivated by essential foundations from economics, sociology, and consumer behavior. Over the course of the semester, students are expected to transition from thinking about these concepts in isolation to a dynamic, integrative framework. This process includes using the marketing strategy framework to assess business and policy problems from a "multiple objective" perspective: that is, the student will be asked to think about how marketing activities along with those of competitors and collaborators will affect the profitability, sustainability, social, and ethical standing of the firm. The synthesis of these concepts will be carried out through the use of case studies, problem sets, classroom lectures, discussions, and a field project. There will also be a midterm and final exam. The pedagogical style of the course emphasizes the students' role in applying the concepts discussed in the lectures to the situations at hand. The role of the instructor is to provide tools to structure thinking and to stimulate and facilitate analysis of the cases.

Prerequisite(s): [(BUS 510)]

(3-0-3)

MBA 513**Operations & Technology Management**

The course seeks to help the student develop an understanding of the concepts and skills needed for the design and control of operations in both services and manufacturing organizations. Students will take a strategic and general management approach to the design of an operating system and its supporting organizational structure and infrastructure including information systems, human resource management, and financial policies. The focus is on the strategic role of operations and technology decisions as a source of competitive advantage for the firm with an emphasis on the integration of R & D/Design/Engineering, operations and marketing within the context of the business unit's strategy, and the organizational structure and skills needed to execute and manage the operating system. The overall goal is to create, achieve, and sustain operational effectiveness. The course will emphasize the analytical tools and techniques that are useful in making decisions about projection facilities and capacity, choices of technology and equipment, task and process design, organizational architecture, human resources policies, and the physical and managerial control of operations. Students will gain an understanding of the economics of operations including trade-offs between fixed and variable costs, marginal/incremental analysis to identify relevant versus sunk costs, optimization, and productivity measurements for both capital and labor. Case studies will provide opportunities for students to develop their skills in process design and choice, process mapping, critical thinking, identification of problems versus symptoms, process improvement, and capacity measurement in the context of the business strategy while the simulations will provide an opportunity to practice the management of a particular operating system. Students will also gain an understanding of how human behavior and organizational design, along with quantitative optimization, forms the theoretical underpinning of operations management.

Prerequisite(s): [(BUS 510)]

(3-0-3)

MBA 518**Ethics & Corporate Social Responsibility**

The corporate scandals and implosions of the past decade, climaxing in the global financial crisis of 2008, have highlighted how critical ethical and socially-responsible decision-making and leadership are to the long-term survival and success of both individual businesses and society. This course will endeavor to teach students why ethics and corporate social responsibility are not just feel-good exercises but are essential for business success in the Next Economy.

(3-0-3)

MBA 522**The General Manager**

This course is about general management, general managers, and the challenges of creating and sustaining competitive advantage by maintaining the fit between industry competitive structure, strategy, organization structure, tactics, and activities (execution) at both the corporate and the business unit levels. Students will be concerned with both the problem of choosing what businesses the firm wants to engage in (the portfolio and diversification of risks) and the task of maximizing profits in the specific businesses the corporation has chosen to enter. In some of the case discussions and the CAPSIM game, students will take the choice of business as a given and focus on how to create a strategy and the network of activities or value chain that implements/executes the strategy of the strategic business unit (SBU), taking into account the interactions and trade-offs among marketing, production, finance, engineering, and human resources decisions as the industry structure changes over time and in the context of active competitors. Students will also be looking at the corporate level choices of entering, growing, or exiting various businesses/markets, the tactics/activities used to execute corporate strategy, the organization structure issues of very large multi-business firms, and the relationships among SBUs and between corporate headquarters and the strategic business units. Completion of program core or instructor permission is required.

(3-0-3)

MBA 523**Negotiations & Strategic Decision Making**

This course is designed to foster an understanding of incentives and strategic decision-making as they apply to negotiations. The course has both theoretical and applied components with the objective of addressing both theory and skills as they apply to dyadic and multiparty negotiations, to buyer-seller transactions, to competitors' interactions, to the resolution of disputes, and to the development of negotiation strategies. The theoretical component is focused on an analytical study of strategic interactions using game theory while the applied component is based on a series of simulated negotiations in a variety of contexts including one-on-one, multiparty, and team negotiations. The objectives of the course are to provide an analytical foundation, to show where practice and theory diverge, and to provide a forum where negotiation tools in a variety of business-oriented settings can be actively applied. Instructor permission is required.

(3-0-3)

MBA 524**Leadership in Multicultural Organizations**

Managerial leadership is one of the primary drivers of an organization's success. Not surprisingly, organizations are demanding effective leadership skills from managers at all levels. This course is designed to enhance students' understanding of leadership in contemporary organizations. Students will develop a conceptual framework of effective leadership in multinational organizations. Besides discussing leadership skills and traits, particular attention will be devoted to exploring the influence of organizational and societal context on leadership. This course will be taught with an experiential learning approach. Through self-assessments, case analyses, and a variety of other exercises, students will augment their leadership skills.

Prerequisite(s): [(MBA 506)]

(3-0-3)

MBA 526

Sustainable Supply Chain Management

We will present models and practices that minimize supply-demand mismatch and therefore maximize companies' own profitability as well as models and practices of collaboration with other companies in a supply chain that minimize risk and environmental costs and therefore maximize the supply chain's sustainability. This course will have an emphasis on the integration of business and technology aspects. We will first introduce an integrated view of the production and logistics functions in organizations such as capacity analysis, inventory management, and logistics management. The course then discusses topics involved in the interaction of a firm with others players in a supply chain such as value of information, supply contracts, and risk sharing. Finally, the course will introduce models/tools enabling sustainability actions plans, for example, reducing waste in the supply chain, both upstream and downstream.

(3-0-3)

MBA 528

Healthcare Management, Technology, & Innovation

Healthcare is one of the most fundamental human problems around the world. Besides food and water, every one of the seven billion people on earth needs healthcare. Yet, the current systems of healthcare delivery have inadequacies in providing quality care to all. In this respect, technological innovations have begun to contribute creative solutions to the many problems that healthcare delivery systems face with access to care, affordability of care, and consistent quality of care. This course focuses on how the management of technology and innovation and business and strategy principles can converge to understand the trends, problems, and potential solutions to the American healthcare delivery system and to other systems around the world. The course aims to acquaint the student with the issues and potential solutions of managing the healthcare delivery system. The healthcare sector has unique characteristics as both a social and business enterprise where private and public organizations and enormous resources are involved. The student will gain knowledge about the structure of the healthcare delivery system and how technology and innovation are contributing to some solutions to its most pressing problems of access, affordability, and quality of care. The student will also gain knowledge about the key technology dimensions and forces that shape the industry.

Prerequisite(s): [(BUS 510)]

(3-0-3)

MBA 529

Social Entrepreneurship

This course gives students a practical introduction to the exciting and rapidly growing field of social entrepreneurship. The course will begin by introducing students to contemporary understandings of poverty, its causes, and traditional poverty alleviation strategies. It will then turn to key concepts regarding social ventures including entrepreneurship, organizational structures (for-profit, non-profit, and hybrid), financing, marketing, and performance assessment (social and environmental impact). We will also examine the challenges that are faced in creating and operating social enterprises in different parts of the world. The course includes guest lectures by other Stuart School of Business faculty and social entrepreneurs working in different areas (such as health, education and environment). Students will gain hands-on experience by either developing a business plan for a social enterprise to address a specific real world problem or assisting an existing social venture in developing a business plan geared towards an expansion of its services. It is expected that the plans can be entered into a variety of social venture competitions.

(3-0-3)

MBA 554

Project Management

This course addresses both analytical and behavioral skills for effective project management. You will learn how to select a project portfolio, develop a work breakdown structure, estimate task times and costs, allocate and level resources, prepare Critical Path and PERT analyses, and assess earned value project performance. A leading project management tool, e.g. MS Project, will be used for project management exercises. Much of the course content will be drawn from the Project Management Institute common body of knowledge and certification program. Management of project risks, structure, team building, and conflict will be addressed. A project management simulation game provides an opportunity to apply your team-based skills. A variety of project management cases across industries will be studied.

Prerequisite(s): [(BUS 510)]

(3-0-3)

MBA 564

Competing in Emerging Markets

For Western MNCs, some of the most intriguing growth opportunities in the Next Economy exist in low-income segments, the so-called markets at the bottom of the income pyramid, in emerging and underdeveloped countries of the world. Historically, MNCs targeted the customers at the top of the pyramid in these countries because their business models worked well for them. But as these bottom-of-the-pyramid markets become more economically profitable, MNCs need to make a serious attempt to evaluate and target them. In order to successfully compete for customers in these markets, MNCs should design innovative business models that could represent a radical departure from the way they do business in more advanced countries. This course is about such business model innovation. Students will learn tools of international market opportunity analysis, foreign market entry strategies, the social, economical, and ethical factors affecting decisions to serve low income customers, the stringent requirements of the customers at the bottom of the pyramid, and business models to profitably serve these customers.

Prerequisite(s): [(BUS 510)]

(3-0-3)

MBA 566

Understanding China: History, Politics & Economics

While the 21st century may or may not be called the Chinese century, there is no doubt that China has become a dominant political, economic, and business force on the global stage. The fastest and the largest markets for many products and services are located in China. The supply chains for most manufacturing industries pass through China. Increasingly, China is becoming the base for high value-added activities, such as research and development. The center of economic gravity is shifting to China, and every aspiring business executive needs to understand China and how to do business with it. In this course, students learn about China's history, politics, and economics. Instructor permission is required.

(3-0-3)

MBA 567

Chinese Language & Culture

The course provides non-Chinese business people an understanding of the Chinese language, culture, ethnic diversity, and traditions. Understanding culture is an essential first step to understanding business practices and customs. So the ultimate objective of this course is to help non-Chinese business people understand how to effectively deal with Chinese customers, suppliers, and business partners.

(3-0-3)

MBA 569**Competitiveness of Asian & Western Enterprises**

This course helps students understand the economic context within which Asian enterprises and Western enterprises evolved and how they tend to compete on very different factors. While many business principles are universal, the key drivers of competitiveness differ substantially between Asian and Western enterprises. More importantly, within these groups there could be significant nationality-based differences. The course provides an insightful comparative study of companies based in opposite ends of the world and helps students understand why they employ different sets of strategies to compete and succeed on the global stage. Instructor permission is required.

(3-0-3)

MBA 570**Business Study Mission to China**

China has become a major business destination for companies around the world. The success of managers and entrepreneurs around the world today may depend on how well they do business with Chinese customers, suppliers, and partners. One of the best ways to understand this is through immersion. This course involves a business study mission trip to some of the epicenters of Chinese business, such as Shanghai. Students will be able to visit foreign and local manufacturing and service companies located in China, listen to business leaders and government officials, and enjoy the cultural immersion experiences. Students will attend several briefing sessions prior to the visit and a debriefing session following the visit. Instructor permission is required.

(3-0-3)

MBA 575**Creativity & Contemporary Entrepreneurial Opportunities**

Entrepreneurship focuses on the concepts, skills, know-how, information, attitudes, and alternatives that are relevant for start-up and early-stage entrepreneurs, entrepreneurial managers, and the relevant stakeholders. Specifically, this course provides an introductory overview of the knowledge and skills needed for the identification, evaluation, and exploitation of opportunities in a variety of circumstances and environments. It concentrates on the study of various innovative thinking in strategy, identifying and screening a business opportunity, developing business models, preparing business plans, securing financing, and managing high-growth firms. It integrates knowledge gained from the prior core business courses (i.e., management, marketing, finance, and accounting) to sharpen the student's ability to think strategically, innovatively, and entrepreneurially and to form new ventures. Further, it is a course that mixes theory with practices covering industries such as computer, cell phone, biotech, and wireless, to name just a few. Students will be challenged to apply principles, concepts, and frameworks to real world situations, culminating in a formal business plan.

Prerequisite(s): [(BUS 510)]

(3-0-3)

MBA 576**Creating & Financing New Technology Ventures**

The course concentrates on the study of entrepreneurship, preparation of business plans, methods for evaluating and screening new venture ideas, formulation and implementation of business strategies for new ventures, development of a business plan, the financing of new ventures, and venture growth strategies and exits. It integrates knowledge gained from the prior core business courses (i. e., management, marketing, finance, and accounting) to sharpen the student's ability to think entrepreneurially and form new ventures. The course will also focus on identifying, examining, and evaluating various sources of original and growth capital. Emphasis will be on legal, financial, and tax issues related to capital formation as well as specific problems experienced by the small-to-medium-sized firm undergoing rapid growth in the high technology space. Topics discussed will include venture valuation, financing startups, financial planning and strategy, going public, selling out, and bankruptcy. A formal proposal for capital acquisition developed through field research will be required of each student.

Prerequisite(s): [(BUS 510)]

(3-0-3)

MBA 577**Got Creativity?: Strategies & Tools for the Next Economy**

This class will look at creativity from three broad perspectives: personal creativity (how to think about this as a personal skill to be enhanced and trained); organizational creativity (why it is job #1 for EVERY organization and how we can systematically enhance the innovation outputs of the enterprises we work for); and civic creativity (how to lift creativity and innovation into sustainable policies for our cities and regions). We will mix presentations with performances. We will have experts visit the class. We will get up on their feet and do small group work and creativity exercises. We will visit creativity hot spots around Chicago and learn first-hand from our leaders on how to make environments that nourish innovation. We will learn about and work on 13 distinct personal creativity competencies. Finally, we will work in teams on special projects and present.

(3-0-3)

MBA 581**Marketing Research & Engineering**

The course is roughly divided into thirds which track the standard market research process: define the problem and design a research plan; develop appropriate primary research tools (primarily survey design and implementation); and analysis and presentation. Marketing engineering focuses on specific data driven marketing tools, regression, cluster analysis, conjoint, etc., and their application to specific marketing problems (segmentation and targeting, new product design, and forecasting). The market research process will be taught backwards from analysis to data acquisition with the aim that students will have a working understanding of their analytical goals by the time they begin their projects and can therefore establish sensible research objectives with an eye to expected use for the data.

Prerequisite(s): [(MBA 511)]

(3-0-3)

MBA 586

Strategic Marketing Management

In this course we will emphasize both marketing strategy formulation and execution and the management of the marketing function. This includes the integration of marketing mix decisions, the longer-term effects of marketing mix decisions, and changes in the mix over time. For example: "Price" becomes price policy, value-in-use, and price discrimination; "Product" becomes product line breadth and variety and product life cycle choices; "Place" becomes the design and control of single or multiple channels of distribution; and "Promotion" becomes communications, customer loyalty, and brand equity. The course will emphasize segmentation of the market, positioning the marketing mix to meet the needs of the market segment, sustaining an integrated marketing mix over the product life cycle, and organizing the strategic business unit to implement the strategy. In addition to the development of a marketing strategy that positions the product/service to the needs of one or more target markets (segmentation), the execution of a marketing strategy will require a marketing plan that includes the economic and financial analysis of the costs and potential profits of the strategy and an implementation plan, including an organizational structure. This will often be an iterative process to find an optimal combination of costs, pricing, and volume to maximize profits. This course will use readings, simulations, and cases for about half its content. The other half of the course will be a team consulting project for an external client.

Prerequisite(s): [(MBA 511)]
(3-0-3)

MBA 587

Nonprofits & 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)

MBA 588

The Nonprofit Sector

Considers the role played by the nonprofit 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)

MBA 589

Regulatory Politics & Contemporary Business

Regulatory activity remains government's major point of interaction with both business and citizens. Government regulation affects a myriad of activities and is the primary function of public administration. Regulation is a key variable of American economic activity, an issue of global concern, and an expanding field of modern jurisprudence. This course is intended to provide an understanding of regulatory activity as influenced by changing social, technological, and economic conditions within a context of dynamic political culture. It will familiarize students with a range of concepts concerning the role of positive government and the growth of the American administrative state. The course will present regulation as a process and examine the role of government, business, and citizen interest group in regulatory development. It will present various types of regulatory activity and review federal, state, and local regulatory networks and responsibilities. The course will also examine the evolution of constitutional interpretation and the subsequent adaptations of American law to facilitate changing and regulatory actions.

(3-0-3)

MBA 595

Special Topics: MBA Program

Special topics in business administration.

(3-0-3)

MBA 597

Independent Study in Business Administration

Independent study in business administration.

(Credit: Variable)

Master of Science in Finance

MSF 501

Mathematics with Financial Applications

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, summations, 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).

(3-0-3)

MSF 502

Statistical Analysis in Financial Markets

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.

(3-0-3)

MSF 503**Financial Modeling**

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 simulations 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.

(3-0-3)

MSF 504**Valuation & 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. The course places a special emphasis on the relationship between macroeconomic conditions and investment opportunities.

Prerequisite(s): [(MSF 501, MSF 502, and MSF 503)]

(3-0-3)

MSF 505**Futures, Options, & 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.

Prerequisite(s): [(MSF 501, MSF 502, and MSF 503)]

(3-0-3)

MSF 506**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(s): [(MSF 501, MSF 502, and MSF 503)]

(3-0-3)

MSF 524**Models for Derivatives**

The practice of financial engineering requires skill in financial theory and practice, mathematics and programming. This course includes instruction in all of these areas. In this class, students will learn mathematical and computational methods that are applicable to the pricing and risk management of derivatives. The class provides an introduction to options pricing theory, covering stochastic calculus, the Black-Scholes partial differential equation, risk-neutral valuation and hedging portfolio replication. The course will focus on important numerical techniques used in finance, including variance reduction techniques in Monte Carlo Simulation and finite difference methods applied to partial differential equations. These methods will be applied to the pricing of exotic options. In this class, students will learn to program and implement financial models in Matlab.

Prerequisite(s): [(MSF 504 and MSF 505)]

(3-0-3)

MSF 525**Term Structure Modeling & Interest Rate Derivatives**

Upon completion of this course, students should know the strengths, weaknesses, appropriate uses, and ways of implementing the major term structure models that are in common use. The course will begin with bootstrapping of forward curves, principal component analysis, and a review of basic fixed income derivatives (swaps, swaptions, caps, and floors). We will then implement short rate models, such as Ho-Lee, Black-Derman and Toy, and extended Vasicek/Hull-White, followed by the Helath-Jarrow-Morton model and market rate models. Students will implement these term structure models in Excel/VBA and Matlab.

Prerequisite(s): [(MSF 504 and MSF 505)]

(3-0-3)

MSF 526**Computational Finance**

Computational finance.

Prerequisite(s): [(MSF 504 and MSF 505)]

(3-0-3)

MSF 534**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.

Prerequisite(s): [(MSF 504, MSF 505, and MSF 506)]

(3-0-3)

MSF 535

Investment Banking

This course covers the financing and formation process of private companies from product concept and angel investors to the Initial Public Offering. Exit strategies for private investments are discussed, including IPOs, mergers and acquisitions. Strategic and financial buyers play a key role in the valuation of a newly public or recently acquired firm. All of the players are discussed, including venture capitalists, entrepreneurs, investment bankers, attorneys, public shareholders, merger partners, institutional investors and private equity/buyout firms. Students will discuss business models; construct staffing and compensation schemes; practice valuation analysis; compare and contrast alternative financial sources; structure business plans; review the types of securities to offer; examine private placement processes; analyze negotiation strategies; and review the implications of financing terms and the role of venture capital and private equity investment in institutional portfolios. The challenges of completing mergers and integrating merged companies are also discussed. Sarbanes-Oxley, anti-trust requirements and other regulatory issues will be presented.

Prerequisite(s): [(MSF 504, MSF 505, and MSF 506)]
(3-0-3)

MSF 543

Alternative Investments

Alternative investments include real estate, hedge funds, managed futures, and emerging markets. They are attractive to institutional investors because they exhibit a low correlation with traditional investments in stocks and bonds. However, they must be approached cautiously because of specific difficulties in valuing these assets. This course will explore a variety of alternative investments and their role in investment strategies.

Prerequisite(s): [(MSF 504 and MSF 505)]
(3-0-3)

MSF 544

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. It also covers relative valuation measures such as price/earnings and price/sales ratios. The valuation techniques taught in the course will be applied to the valuation of equity shares, corporate bonds, and derivatives such as stock options and convertible bonds. Completion of a comprehensive analysis of a public company is a requirement for the course. This course is recommended for students who are planning on sitting for Certified Financial Analyst (CFA) qualification.

Prerequisite(s): [(MSF 504, MSF 505, and MSF 506)]
(3-0-3)

MSF 545

Structured Fixed Income Portfolios

This course will cover the characteristics, valuation and risk management of fixed income instruments. These instruments include bonds, repos, interest rate derivatives, inflation indexed securities, mortgage-backed and asset-backed securities, CDOs and default swaps. The focus will be on understanding how these instruments are structured and used. Term structure modeling and hedging techniques will be presented, with a minimum of mathematics.

Prerequisite(s): [(MSF 504 and MSF 505)]
(3-0-3)

MSF 546

Quantitative Investment Strategies

This course develops the primary quantitative tools used in the portfolio selection process. The applied focus of the course centers on the process of moving from a data set of historical information to the formulation of a forecasting model, the estimation of mean-variance efficient portfolios, and the testing of efficiency hypotheses within an in-sample and post-sample setting. The course covers the estimation of efficient portfolios, factor models, forecasting models, and risk analysis.

Prerequisite(s): [(MSF 504 and MSF 505)]
(3-0-3)

MSF 549

Commodities & Managed Futures

Commodity markets have experienced dramatic growth and increased institutional investment in recent years. This course explores cash and futures markets in energy, grains, metals and soft commodities, as well as equity investments in commodity related firms. Students will explore the role of hedgers, speculators and institutional investors in commodity markets. The value of commodities in the institutional portfolio will be presented, which may allow hedging against inflation and the risks of declining stock and bond prices. Commodity trading advisers, commodity pool operators and the managed futures industry will be discussed. These fund managers initiate both long and short positions in futures markets, typically constructing portfolios from either a systematic or discretionary perspective.

Prerequisite(s): [(MSF 504 and MSF 505)]
(3-0-3)

MSF 554

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 payoffs 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.

Prerequisite(s): [(MSF 504, MSF 505, and MSF 506)]
(3-0-3)

MSF 555

Credit Risk Management

The extensive use of leverage by individuals, corporations, hedge funds and private equity managers has led to a significant increase in the demand for models that analyze credit risk exposures. For many users, the credit risk function has evolved from models used to analyze the quality of an individual borrower to models that aggregate exposure across borrowers, industries and geographic regions. This course provides an extended overview of the exciting and rapidly developing field of credit risk analysis.

Prerequisite(s): [(MSF 554)]
(3-0-3)

MSF 556**Enterprise Risk Management**

This course follows up on FIN 581 (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.

(3-0-3)

MSF 564**Financial Theory**

This course covers the foundations of financial economics and the theoretical underpinnings of contemporary asset pricing models. We will explore the many uses and extensions of the fundamental pricing equation: $P_t = \mathbb{E}_t \left[\frac{P_{t+1}}{1+r} + \frac{D_{t+1}}{1+r} \right]$, where P_t is the current price, \mathbb{E}_t is the pricing kernel or stochastic discount factor, and D_{t+1} is a future random payoff. The art of asset pricing is in how one specifies the functional form of the pricing kernel. With different assumptions yields the Capital Asset Pricing Model, the Consumption-CAPM, the Black-Scholes-Merton option-pricing model, and many popular term structure models. The Consumption-CAPM does not fair well in the empirical literature motivating the study a promising group of next-generation risk/return models. The latter part of the course will be devoted to continuous-time asset pricing of options and the modeling of the term structure. The emphasis will be on risk-neutral, Martingale pricing methods, rather than solving partial differential equations. This material is a theoretical complement to the Computational Finance and Financial Modeling sequences.

(3-0-3)

MSF 565**International Finance Theory**

This course will focus on the determination of prices, interest rates and exchange rates within the context of neo-classical equilibrium models. The theoretical foundations of the course will be supplemented by extensive exercises in econometric testing of maintained hypotheses and exercises in real time trading.

(3-0-3)

MSF 566**Time Series Analysis**

This course develops a portfolio of techniques for the analysis of financial time series. Distribution theory covers the normal, student T, chi-squared, and mixture of normal 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(s): [(MSF 504 and MSF 505)]

(3-0-3)

MSF 567**Bayesian 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 deficiency early in the course.

Prerequisite(s): [(MSF 504 and MSF 505)]

(3-0-3)

MSF 574**.NET & Database Management**

The course provides students with a comprehensive knowledge of .NET (VB and C#) programming, relational database design and SQL as they apply to quant finance and real-time trading. Specifically, topics covered include the .NET framework and libraries, ADO.NET, OOP, generics, market data feeds, XML and the Unified Modeling Language, as well as an overview of the hardware and network infrastructure necessary to enable electronic trading.

Prerequisite(s): [(MSF 504 and MSF 505)]

(3-0-3)

MSF 575**C++ with Financial Markets**

This course presents the C/C++ programming language. Students learn the language from the ground up, from data types, to functions, arrays, classes, dynamic memory management, data structures and the Standard Template Library. Object-oriented programming is also discussed, including a review of commonly used design patterns. The focus is to understand C/C++ as it applies to financial mathematics and several practical examples from computational finance are presented.

Prerequisite(s): [(MSF 504 and MSF 505)]

(3-0-3)

MSF 576**OOP & Algorithmic Trading Systems**

In this course, students learn advanced programming topics in .NET for real-time financial applications and automated trading systems, including multithreading, sockets, APIs, synchronization, the FIX and FAST protocols, and object oriented design for event-driven applications. Also, project management and software quality are covered in depth. Lastly, topics related to latency in real-time financial applications and alternative network architectures are also discussed. Students are expected to propose, design, document and develop an original project combining concepts from quantitative finance and trading strategy (presented in other courses) into a working software application.

Prerequisite(s): [(MSF 504 and MSF 505)]

(3-0-3)

MSF 577**High Frequency Finance**

High frequency trading is concerned with the development of robotic trading algorithms within a real time market environment. This course will be concerned with the development of high frequency models and the assessment of their performance.

Prerequisite(s): [(MSF 504 and MSF 505)]

(3-0-3)

MSF 584**Equity & Equity Derivatives Trading**

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.

Prerequisite(s): [(MSF 504 and MSF 505)]
(3-0-3)

MSF 585**FOREX & Fixed Income 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 may be introduced.

Prerequisite(s): [(MSF 504 and MSF 505)]
(3-0-3)

MSF 591**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.

Prerequisite(s): [(MSF 504 and MSF 505)]
(3-0-3)

MSF 593**Market Microstructure**

Market microstructure is one of the youngest but most rapidly growing areas of finance. It focuses on the organization of traded markets, including those for equities, bonds, money market instruments, foreign exchange and derivatives (including futures, options and swaps). It explores the concepts of liquidity, transparency, the information content of bids, offers and trades, information asymmetries, order flow externalities, principal-agent problems, the design of markets, the rules of markets, the volatility of markets, the failure of markets, the regulation of markets and the costs of trading. Empirical work in this area typically involves huge datasets. Students will leave this course with a thorough understanding of the structure of the markets in which they will likely spend their careers.

Prerequisite(s): [(MSF 504 and MSF 505)]
(3-0-3)

MSF 595**Entrepreneurial Finance**

Most new ventures are not created by financial analysts. However, the success of a new venture is vitally dependent upon the strength of its financial controls. Knowledge of finance is also an important determinant of an entrepreneur's ability to convey information about his company to banks, regulators, and potential investors. This course provides entrepreneurs with the financial knowledge that they require to create successful new ventures.

Prerequisite(s): [(MSF 504, MSF 505, and MSF 506)]
(3-0-3)

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., Metron'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.

Prerequisite(s): [(ACCT 501) OR (MSF 532)] AND [(MSF 521 and MSF 551)]
(3-0-3)

MSF 597**Independent Study in Finance**

Independent study in finance.
(Credit: Variable)

MSF 598**The Venture Capital Process**

Venture Capitalists are involved with the funding of new enterprises. The funding process begins with the review of a business plan submitted by the enterprise. If the business plan is accepted, the venture capitalist must then decide on the form of financing, the participation in the enterprise, and the compensation structure for the new enterprise. The course will introduce students to the process of venture capital financing and will allow them to participate in the process by reviewing actual business plans submitted by the entrepreneurs. Students will be required to evaluate the business plans and determine the type and quantity of financing to be provided.

Prerequisite(s): [(MSF 504, MSF 505, and MSF 506)]
(3-3-3)

MSF 599**Special Topics in Finance**

Special topics in finance.
(3-0-3)

Professional Communication Advancement

PCA 500

Professional Communication

Professional communication.
(3-0-3)

PCA 510

Communication Essentials

This course will prepare students to communicate effectively with native speakers in a variety of settings by teaching language strategies, phrases, linguistic structures, and vocabulary in English. The course will focus on initiating, maintaining, and ending basic conversations. Understanding cultural context and responding appropriately will be emphasized. Prerequisite: Department approval only; determined by assessments.

(1.5-0-1.5)

PCA 515

Strategies for Effective Communication

Students will incorporate subject material learned in PCA 510 and use the knowledge gained to develop higher communicative fluency in order to discuss topics with more competency. This course will focus on developing students' ability to build and sustain communication across a variety of settings with an emphasis on asking for and providing information, expressing feelings, asking for and giving advice, and asking for and giving opinions. Prerequisite: Department approval only; determined by assessments.

(1.5-0-1.5)

PCA 520

Advanced Communication Skills

Students in this course will learn higher-level communication strategies necessary to communicate in various settings and for a wide range of purposes – academic, business, and social. Students will learn language and cultural strategies for effectively working as a team. Prerequisite: Department approval only; determined by assessments.

(1.5-0-1.5)

PCA 525

Advanced Presentation Skills

Students will incorporate course material learned in PCA 520 to practice speaking and presenting on a wide variety of topics including subject matter currently being learned and discussed in their business classes. By the end, students will present complex and detailed presentations working on sophisticated vocabulary and advanced communication skills. Prerequisite: Department approval only; determined by assessments.

(1.5-0-1.5)

PCA 527

Foundations of Academic Writing

Students will learn to write effective, organized, and coherent paragraphs and a variety of writing assignments following the deductive organizational structure used in academic English. Students will learn how to use standard academic vocabulary and appropriate word forms to express their ideas effectively in writing. The following topics will be taught in the course: vocabulary expansion; editing skills; unity and coherence in writing; and paragraph structure. Prerequisite: Department approval only; determined by assessments.

(1.5-0-1.5)

PCA 530

Academic Writing I

Students will learn to write effective, organized, and coherent academic paragraphs and essays in English. Students will learn and practice ways to express themselves clearly in writing. The following topics will be taught: brainstorming and planning; topic sentences and thesis statements; transitional words and phrases; the American organization style; grammar; proofreading; and editing. Prerequisite: Department approval only; determined by assessments.

(1.5-0-1.5)

PCA 540

Academic Writing II

In this course, students will build on paragraph development to write essays with greater complexity and logical organization of outside support. Students will learn to develop critical and analytical skills through the essay writing process using proper reference and citation techniques. This course includes a review and refinement of English grammar to produce clear, concise, and polished academic writing. Prerequisite: Department approval only; determined by assessments.

(1.5-0-1.5)

PCA 550

Business Writing

Students in this course will learn the higher-level business writing tasks and writing skills needed to effectively communicate using various business formats. Students will learn and practice appropriate language structures, phrases, and vocabulary commonly used in American business writing. Prerequisite: Department approval only; determined by assessments.

(1.5-0-1.5)

PCA 560

Prof Commn Adv - Presentation

Presentation.

(1.5-0-1.5)

PCA 570

Pronunciation

1.5 credit hours. Students will learn pronunciation strategies to communicate more effectively with others in English. There are many individual components necessary for good English pronunciation including vowel and consonant sounds, word stress and rhythm, sounds in connected speech, and intonation. Students will learn what these components are and be taught strategies for using them in their everyday communication. Students will be responsible for practicing these strategies in and out of class. Prerequisite: Department approval only; determined by assessments

(1.5-0-1.5)

PCA 594

Professional Communication Advancement Independent Study

Full or half-semester course. Independent study to meet the special English communication needs of Stuart graduate students. Subject matter will vary with the backgrounds and skill levels of students. Requires written consent of the instructor.

Public Administration

PA 501

Essentials for Public Management in a Complex Society: Processes, Structures, & Values

This course provides an understanding of the fundamental theories, key practices, and underlying issues that provide the framework for contemporary American public administration. It will discuss the political and administrative values affecting the theory and practice of public administration in the United States; review the historical development of American public administrative systems and processes; examine key issues facing public administrators in the light of both traditional and contemporary values and views; critically evaluate administrative approaches to public service delivery; and explore contemporary strategies to address critical problems in a rapidly changing world, such as new public management, public private partnerships, and strategic competitiveness.

(3-0-3)

PA 502

Leading & Managing Knowledge-Intensive Organizations

PA 502 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.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 503

Administration Law

This course considers the role of statutes, case law, and administrative law in the establishment, operation, and control of public agencies. It also 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(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 505

The Law & the Nonprofit Sector

This course is an examination of 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.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 506

Managerial Economics

This course examines the behavior of firms and households and the determination of prices and resource allocation in market economy. Topics include empirical demand, production and cost functions, monopoly, oligopoly, and pricing practices.

(3-0-3)

PA 507

Contemporary Issues in International Business

To operate in the complex environment of a globalized world, managers must develop an in-depth understanding of current events. The international business professional must develop an appreciation for topics such as the OPEC oil cartel, international risk analysis, technological advances as a driver of global markets, major international strategies, cross-cultural competence, the political economy of modernization, collaborative ventures, and international acquisitions. The course also provides rigorous economic analysis of the modern theory of trade as well as government trade policies. It deals with the factors that determine the exchange rate systems. Furthermore, the course analyzes the crises in emerging markets and the need to revamp the international financial system. In the areas of trade, topics covered include: the Doha round, economic integration (i.e. the EU, free trade areas), and the meteoric rise of sovereign wealth funds (SWF).

(3-0-3)

PA 509

Integrative Practicum for Effective Leadership in Public & Nonprofit Organizations

PA 509 is a capstone course where students apply concepts and theories they have studied to analyze an organizational or policy problem and deliver a report that normally specifies the problem or task, defines alternatives, and proposes recommended course of action. The recommendation will be supported by reasons and evidence. PA 509 should be taken in the student's last semester.

Prerequisite(s): [(PA 580*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 510

Managerial Communications

This course provides hands-on training and practice in the 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.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 511

Comparative Public Administration

This course provides an introduction to comparative analysis of systems of public administration in selected nations, including Great Britain, Japan, China, and major non-governmental organizations such as the European Union and the United Nations. The nations and organizations discussed will be compared to each other and to the United States. Areas explored will include: the historical antecedents of current national administrative systems (including the development of the nation-state), public administration models and structure in both developed and developing nations, the relationship between bureaucracies and political systems, the rise of the international nongovernmental organization, and the impact of corruption on public administration.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 512**Public Advocacy**

The goal of this course is to assist students functioning as strong advocates in their future careers and to help them prepare for their thesis or final project presentation. This is an advanced research and writing course. Public Advocacy is the study of effective argument. The course is designed to allow students to focus their prior learning experiences through problem analysis and advocacy. Using individual topics, students will address the problems of advocacy including different types of advocacy situations requiring different information, analyses, and presentations. Substantive topics of current interest and controversy will be discussed in the context of developing and advocating a particular position.

(3-0-3)

PA 514**Government Management & 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(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 516**Information Technology in Public Administration**

The course has the learning objective of becoming aware of the general management challenges that the use of information technology presents for governments and to be able to develop appropriate policies that address these challenges. Upon completion, students should be able to apply best practices to the management of computer hardware, software, networking, and other technologies in government and appreciate how the use of electronic government technology can transform government and be able to help governments develop and manage effective programs of e-government use.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 522**Effective Management of Human Resources in Environments of Scarce Resources**

This course focuses on human resource planning, recruitment, examination, and promotion of procedure. It familiarizes students with the key human resources management factors involved in supervising employees as well as collective bargaining, affirmative action, and employee productivity and performance evaluation. It is directed towards practical applications in dealing with these topics as managers and employees working in their teams or individually and covers employee professional responsibility and behavior. Students in this class will learn to utilize human resource planning, recruiting, interviewing and selection processes to improve organizational outcomes; analyze the legal/cultural aspects of personnel when making organizational decisions; identify the key components of performance management to improve themselves and their direct reports; develop specific solutions to solve critical workplace personnel issues; and apply a variety of motivation and team performance techniques in current and future organizational settings.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 532**Managing Public Financial Resources in a Changing World**

Managing Public Financial Resources in a Changing World exposes students to fundamental concepts and strategies of public financial resource management in a rapidly changing fiscal environment. It provides students with the concepts and skills needed to evaluate budget processes and documents, understand the role of politics and planning in financial management, and to evaluate the financial condition of governments. Emphasizing best practice models and case studies, the course will focus primarily on local government finance with some reference to state government policies and practices. Some references also will be made to nonprofit budgeting accounting practices.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 533**Advanced Financial Management for Public & Nonprofit Sectors**

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(s): [(PA 532*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 534**Financial Management in the Nonprofit Sector**

Nonprofits are business organized on many of the same principle 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.

Prerequisite(s): [(PA 532)]

(3-0-3)

PA 535**Resource Development in the Nonprofit Sector**

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.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

PA 536**Strategy & Structure: Homeland Security**

This course introduces the student to the National Strategy for Homeland Security and describes the structure under which it was originally designed, the events that have affected the original concept and the various changes that it has undergone since the events of 09/11/2001. The student will become intimately acquainted with the key legal parameters affecting HS and the government components involved in HS operations, enforcement and intelligence. An emphasis on the overall integration of state, local, tribal, and private sectors will enable the student to apply the tenets of HS to their own individual situations. Other topics will include an understanding of how to conduct Threat Assessments as well as a cursory understanding of the Intelligence Cycle.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

PA 537**Crisis Management & Homeland Security**

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 issues related to homeland security, awareness on the types of threats (damage to building 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 operation; weapon effect; 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 passive/active security system for a given facility and develop post event search and rescue operations.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(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.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

PA 539**Local Government Management**

This course 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 & budgeting in local government, and ethics in the profession will be examined.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

PA 540**Public Sector Dispute Resolution**

This course will introduce you to the formally accepted varieties of resolving disputes without going to court: negotiation, mediation, fact-finding, mini-trials, court sponsored settlement procedures, and arbitration. We will focus on process: what each term means; how the different processes work and compare with one another; when they can and cannot be used more effectively and how; and what considerations, techniques and/or factors make each kind of process work best. This is a survey course to give a general idea of the different kinds of alternative dispute resolution methods. Although simulations are used it is not equivalent to a full skills training program. Note: This course is also applicable to the nonprofit sector.

(3-0-3)

PA 541**Performance Measurement in Nonprofit & Public Management**

Performance management is a process of measuring progress toward specific organizational goals and objectives through the use of quantitative indicators of efficiency, effectiveness and quality. It is an essential tool that can help nonprofit and government leaders and staff plan and manage the programs and services they offer to customers, clients, and the public. This is an applied course which will help students understand performance management concepts, develop specific performance measures, and apply performance management techniques to solve real world problems in both the nonprofit and public sectors.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

PA 543**Public Policy, Nonprofits, & Philanthropy**

This course 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.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

PA 550**Social Entrepreneurship**

This course gives students a practical introduction to the exciting and rapidly growing field of social entrepreneurship. The course will begin by introducing students to contemporary understandings of poverty, its causes, and traditional poverty alleviation strategies. It will then turn to key concepts regarding social ventures including entrepreneurship, organizational structures (for profit, nonprofit, and hybrid), financing, marketing, and performance assessment (social and environmental impact). We will also examine the challenges that are faced in creating and operating social enterprises in different parts of the world. The course includes guest lectures by the Stuart School of Business faculty and social entrepreneurs working in different areas (such as health, education, and environment). Students will gain hands-on experience by either developing a business plan for a social enterprise to address a specific real world problem or assisting an existing social venture in developing a business plan geared towards an expansion of its services. It is expected that the plans can be entered into a variety of social venture competitions.

(3-0-3)

PA 551**Public Infrastructure Management**

This course 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 relationship between the engineering, administrative, and political aspects of public works management. Focuses on critical infrastructure issues through case studies.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 552**Human Services Policy & Administration**

This course examines the major issues associated with the administration and operation of social welfare and health services in the United States by governments and nonprofit organizations. It is 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.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 553**Public Safety Administration**

This course 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.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 555**Introduction to Urban & Regional Planning**

The subject of this course is 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, and 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.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 556**Public Management Strategies for the 21st Century**

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.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 557**Urban & Regional Development**

This course 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.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 558**Energy & Environmental Policy**

This course requires successful completion of at least one other course marked with a satisfaction of IIT's Basic Writing Proficiency Requirement. This course places energy and environmental policy in domestic and global contexts. It also traces the economic and political implications of dependence on fossil fuels and the attempt to develop alternate energy sources and promote conservation. It assesses the environmental effects of resource consumption and the effort to control these effects by increased efficiency and regulation of pollution, and explores such problems such as nuclear waste, acid rain, global warming, and deforestation. Finally, it examines national and international attempts at economic, political, and technological solutions.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(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.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

PA 560

Political Economy

This course is an introduction to political economy exploring the relationship between economy and government or political system. Role of the state, role of the market, and impact of 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. The impact of the political and economic institutions on the problems of public administration at both the national and state level will be covered as well as the appropriate role for administrators, elected officials, and private sector leaders in the formulation of political and economic policy.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

PA 561

The Political Process & Administration

This course addresses the relationship between democratic institutions and processes of American politics and the administrative agencies of government. It also examines obligations of citizenship, influence of private interests (especially economic) on public purposes, and effects of demographic, economic, and technological change on self-government.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

PA 562

Urban & Metropolitan Government

This course analyzes the decision-making process in urban and metropolitan government. It is designed to emphasize the role of elected and appointed officials, business, organized labor, community organizations, and the electorate. It also focuses on the major problems of city-suburban relations.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

PA 565

The Nonprofit Sector

This course considers the role played by the nonprofit 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.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

PA 566

Nonprofits & the Public Sector

Nonprofits and the Public Sector provides an overview of the complex and important relationship between government and nonprofits. This course includes a review of the history, funding schemes, the differences between grant and contract funding, recent trends, and more.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

PA 567

Regulatory Policy & Politics

This course examines the changing role of government regulation of private and public activities from a political and administrative perspective. It also explores the reasons for growth and reform of economic and social regulation and investigates the regulatory process including standards for rule-making and the involvement of organized groups and the courts.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

PA 568

Strategic Competitiveness in the Public Sector

This course is a strategy, competitiveness, and leadership laboratory for public sector managers and leaders of the 21st century. Students will gain an understanding of IIT Stuart's unique core concept of strategic competitiveness as well as frameworks from theories of entrepreneurial government, strategic management, and economic competitiveness. Students will critically analyze conventional frameworks for relevance to various contexts across the public sector in the rapidly changing Next Economy. Cases discussing the public sector's efforts to transform its management processes to meet the challenges of the Next Economy and to successfully interact with the business community are emphasized. The course employs a dynamic classroom environment using case method, class discussions, and group projects. Students will appreciate the challenges, complexities, and characteristics needed to effectively lead and be successful in the competitive global economy by delving into questions such as: How do countries, regions, states, and cities compete in the global economy? How do public leaders create innovative economic development strategies by influencing firms' strategic decisions regarding investment and trade? How can public leaders enhance the competitiveness of their business environment by adopting entrepreneurial government strategies? What are best practices for economic development in the Next Economy?

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

PA 570

Social Capital & the Community

The 21st century confronts the public sector with new challenges and opportunities. Many of these challenges and opportunities will take place on the community level, and many of those challenges and opportunities will be centered on the notion of social capital and the community. Social capital means the building of and use of community assets – those resources available to the community through its residents or citizens, association, institutions, and economic life. Using an asset-based community development approach, the objective of this course is to help the student understand and use the concepts of asset-based approaches to social capital and community as it relates to public administration.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

PA 577**Topics in Public Management**

This reading and seminar will focus on a contemporary topic in public administration or policy. Subject matter will change in successive offerings of the seminar.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(Credit: Variable)

PA 578**Planning, Policy-Making, & the Built Environment**

This course introduces students to governmental planning, policy-making, and their impact on the built environment. Using Chicago and nearby municipal areas as examples, the course acquaints students with the basic theories of urban and regional planning and development, and the regulatory tools and techniques used by government to impact the built environment. The course also includes material on housing, environmental protection, brownfields, historic preservation, new-urbanism and growth management, and various policy-making processes that determine governmental policies intended to influence the built environment.

(3-0-3)

PA 579**Ethics & Professional Responsibility in Public Service**

This course focuses on the ethical problems and issues faced by individuals in public service organizations. It also examines questions related to corruption, abuse of power, financial impropriety, ethics codes and standards in government and professional fields, whistle-blowing, and other topics related to front-page concerns and individual problems of conscience and judgment. The course traces the growth of concern about the standards of ethical behavior in government in the U.S.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 580**Policy Evaluation Analytics**

This course will present a variety of tools and techniques to evaluate existing programs and policies to determine and measure their most important elements, and to give policy-makers the necessary information to fund, improve or terminate programs based on empirical evidence regarding factors such as cost/benefit, efficiency, effectiveness, equity, and other important characteristics. Evaluation can also allow policy-makers and staff to focus budgets and efforts to best achieve policy or program goals.

(3-0-3)

PA 581**Policy Design Analytics**

This course is designed to present practical, cost-effective techniques that can be used to make better decisions regarding the allocation of scarce resources. Topics covered include problem identification, goal development, data needs and collection, generation of alternative solutions, projecting impacts, goals-oriented evaluation, and strategies for implementation.

Prerequisite(s): [(PA 501)]

(3-0-3)

PA 588**Incident Response, Disaster Recovery, & Business Continuity**

Students learn to design and manage key business information security functions including incident response plans and incident response teams; disaster recovery plans; business continuity plans; and crisis management teams and plans. Reporting, response planning, and budgeting are all addressed. Students working in teams will prepare an incident response, disaster recovery, business continuity, or crisis management plan for a real world organization such as a business or a government body or agency.

Prerequisite(s): [(PA 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PA 590**Internship in Public Administration**

This course provides practical experience in public administration and may be taken only by students lacking extensive work experience in governmental administration.

Prerequisite(s): [(PA 501)]

(Credit: Variable)

PA 592**Directed Readings in Public Administration**

This course consists of independent reading and analysis centered on particular problems and supervised by a member of the public administration faculty.

(Credit: Variable)

PA 597**Special Problems**

The subject matter of this course will vary with the interests and the background of the students and the instructor, and the course may be taken more than once. Instructor permission is required.

(3-0-3)

PA 600**Continuation of Residence**

Continuation of residence.

(0-0-1)

Stuart School of Business

SSB 510**ACE Seminar**

The two-semester Advancing Career and Education is a graduation requirement that complements the graduate business student's academic experience and prepares the student for professional internship placement and the post-graduation job market. The first semester course (SSB 510) explores personal development topics communication skills, acculturation, competitive job search skills, and self-awareness. This course also builds skills and self-awareness. This course also builds an awareness related to the workplace including resume development, communication, workplace etiquette, presentation skills, teamwork and motivation, and workplace relationships. During the first semester students are assigned to a partner organization where they will begin completion of the 100 project hours required at the end of their second semester in the program.

(0-0-0)

SSB 511**Advancing Career & Education II**

The two-semester Advancing Career and Education seminar is a graduation requirement that complements the graduate business student's academic experience and prepares the student for professional internship placement and the post-graduation job market. The second semester course (SSB 511) focuses on internship search and interviewing skills including how to leverage relational or "soft" skills, internship strategies and tools, networking and informational interviewing, and employer expectations. Additional topics covered include workplace themes such as organizational structure, personal influence, and conflict negotiation. Students must complete 100 project hours at their partner organization by the end of the semester in order to pass the course.

(0-0-0)

SSB 520**Service Learning-Sem II**

Service learning.

(0-0-0)

Department of Chemical and Biological Engineering

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Chair:

Sohail Murad

The mission of the Department of Chemical and Biological 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, 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 Science in Chemical Engineering
Doctor of Philosophy in Chemical Engineering

With the Department of Computer Science:

Master of Science in Computer Science/Master of Chemical Engineering

Interdisciplinary Programs

Master of Chemical Engineering with specialization in Energy/Environment/Economics (E³)

Master of Science in Chemical Engineering with specialization in Energy/Environment/Economics (E³)
Doctor of Philosophy of Chemical Engineering with specialization in Energy/Environment/Economics (E³)

Certificate Programs

Biological Engineering
Current Energy Issues
Particle Processing

Pharmaceutical Engineering
Polymer Science and Engineering
Process Operation Management

Research Centers and Institutes

Center for Electrochemical Science and Engineering:
Jai Prakash, Director

Center for Molecular Study of Condensed Soft Matter:
Jay Schieber, Director

Center of Excellence in Polymer Science and Engineering:
David Venerus, Director

Center for Complex Systems and Dynamics:
Fouad Teymour, Director

Engineering Center for Diabetes Research and
Education: Ali Cinar, Director

Wanger Institute for Sustainable Energy Research:
Hamid Arastapoor, Director

Research Facilities

Research facilities of the department include:

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
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
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
Hydrogen Storage 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 undergraduate 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:

Energy and Sustainability

Fuel Cells
Fluidization and Gasification
Hybrid Systems

Biological Engineering

Molecular Modeling
Diabetes
Biomedical and Pharmaceutical Engineering
Biochemical Engineering
Food Processing

Advanced Materials

Interfacial and Transport Phenomena
Nanotechnology
Polymers
Biomaterials

Systems Engineering

Complex Systems
Advanced Process Control
Process Monitoring

Faculty

Abbasian, Javad, GTI Professor of Chemical Engineering. B.S., Abadan Institute of Technology (Iran); M.B.A., University of Chicago; M.S., Ph.D., Illinois Institute of Technology. High temperature gas cleaning, pollution control and solid waste management; gas separation and purification; and process design and development.

Anderson, John L., Professor of Chemical Engineering and President of Illinois Institute of Technology. B.S., University of Delaware; Ph.D., University of Illinois, Urbana-Champaign.

Arastoopour, Hamid, Professor of Chemical Engineering and Mechanical Engineering, Henry R. Linden Professor of Engineering, and Director of the Wanger Institute for Sustainability and Energy Research (WISER). B.S., Abadan Institute of Technology (Iran); M.S., Ph.D., G.E., Illinois Institute of Technology. Computational fluid dynamics (CFD) and transport phenomena of multiphase flow, fluidization, flow in porous media, particle technology and material processing, and environmental engineering problems, hydrogen storage, tire recycling, particle technology in applications to coal gasification, production of gas from unconventional gas reserves and hydrates, and energy sustainability issues.

Chmielewski, Donald J., Associate Professor of Chemical Engineering. B.S., Illinois Institute of Technology; M.S., Ph.D., University of California Los Angeles. Advanced process control; economic based control system design; modeling, design, and control of power and energy related systems.

Cinar, Ali, Professor of Chemical Engineering and Biomedical Engineering and Director of the Engineering Center for Diabetes Research and Education. B.S., Robert College (Turkey); M.Eng., Ph.D., Texas A&M University. Diabetes and control of artificial pancreas systems; modeling, supervision, and control of biological, biomedical, and chemical processes with agent-based systems, multivariate statistics and artificial intelligence applications; modeling of angiogenesis and tissue growth.

Feng, Hualong, Research Assistant Professor of Chemical and Biological Engineering.

Karuri, Nancy W., Assistant Professor of Chemical Engineering. B.Eng., University of New South Wales (Australia); Ph.D., University of Wisconsin-Madison. Bioengineering, biomimetic scaffolds, extracellular matrix assembly.

Murad, Sohail, Professor of Chemical Engineering and Chair. B.S., University of Engineering (Pakistan); M.S., University of Florida; Ph.D., Cornell University. Computational molecular modeling for transport processes; thermodynamics and statistical mechanics of fluids and mixtures; ion and fluid transport in membranes (inorganic and biological).

Parulekar, Satish, Professor of Chemical Engineering. B.Ch.E., University of Bombay (India); M.S., University of Pittsburgh; Ph.D., Purdue University. Biochemical engineering, chemical reaction engineering, modeling and optimization of biological and chemical processes, reactions with separations, food processing for bacterial inactivation, biofuel synthesis.

Pérez-Luna, Victor H., Associate Professor of Chemical Engineering. B.S., M.S. Universidad de Guadalajara (Mexico); Ph.D., University of Washington. Surface analysis and modification, biomaterials and biosensors, and tissue engineering.

Prakash, Jai, Professor of Chemical Engineering and Director of the Center for Electrochemical Science and Engineering. B.S., M.S., Ph.D., University of Delhi (India); Ph.D., Case Western Reserve University. Electrochemistry, materials development, and batteries and fuel cells.

Ramani, Vijay K., Hyosung S.R. Cho Professor of Chemical Engineering. B.E. Annamalai University (India); Ph.D., University of Connecticut. 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.

Schieber, Jay D., Professor of Chemical Engineering and Physics and Director of the Center for the Molecular Study of Condensed Soft Matter. Ph.D., University of Wisconsin-Madison. Experiment, theory, and computation in the multiscale study of soft matter, including both biological and synthetic materials.

Teymour, Fouad A., S.C. Johnson Professor of Chemical Engineering and Director of the Center of Complex Systems and Dynamics. B.Sc., M.Sc., Cairo University (Egypt); Ph.D., University of Wisconsin-Madison. Polymer reaction engineering, mathematical modeling, nonlinear dynamics, and complexity and complex systems.

Turitto, Vincent, Pritzker Professor and Director of the Pritzker Institute of Biomedical Science and Engineering and Interim Chair of the Department. B.Ch.E., Manhattan College; D.Eng.Sc., Columbia University. Blood flow and thrombosis, atherosclerosis, cellular biodynamics, biomaterials.

Venerus, David C., Professor of Chemical Engineering and Director of the Center of Excellence in Polymer Science and Engineering. B.S., University of Rhode Island; M.S., Ph.D., Pennsylvania State University. Transport phenomena in complex materials, forced Rayleigh scattering, polymer rheology, and polymer foam processing.

Chemical and Biological Engineering

Wasan, Darsh T., Distinguished Motorola Professor of Chemical Engineering and Vice President for International Affairs. B.S., University of Illinois, Urbana-Champaign; Ph.D., University of California-Berkeley. Thin liquid films, foams, emulsions and nanoparticle suspensions, film rheology and applications, wetting, spreading and adhesion of nano-fluids on solid surfaces, environmental technologies, food colloids.

Research Faculty

Aderangi, Nader, Senior Lecturer of Chemical Engineering and Director of the Undergraduate Laboratories. B.S., University of Tehran (Iran); M.S., University of Colorado; Ph.D., Illinois Institute of Technology. Unit operations, chemical processes, interfacial mass transfer, rheological properties.

Indei, Tsutomu, Research Associate Professor of Chemical Engineering. B.S., M.S., Ph.D., University of Tsukuba (Japan).

Nikolov, Alexander, Research Professor of Chemical Engineering. B.S., Ph.D., University of Sofia (Bulgaria). Interfacial rheology, foams, emulsion, dispersion, and thin liquid films.

Selman, J. Robert, 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

Anderson, Robert, Master of Management, Northwestern University.

Admission Requirements

Cumulative Undergraduate GPA: 3.0/4.0

GRE score minimum:

1. MAS 950 (quantitative + verbal),
2.5 (analytical writing)
2. After August 2011 MAS 295 (quantitative + verbal),
2.5 (analytical writing)
1. M.S./Ph.D.: 1100 (quantitative + verbal),
3.0 (analytical writing)
2. After August 2011 M.S./Ph.D.: 304 (quantitative
+ verbal), 3.0 (analytical writing)

TOEFL minimum score: 550/213/80*

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 or biological engineering normally requires the completion of a program leading to a bachelor's degree in chemical engineering or another engineering discipline from an accredited institution. Depending on the student's background, deficiency courses, some of which may not count toward the degree, may be required. Please see the department's list of applicable undergraduate 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.

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

Master of Biological Engineering

30 credit hours

No Thesis Requirement

The objective of this degree program is to prepare students for professional practice in any field of engineering involving biological processes, and to provide a foundation in the fundamental knowledge of biological engineering. The student must have a minimum grade point average of 3.0/4.0 in the core areas. 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 professional course, and 12 credits of electives chosen from the list below.

Core Courses

CHE 406 Transport Phenomena

CHE 503 Thermodynamics

CHE 577 Bioprocess Engineering

A minimum grade point average of 3.0/4.0 is required for core courses.

Biology Requirements

BIOL 504 Biochemistry

BIOL 515 Molecular Biology

Professional Requirement

CHE 506 Entrepreneurship and Intellectual Property Management

Electives

BME 525 Concepts of Tissue Engineering

BME 533 Biostatistics

BME 570 Engineering Biocompatible Materials

CHE 545 Metabolic Engineering

CHE 580 Biomaterials

CHE 583 Pharmaceutical Engineering

CHE 584 Tissue Engineering

CHE 585 Drug Delivery

CHE 597 Special Problems

ENVE 513 Biotechnological Processes in Environmental Engineering

Any 500 level Food Process Engineering course

Other approved electives from CHE, CHEM, BME, BIOL

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. Elective courses are to be determined in consultation with academic advisor.

Core Courses

CHE 406 Transport Phenomena

CHE 503 Thermodynamics

CHE 525 Chemical Reaction Engineering*

AND one of the following:

CHE 530 Advanced Process Control

CHE 535 Applications of Mathematics to Chemical Engineering

A minimum grade point average of 3.0/4.0 is required in the core courses.

*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 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. Elective courses are to be determined in consultation with academic advisor.

Core Courses

CHE 525 Chemical Reaction Engineering

CHE 535 Applications of Mathematics to Chemical Engineering

CHE 551 Advanced Transport Phenomena

CHE 553 Advanced Thermodynamics

A minimum grade point average of 3.0/4.0 is required for core courses. Aside from the core courses, coursework may be selected (with advisor approval) to satisfy the needs of the individual student and may be aligned with the research areas listed in the Department of Chemical and Biological Engineering section of this bulletin.

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.

Energy/Environment/Economics (E³)

32 credit hours

Faculty Advisor
Chemical and Biological Engineering
Javad Abbasian
127 Perlstein Hall
10 W. 33rd St.
Chicago, IL 60616
312.567.3047
abbasian@iit.edu

The Energy/Environment/Economics (E³) 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 and sustainability issues and economic forces that drive technology choice.

The E³ specialization requires an interdisciplinary thesis in an E³ area of research for M.S. and Ph.D. degrees, and an interdisciplinary graduate project or additional energy and sustainability courses for professional master's degrees. Graduate students in E³ should also be enrolled in fundamental courses related to the topics of energy, environment, and economics. E³ is designed primarily for students majoring in 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, of sustainability issues related to energy extraction, conversion, and utilization, and of the impact of sustainability principles on the design and operation of energy systems. Furthermore, students will gain sufficient knowledge of sustainability and regulatory issues to enable them to make more viable technology choices.

Master of Chemical Engineering with (E³) Specialization

32 credit hours

This program has the same requirements as the M.S. degree program, except that, in place of six to 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 E³ courses with the approval of their advisor. Students are also encouraged to register or attend the interdisciplinary graduate seminar (CHE 593) or general seminars offered in energy and/or sustainability areas by WISER.

Master of Science in Chemical Engineering with (E³) Specialization

32 credit hours

Students pursuing the M.S. in Chemical Engineering with E³ specialization are required to take CHE 543 and select at least one course from Group A and one course from Group B (listed in the E³ course section of this bulletin), and register for up to eight credit hours of M.S. thesis preparation (CHE 591) in an interdisciplinary E³ area. In addition, the students are required to

take all required core courses for the M.S. in Chemical Engineering degree.

Students may apply up to 12 credit hours of 400-level courses to the M.S. degree requirements with their advisors approval. Students are also encouraged to register or attend the interdisciplinary graduate seminar (CHE 593) or general seminars offered in energy and/or sustainability areas by WISER.

Doctor of Philosophy in Chemical Engineering with (E³) Specialization

84 credit hours
Qualifying exam
Comprehensive exam
Dissertation and oral defense

Students interested in the Ph.D. program in chemical engineering are required to take at least 84 credit hours beyond the B.S. degree requirements, including required chemical engineering core courses for Ph.D. in chemical engineering, CHE 543, and at least five E³ courses (from Groups A and/or B). Registration for approximately

32 hours of Ph.D. thesis research in E³ areas of study is also required. Candidates must pass written qualifying and comprehensive examinations and must defend their thesis in an oral examination. The Ph.D. committee for E³ students must include at least one professor with specialization in an energy and sustainability area from outside the student's department. The students are also encouraged to register or attend the interdisciplinary graduate seminar (CHE 593) or general seminars offered in energy and/or sustainability areas by WISER.

E³ Courses

See descriptions under the respective department's course listings.

Group A

CHE 541
Renewable Energy Technologies

CHE 542
Fluidization and Gas-Solids Flow Systems

CHE 565
Fundamentals of Electrochemistry

CHE 567
Fuel Cell Fundamentals

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 System Relaying

ECE 555
Power Market Operations

ECE 556
Power Market Economics & 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 564
Control and Operation of Electric Power Systems

MMAE 522
Nuclear, Fossil-Fuel, and Sustainable Energy Systems

MMAE 523
Fundamentals of Power Generation

MMAE 524
Fundamentals of Combustion

Group B

EMS 500
Fundamentals of Environmental Science

EM 503
Environmental Pollution Prevention and Control Strategies

EM 504
Industrial Ecology and Systems Thinking

ENVE 501
Environmental Chemistry

ENVE 506
Chemodynamics

ENVE 542
Physiochemical Processes in Environmental Engineering

ENVE 551
Industrial Waste Treatment

ENVE 561
Design of Environmental Engineering Processes

ENVE 570
Air Pollution Meteorology

ENVE 577
Design of Air Pollution Control Devices

ENVE 578
Physical and Chemical Processes for Industrial Gas Cleaning

ENVE 580
Hazardous Waste Engineering

Doctor of Philosophy

84 credit hours
Qualifying exam
Comprehensive exam
Thesis proposal
Dissertation and oral defense

The doctorate degree in chemical engineering is awarded in recognition of mastery in chemical/biological engineering and upon demonstration of an ability to make substantial creative contributions to knowledge in chemical 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.

Coursework must include 15 credits of core courses.

Core Courses

CHE 525 Chemical Reaction Engineering

CHE 530 Advanced Process Control

OR

CHE 536 Computational Techniques in Engineering

CHE 535 Applications of Mathematics to Chemical Engineering

CHE 551 Advanced Transport Phenomena

CHE 553 Advanced Thermodynamics

A minimum grade point average of 3.0/4.0 is required in the core courses. The upper and lower limit for pass/fail research coursework (CHE 691) is 42-24 credits. The upper limit for independent study coursework (CHE 597) is 18 credits. Please refer to the credit requirements section at the front of this bulletin for additional details.

Students should consult the Transfer Credits section at the front of this bulletin 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 na-

ture, 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 will cover 4 core areas: thermodynamics, reaction engineering and kinetics, transport phenomena, and process modeling and control.

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 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 advisor and approved by the chairperson at least three weeks prior to the examination.

The thesis proposal 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.

Certificate Programs

The department offers 6 graduate certificate programs. These programs provide students with post-baccalaureate knowledge of an area of specialization within chemical. 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 biology requirements and the elective courses listed under the Master of Biological Engineering

Current Energy Issues

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 5 courses (9 credits) to receive the certificate.

Required Courses

At least three from the following:

CHE 541 Renewable Energy Technologies
CHE 542 Fluidization & Gas-Solids Flow Systems
CHE 543 Energy, Environment, and Economics
CHE 565 Fundamentals of Electrochemistry
CHE 567 Fuel Cell Fundamentals

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 (9 credits) to receive a certificate.

Required Courses

At least one of the following courses:

CHE 489 Fluidization
CHE 542 Fluidization and Fluid/Particle Flow Systems

AND one/two of the following:

CHE 582 Interfacial and Colloidal Phenomena with Applications
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

CHE 583 Pharmaceutical Engineering
CHE 585 Drug Delivery
CHE 511 Regulatory Issues in Pharmaceutical Processes

AND one of the following:

CHE 514 Process Analytical Technology
CHE 560 Statistical Quality and Process Control

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 Sciences

AND three of the following:

CHE 538 Polymerization Reaction Engineering

CHE 555 Polymer Processing

CHEM 535 Polymer Synthesis

CHEM 542 Polymer Characterization and Analysis

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 560 Statistical Quality and Process Control

II

CHE 435 Process Control

CHE 508 Process Design Optimization

CHE 530 Advanced Process Control

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 processes and auxiliary equipments. Core course.

Prerequisite(s): [(CHE 351 and CHE 451)]
(3-0-3)

CHE 506

Entrepreneurship & Intellectual Property Management

Graduate standing or consent of instructor. 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.

(2-0-2)

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: An undergraduate course in process design.

(3-0-3)

CHE 525

Chemical Reaction Engineering

Advanced treatment of chemical kinetics and reactor systems including non-isothermal, nonideal flow systems. Modeling of complex reactions, catalysis and heterogeneous reactor analysis. Reactor stability concepts. Core course.

Prerequisite(s): [(CHE 423)]
(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.

Prerequisite(s): [(CHE 435)]
(3-0-3)

CHE 535

Applications of Mathematics to Chemical Engineering

Mathematical techniques and their application to the analytical and numerical solution of chemical engineering problems. The analytical component includes review of matrices and determinants, as well as solution of ordinary, partial differential and integral equations. The numerical component includes iterative solution of algebraic 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 engineering. Review of iterative solution of algebraic equations. Nonlinear initial 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 equations. Solution of transient two-phase flow problems using CFD codes.

(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 engineering reactor design.

Prerequisite(s): [(CHE 423)]
(3-0-3)

CHE 541

Renewable Energy Technologies

The course will cover three topics related to renewable Energy Technologies. 1. Review of renewable energy sources; solar, wind, biomass, etc. 2. Energy storage and conversion with emphasis on batteries and fuel cells 3. Hydrogen as an energy carrier and the Hydrogen Economy Requires senior standing.

(3-0-3)

CHE 542

Fluidization & Gas-Solids Flow Systems

Fluidization phenomena (bubbling, slugging, elutriation, and jets in fluidized 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 conveying lines (dilute flow) and stand pipe (dense flow). Hydrodynamic analysis of spouted and circulating fluidized beds. Examples from current literature on applications of multiphase flow.

Prerequisite(s): [(CHE 501 and CHE 535)]
(3-0-3)

CHE 543

Energy, Environment & 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.

(3-0-3)

CHE 545

Metabolic Engineering

Cellular metabolism, energetics and thermodynamics of cellular metabolism, 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 interpretation of problems in momentum, energy and mass transport phenomena that occur in chemical and biological processes.

Prerequisite(s): [(CHE 406)]
(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.

Prerequisite(s): [(CHE 351 and CHE 451)]

(3-0-3)

CHE 555**Polymer Processing**

Analysis of momentum, heat and mass transfer in polymer processing operations. Polymer processes considered include extrusion, calendaring, fiber spinning, injection molding, and mixing.

Prerequisite(s): [(CHE 406)]

(3-0-3)

CHE 560**Statistical Quality & 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 565**Fundamentals of Electrochemistry**

Thermodynamics and potential, Marcus theory, charge transfer kinetics and mass transport of simple systems. Electrode reactions couple with homogeneous chemical reactions. Double layer structure and adsorbed intermediates in electrode processes. Potential step and potential sweep methods.

(3-0-3)

CHE 566**Electrochemical Engineering**

Basic concepts of electrochemistry used in electrochemical reactor analysis and design. Thermodynamics, kinetics and transport processes in electrochemical systems, current and potential distribution, corrosion engineering, electrodeposition, batteries and fuel cells, industrial electrolysis, and electrosynthesis.

(3-0-3)

CHE 567**Fuel Cell Fundamentals**

A detailed study of the thermodynamics, electrochemistry, electrode kinetics and materials aspects of fuel cells with an emphasis on polymer electrolyte fuel cells. The course will include a vigorous laboratory component and will cover the development of detailed data analysis procedures. A part of the course will cover current trends and interests through the critical discussion of recent archival publications.

(2-1-3)

CHE 575**Polymer Rheology**

Flow of viscoelastic fluids, integral and differential constitutive equations from continuum and molecular considerations, methods of experimental evaluations.

Prerequisite(s): [(CHE 406)]

(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 and their applications.

(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 582**Interfacial & 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, electro kinetic 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.

Prerequisite(s): [(CHE 351) OR (CHE 451)] AND [(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 process. 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)

CHE 585**Drug Delivery**

Principle of diffusion in liquids membrane 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 system based on pharmacokinetic/ pharmacodynamic requirements.

(3-0-3)

CHE 591**Research & Thesis for M.S. Degree**

Research and thesis writing.

(Credit: Variable)

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 hours.)
(Credit: Variable)

CHE 597**Special Problems**

Independent study and project. (Credit: variable)
(Credit: Variable)

CHE 600**Continuance of Residence**

Continuation of residence.
(0-0-1)

CHE 691**Research & Thesis for Ph.D. Degree**

Research and thesis writing.
(Credit: Variable)

Undergraduate Courses Available to Graduate Students

With the approval of their advisors, students in the chemical and biological engineering graduate programs may apply up to 12 credits hours to their program from 400-level undergraduate courses.

Department of Civil, Architectural, and Environmental Engineering

228 Alumni Hall
3201 S. Dearborn St.
Chicago, IL 60616
312.567.3540
312.567.3519 fax
caee@iit.edu
www.iit.edu/engineering/cae/

Chair:
Gongkang Fu

The Department of Civil, Architectural, and Environmental Engineering offers graduate instruction in structural engineering, transportation engineering, geotechnical engineering, geoenvironmental engineering, environmental 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 Engineering in Architectural Engineering
Master of Engineering in Construction Engineering and Management
Master of Engineering in Environmental Engineering
Master of Engineering in Geoenvironmental Engineering
Master of Engineering in Geotechnical Engineering
Master of Engineering in Public Works
Master of Engineering in Structural Engineering
Master of Engineering in Transportation Engineering

Master of Science in Architectural Engineering
Master of Science in Civil Engineering with specialization in:

Architectural Engineering
Construction Engineering and Management
Geotechnical Engineering
Geoenvironmental Engineering
Structural Engineering
Transportation Engineering

Master of Science in Environmental Engineering
Doctor of Philosophy in Civil Engineering
Doctor of Philosophy in Environmental Engineering

Joint-Degree Program

Bachelor of Architecture/Master of Science in Civil Engineering

Bachelor of Architecture/Master of Engineering in Construction Engineering and Management
Bachelor of Architecture/Master of Engineering in Structural Engineering

Certificate Programs

Air Resources
Construction Management
Earthquake and Wind Engineering Design
Geoenvironmental Engineering
Hazardous Waste Engineering

Indoor Air Quality
Infrastructure Engineering and Management
Transportation Systems Planning
Waste and Wastewater Treatment

Research Facilities

Research facilities include laboratories devoted to concrete structures, structural models, metal structures, materials, architectural engineering, geotechnical engineering, transportation engineering, construction engineering and management, and environmental engineering.

In addition, faculty and graduate students have access to regional facilities such as the Argonne National Laboratory. 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 architectural engineering, construction engineering and management, environmental engineering, geotechnical and geoenvironmental engineering, public works, structural engineering, and transportation engineering.

In architectural engineering, faculty conduct research in acoustics, airflow and thermal modeling, energy conservation, indoor air quality, and thermal comfort.

Construction engineering and management research involves construction productivity, scheduling and progress control, dispute resolution, construction company organization, sectorial studies, and project management.

Environmental engineering research areas include air pollution, energy and sustainability, hazardous waste engineering, indoor air quality, and wastewater engineering.

Geotechnical and geoenvironmental research emphasizes soil mechanics, rock mechanics, engineering geology, earthquake engineering, soil structure, and soil-water interactions.

Research in the public works specialty area includes public policy evaluation, management of engineering operations, maintenance, and rehabilitation and construction of civil infrastructures such as roads, bridges, and traffic safety hardware.

Structural engineering research concentrates on structural dynamics and earthquake resistant design, inelastic behavior and non-linear analysis of steel structures, and bridge engineering.

Transportation engineering research areas include multimodal transportation infrastructure and dynamic traffic network mobility, safety, security and emergency evacuation, as well as energy consumption and vehicle emission performance modeling; transportation asset management, addressing system integration, risk and uncertainty, and sustainability; and network economics.

Faculty

Anderson, Paul, Associate Professor of Environmental Engineering. B.S., Purdue University; M.S., University of California-San Diego; Ph.D., University of Washington. Physical-chemical processes in water and wastewater treatment, water resources management, industrial ecology.

Arditi, David, Professor of Civil and Architectural Engineering. B.S., M.S., Middle East Technical University (Turkey); Ph.D., Loughborough University of Technology (United Kingdom). Construction engineering and management.

Budiman, Jeffry S., Associate Professor of Civil and Architectural Engineering. B.S., Bandung Institute of Technology (Indonesia); M.S., Illinois Institute of Technology; Ph.D., University of Colorado-Boulder. Geotechnical and geoenvironmental engineering.

Du, Lili, Assistant Professor of Transportation Engineering. B.S., Xi'an Jiaotong University (China); M.S., Tsinghua University (China); M.S., Ph.D., Rensselaer Polytechnic Institute. Transportation system analysis, operations research and statistics, network modeling and algorithm design, data fusion.

Fu, Gongkang, Professor of Civil and Architectural Engineering and Chair of the Department. B.S., M.S., Tongji University (China); Ph.D., Case Western Reserve University. Bridge engineering, probabilistic mechanics, infrastructure system engineering.

Guralnick, Sidney A., Perlstein Distinguished Professor of Engineering, Emeritus. B.S., Drexel Institute of Technology; M.S., Ph.D., Cornell University. Structural engineering and materials of construction.

Khisty, C. Jotin, Professor Emeritus of Civil and Architectural Engineering. 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.

Li, Zongzhi, Associate Professor of Civil and Architectural Engineering. B.E. Changan University, (China); MSCE, MSIE, Ph.D., Purdue University. Multimodal transportation systems analysis, evaluation, and asset management, and network economics.

Modares, Mehdi, Assistant Professor of Civil and Architectural Engineering. B.S., Tehran Azad University (Iran); MS., Cleveland State University; Ph.D., Case Western Reserve University. Computational mechanics, solid mechanics.

Mohammadi, Jamshid, Professor of Civil and Architectural Engineering and Associate Dean of the Graduate College for Academic Affairs. B.S., M.S., University of Teheran (Iran); M.S., Ph.D., University of Illinois, Urbana-Champaign. Structural reliability and bridge engineering.

Moschandreas, Demetrios J., Professor of Environmental Engineering. B.S., Stetson University; M.S., University of Kentucky; M.S., Ph.D., University of Cincinnati. Air quality transport, exposure analysis, risk assessment, indoor air quality, Environmental Index theory and application, sustainable environmental development.

Noll, Kenneth E., Professor of Environmental Engineering. B.S., Michigan Technological University; M.S., Ph.D., University of Washington. 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.

Pagilla, Krishna, Professor of Environmental Engineering. B.E., Osmania University (India); M.S., University of Oklahoma; Ph.D., University of California-Berkeley. Water and wastewater engineering, environmental microbiology, biological nutrient control, soil remediation, and sludge treatment.

Pan, Tongyan, Assistant Professor of Civil Engineering. B.S., M.S., Tongji University (China); M.S., Louisiana State University; Ph.D., University of Illinois, Urbana-Champaign. Engineering materials and pavement engineering, pavement management, multiscale computational mechanics, finite element analysis, concrete structures, geotechnical engineering.

Snyder, Mark E., Senior Lecturer of Civil and Architectural Engineering. B.S., M.S., Creighton; M.S., Illinois Institute of Technology; Ph.D., Texas Tech University. Building energy and lighting systems, measurement techniques, fire engineering.

Stephens, Brent, Assistant Professor of Civil and Architectural Engineering. B.S., Tennessee Technological University; M.S., Ph.D., University of Texas-Austin. Architectural engineering, indoor air quality, HVAC systems.

Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0

GRE minimum score:

M.S./M.E.: 900 (quantitative + verbal),
2.5 (analytical writing)

Ph.D.:1000 (quantitative + verbal),
3.0 (analytical writing)

TOEFL minimum: 550/213/80*

Note: The GRE requirement is waived for Master of Engineering degree applicants who hold a Bachelor of Science in a related field, from an ABET-accredited university in the U.S., with a minimum GPA of 3.0/4.0.

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 in civil engineering 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 may also accept a bachelor's degree in architecture or engineering. 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.

Admission to graduate degree programs in environmental engineering requires a bachelor's degree in an appropriate undergraduate field from an accredited institution. Prerequisites for the program are somewhat flexible, but all applicants should have had one year of chemistry, and math through differential equations. Qualified applicants with degrees in the life sciences, engineering, and physical sciences will normally be admitted to the program without extensive prerequisites.

Each full-time graduate student is assigned a faculty advisor at the time of initial registration. Part-time or non-degree students who have not been assigned an advisor and who intend to pursue a program toward a degree should contact the department for counseling before registering for courses. Departmental seminars and colloquia are conducted on a regular basis each semester. All full-time civil and architectural engineering graduate students are expected to register for CAE 593 and attend these seminar meetings regularly for two semesters.

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

Master of Engineering in Architectural Engineering

Master of Engineering in Construction Engineering and Management

Master of Engineering in Environmental Engineering

Master of Engineering in Geoenvironmental Engineering

Master of Engineering in Geotechnical Engineering

Master of Engineering in Public Works

Master of Engineering in Structural Engineering

Master of Engineering in Transportation Engineering

32 credit hours (minimum)

These Master of Engineering programs are course-only, professionally oriented degree programs that permit a concentration in preparation for engineering practice. Admission requirements to these programs are the same as those for the M.S. program. Candidates in these programs must complete a minimum of 32 credit hours,

up to three of which may be a special project course, CAE 597 or ENVE 597. Up to 12 credit hours of 400-level undergraduate coursework (except CAE 431 and CAE 432) may be included in the Master of Engineering program with prior advisor approval. No thesis or comprehensive examination is required for completion of the degree.

Master of Engineering in 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: building 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 513 Building Science

AND

CAE 502 Acoustics & Lighting

OR

CAE 521 Building Illumination Design

CAE 574 Economic Decision Analysis in Civil Engineering

Master of Engineering in Construction Engineering and Management

The Master of Engineering 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, plan and manage real estate developments, and address legal problems.

Core Courses

CAE 570 Legal Issues in Civil Engineering

CAE 571 Lean Construction and Control

CAE 574 Economic Decision Analysis in Civil Engineering

CAE 577 Construction Equipment Management

Master of Engineering in Environmental Engineering

All environmental engineering students must take five core courses. The remaining credit hours in the program of study should be selected, in consultation with the student's advisor, to meet the student's professional goals. Up to nine credit hours in courses numbered 400-499 may be selected in some cases to overcome deficiencies or broaden the student's background.

Core Courses

CAE 523 Statistical Analysis of Engineering Data

ENVE 501 Environmental Chemistry

ENVE 506 Chemodynamics

ENVE 542 Physiochemical Processes in Environmental Engineering

ENVE 580 Hazardous Wastes Engineering

Master of Engineering in Geoenvironmental Engineering and Master of Engineering in Geotechnical Engineering

The geoenvironmental and geotechnical 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, and waste disposal facilities. Laboratory experiments and computer analyses/modeling are incorporated.

Geoenvironmental Engineering Core Courses

- CAE 562 Engineering Behavior of Soil
- CAE 567 Physicochemical Behavior of Soils
- CAE 589 Groundwater Hydrology and Sampling
- CAE 590 Geotechnical Landfill Design and Maintenance

Geotechnical Engineering Core Courses

- CAE 562 Engineering Behavior of Soil
- CAE 564 Design of Foundations, Embankments and Earth Structures
- CAE 565 Rock Mechanics and Tunneling
- CAE 566 Earthquake Engineering and Soil Dynamics

Master of Engineering in Public Works (Infrastructure Engineering and Management)

The Master of Engineering in Public Works (M.P.W.) degree is the most widely recognized educational credential for professionals engaged in public works and infrastructure engineering and management. The M.P.W. program consists of four core courses, four engineering electives (in construction engineering and management, geotechnical engineering, structural engineering, or transportation engineering), two public administration electives (in administration process or policy planning), and one CAE 597 special problems course. The elective courses should be selected in consultation with the student's advisor. This program is offered in cooperation with IIT's Master of Public Administration program.

Core Courses

- CAE 574 Economic Decision Analysis in Civil Engineering
- CAE 575 Systems Analysis in Civil Engineering
- PA 501 Essentials for Public Management in a Complex Society: Processes, Structures and Values
- PA 551 Public Infrastructure Management

Master of Engineering in Structural Engineering

IIT's Master of Engineering 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 501 Engineering Analysis 1
- OR**
- CAE 514 Mathematical Methods for Structural Engineering
- CAE 503 Advanced Structural Analysis
- CAE 518 Advanced Reinforced Concrete
- CAE 525 Advanced Steel and Composite Structures

Master of Engineering in Transportation Engineering

With a Master of Engineering in Transportation Engineering degree, a student will be a qualified transportation planner, traffic engineer, and traffic safety engineer. Additionally, the student will be trained to understand and evaluate the socioeconomic impacts of transportation and infrastructure engineering projects.

Core Courses (choose four, with advisor consent)

- CAE 523 Statistical Analysis of Engineering Data
- CAE 543 Demand Models for Urban Transportation
- CAE 544 Urban Transportation Planning
- CAE 546 Public Transportation Systems
- CAE 548 Transportation Systems Management
- CAE 555 Transportation Systems Evaluation
- CAE 575 Systems Analysis in Civil Engineering

Master of Science in Architectural Engineering

32 credit hours
Thesis and oral defense

The M.S. in Architectural Engineering couples the architectural engineering coursework curriculum for the advanced study of buildings, building systems, and their construction, with a research and thesis-based curriculum in the same fields. Students are expected to develop advanced knowledge and conduct research at a rigorous level. The program will also serve as a foundation for research for students who intend to pursue a doctoral degree.

Degree candidates in the Master of Science program must complete a minimum of 32 credit hours, six to eight of which must be research and thesis credits. Up to 12 credit hours of 400-level undergraduate coursework may be included in the M.S. program with prior advisor approval. An oral defense of the thesis constitutes the comprehensive examination, and no additional written comprehensive examination is required.

Required Courses

CAE 513 Building Science
CAE 574 Economic Decision Analysis in Civil Engineering

AND minimum of two of the following:

CAE 502 Acoustics & Lighting
CAE 521 Building Illumination Design
CAE 524 Building Enclosure Design
CAE 553 Measurement & Instrumentation in Architectural Engineering
ENVE 576 Indoor Air Pollution

AND research (6-8 credit hours):

CAE 591 Research and Thesis for M.S. Degree

AND 9-15 credit hours of electives

Master of Science in Civil Engineering

32 credit hours
Thesis and oral defense

Six technical areas (architectural, construction, 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 Design) and CAE 432 (Concrete and Foundation Design)] may be included in the M.S. program with prior advisor approval. An oral defense of the thesis constitutes the comprehensive examination, and no additional written comprehensive examination is required.

Master of Science in Environmental Engineering

32 credit hours
Thesis

This program makes it possible for the student to build a strong foundation in environmental engineering and, through their research, to specialize in one area. Candidates are required to take at least 32 credit hours, 15 credits of which must be from the environmental engineering core courses listed below.

Core courses

CAE 523 Statistical Analysis of Engineering Data
ENVE 501 Environmental Chemistry
ENVE 506 Chemodynamics
ENVE 542 Physicochemical Processes in Environmental Engineering
ENVE 580 Hazardous Waste Engineering

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.

Up to nine credit hours in courses numbered 400-499 may be selected in some cases to overcome deficiencies or broaden the student's background. In addition, master's degree students take six to eight credit hours of research (ENVE 591). The final step in this program is an oral defense of the thesis; no additional written comprehensive exam is required.

Bachelor of Architecture/Master of Science in Civil Engineering

Bachelor of Architecture/Master of Engineering in Construction Engineering and Management

Bachelor of Architecture/Master of Engineering in Structural Engineering

Qualified students regularly enrolled at IIT may earn both the Bachelor of Architecture and either the Master of Science or Master of Engineering degree. They must complete preparatory courses for any of these master's programs prior to entry into the combined program.

Students who anticipate entry into the combined B.Arch. and M.S. in Civil Engineering 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, MATH 252, PHYS 123, PHYS 221, PHYS 224, MMAE 200/CAE 200, MMAE 202/CAE 202, CAE 303, CAE 304, CAE 307, CAE 310, CAE 431 and CAE 432 (in place of MATH 119, MATH 122, and all structural engineering courses for the Architecture major).

Students who anticipate entry into the M.E. in Construction Engineering and Management are not required to complete any additional courses as part of the technical electives in their undergraduate program in architecture.

Students who anticipate entry into the M.E. in Structural Engineering program must successfully complete the following courses as part of their undergraduate program in Architecture: MATH 151, MATH 152, MATH 251, MATH 252, PHYS 123, PHYS 221, PHYS 224, MMAE 200/CAE 200, MMAE 202/CAE 202, CAE 303, CAE 304, CAE 307, CAE 310, CAE 431 and CAE 432 (in place of MATH 119, MATH 122, and all structural engineering courses for the Architecture major).

For undergraduate course descriptions, students should refer to the undergraduate bulletin.

Doctor of Philosophy in Civil Engineering

84 credit hours, which includes a master's degree

Qualifying exam

Comprehensive exam

Dissertation (24 credit hours)

Oral defense

The full-time doctoral program generally consists of at least two complete years of academic preparation, followed by at least 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 three semesters of entry into the program. The student selects a research advisor after he or she is admitted to candidacy. 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. In those

cases, the student must register for CAE 691 during each semester in which the thesis is being prepared.

The candidate should complete the comprehensive examination at least one year prior to the date of graduation. The comprehensive examination is an oral examination that is administered by a research committee approved by the chairperson. The candidate presents the research proposal and answers questions of a general professional nature.

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.

Doctor of Philosophy in Environmental Engineering

84 credit hours

Qualifying exam

Comprehensive exam

Thesis proposal

Dissertation and oral defense

The doctorate degree in environmental engineering is awarded in recognition of mastery in environmental engineering and upon demonstration of an ability to make substantial creative contributions to knowledge in 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. Typically, the program of study includes 30-40 percent environmental engineering coursework, 40-50 percent research, and 10-30 percent in other fields of study. The coursework must include 15 credits of core environmental engineering courses listed in the section describing the Master of Science in Environmental Engineering.

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 will cover core areas, including environmental chemistry, chemodynamics, environmental systems and analysis, and physiochemical processes.

The comprehensive examination is oral and may include a written exam based on the student's performance on the qualifying exam. Exam questions will be formulated by the members of the Ph.D. examining committee. The examination will also include an oral presentation and discussion of one or more research articles 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 advisor and approved and appointed by the chairperson at least three weeks prior to the examination.

The thesis proposal approval examination should be conducted after the comprehensive exam and at least one year before the final thesis defense. This oral exam is administered by the Ph.D. thesis committee.

Although doctoral research can begin after admission to the Ph.D. program, the major portion of the research should take place after the comprehensive examination is passed and the thesis proposal is approved by the committee. Research will be conducted under the supervision of a full-time department faculty member and students should work to involve all the members of their research committee. 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.

Certificate Programs in Civil Engineering

Construction Management

Required Courses (choose four)

CAE 470 Construction Methods and Cost Estimating
CAE 471 Construction Planning and Scheduling
CAE 472 Construction Site Operation
CAE 473 Construction Contract Administration
CAE 570 Legal Issues in Civil Engineering
CAE 571 Lean Construction and Control
CAE 572 Construction Cost Accounting and Control

CAE 573 Construction Management with BIM
CAE 574 Economic Decision Analysis in Civil Engineering
CAE 575 Systems Analysis in Civil Engineering
CAE 576 Legal Aspects of Real Estate and Development
CAE 577 Construction Equipment Management
CAE 578 Construction Claims Management
CAE 579 Real Estate Fundamentals for Engineers and Architects

Earthquake and Wind Engineering Design

Required Courses (choose four)

CAE 410 Introduction to Wind and Earthquake Engineering
CAE 518 Advanced Reinforced Concrete
CAE 525 Advanced Steel and Composite Structures

CAE 582 Structural Wind and Earthquake Engineering
CAE 583 Performance-Based Structural and Seismic Design of Buildings and Bridges
CAE 586 Seismic Design of Building and Bridge Structures

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:

CAE 589 Groundwater Hydrology & Sampling
ENVE 580 Hazardous Waste Engineering

Infrastructure Engineering and Management

Required Courses

PA 501 Processes, Structures, and Values
PA 551 Public Infrastructure Management

Elective Courses (choose two)

CAE 408 Bridge and Structural Design
CAE 416 Facility Design of Transportation Systems
CAE 417 Railroad Engineering and Design
CAE 419 Introduction to Transportation Engineering and Design
CAE 471 Construction Planning and Scheduling
CAE 486 Soil and Site Improvement
CAE 508 Advanced Bridge Engineering
CAE 523 Statistical Analysis of Engineering Data
CAE 539 Introduction to Geographic Information Systems

CAE 541 Pavement Evaluation and Management
CAE 544 Urban Transportation Planning
CAE 546 Public Transportation Systems
CAE 548 Transportation Systems Management
CAE 549 Transportation Economics, Development, and Policy
CAE 555 Transportation Systems Evaluation
CAE 568 Transportation Asset Management
CAE 574 Economic Decision Analysis in Civil Engineering
CAE 575 Systems Analysis in Civil Engineering
CAE 581 Algorithms in Transportation
CAE 590 Geotechnical Landfill Design and Maintenance
ENVE 404 Water and Wastewater Engineering
ENVE 551 Industrial Waste Treatment

Transportation Systems Planning

Required Courses (choose two)

CAE 523 Statistical Analysis of Engineering Data
CAE 544 Urban Transportation Planning
CAE 546 Public Transportation Systems
CAE 548 Transportation Systems Management
CAE 555 Transportation Systems Evaluation
CAE 575 Systems Analysis in Civil Engineering

Elective Courses (choose two)

CAE 416 Facility Design of Transportation Systems
CAE 417 Railroad Engineering and Design
CAE 419 Introduction to Transportation Engineering & Design
CAE 539 Introduction to Geographic Information Systems
CAE 549 Transportation Economics, Development, and Policy
CAE 568 Transportation Asset Management
CAE 574 Economic Decision Analysis in Civil Engineering
CAE 581 Algorithms in Transportation

Certificate Program in Architectural Engineering

Architectural Engineering

Required Course

CAE 513 Building Science

Elective Courses (choose two)

CAE 461 Plumbing and Fire Protection Design
CAE 464 HVAC Systems Design
CAE 507 Control of Sound and Vibrations in Buildings
CAE 509 Analysis and Design of Acoustic Spaces
CAE 521 Building Illumination Design
CAE 524 Building Enclosure Design
CAE 526 Energy Conservation Design in Buildings
CAE 528 Building Electrical Systems Design
CAE 597 Special Problems

Certificate Programs in Environmental Engineering

Air Resources

This program explores outdoor air quality, causes of outdoor air pollution, and investigative and diagnostic techniques used in outdoor air quality control.

Required Course

ENVE 570 Air Pollution Meteorology

Elective Courses

ENVE 576 Indoor 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.

Required Course

ENVE 580 Hazardous Waste Engineering

Elective Courses (choose two)

CAE 589 Groundwater Hydrology and Sampling
ENVE 506 Chemodynamics
ENVE 542 Physicochemical Processes in Environmental Engineering
ENVE 577 Design of Air Pollution Control Devices

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.

Required Course

ENVE 576 Indoor Air Pollution

Elective Courses (choose one)

CAE 523 Statistical Analysis of Engineering Data
MMAE 452 Aerospace Propulsion
BIOL 514 Toxicology

Water 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.

Required Courses

ENVE 513 Biotechnological Processes in Environmental Engineering
ENVE 542 Physicochemical Processes in Environmental Engineering
ENVE 551 Industrial Waste Treatment
ENVE 561 Design of Environmental Engineering Processes

Course Descriptions

Civil and Architectural Engineering

CAE 502

Acoustics & 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. (3-0-3)

CAE 503

Advanced Structural Analysis

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(s): [(CAE 411) OR (CAE 514*) OR (MMAE 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

CAE 504

Seismic Retrofit & 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(s): [(CAE 410 with min. grade of D) OR (CAE 420 with min. grade of D) OR (CAE 582) OR (CAE 583)]

(4-0-4)

CAE 506

Building Envelope Rehabilitation

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.

(3-0-3)

CAE 507

Control of Sound & 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.

(3-0-3)

CAE 508

Advanced Bridge Engineering

Specifications for bridge design and evaluation. Advanced bridge design and evaluation topics such as design load envelope, seismic load design, bridge condition rating, bridge load rating, and steel bridge fatigue evaluation. Bridge management systems. Life cycle analyses. Use of high performance materials in bridge engineering.

Prerequisite(s): [(CAE 408)]

(3-0-3)

CAE 509

Analysis & 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(s): [(CAE 502) OR (CAE 542)]

(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, & solids), fire phenomena in enclosures such as pre-flashover and post-flashover.

(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 & other fire protection systems. For architects, and engineers not majoring in fire protection and safety engineering.

(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.

(3-0-3)

CAE 513

Building Science

Study of the physical interaction of climate (humidity, temperature, wind, sun, rain, snow, etc.) and buildings. Topics include psychrometrics, indoor air quality, indoor thermal comfort, heat transfer, air infiltration, solar insolation, and heating and cooling load calculation.

(3-0-3)

CAE 514

Mathematical Methods for Structural Engineering

Matrices, linear spaces and transformations, eigenvalue problems, and their application to civil engineering. First-order differential equations for structural dynamics. Calculus of variations and variational principles for dynamics and statics. Rayleigh-Ritz method, finite element approximations, Newmark-Beta method, Green's Function, and Duhamel Integral and their application to civil engineering.

(3-0-3)

CAE 515

Building Energy Modeling

Building energy modeling (BEM) is the core of building information modeling (BIM) and sustainable design which are changing the way of architectural design and engineering. This course builds essential knowledge of building performance simulation and provides necessary background to use a building energy simulation software tool. Proven methods for using BEM to deal with such essential building performance and sustainability issues will be presented by using real world examples placing particular emphasis on using BEM-enabled quantitative analysis to evaluate design alternatives for the whole life cycle of a building. Complete with coverage of integrated design and lean construction requirements, this is a valuable course for architects, engineers, and construction professionals involved in energy performance modeling for buildings.

Prerequisite(s): [(CAE 513)]
(3-0-3)

CAE 516

Lighting Systems Design & Analysis

Intensive study of the calculation techniques and quantitative aspects of good luminous design. Topics covered include photometric quantities and color theory, visual perception, IESNA standards, daylight and artificial illumination, radiative transfer, luminaire characteristics, control systems, and energy conservation techniques. Design and analysis problems, field measurements, and use of industry computer simulations for design and luminaire systems.

(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 limit analysis of frames and yield-line analysis of plates.

Prerequisite(s): [(CAE 432*)] An asterisk (*) designates a course which may be taken concurrently.
(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.

Prerequisite(s): [(CAE 411 and CAE 431)]
(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. Requires senior standing.

Prerequisite(s): [(CAE 467 with min. grade of D) OR (CAE 502) OR (CAE 515)]
(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 photo elasticity and Moire methods.

Prerequisite(s): [(CAE 503)]
(2-2-4)

CAE 523

Statistical Analysis of Engineering Data

Descriptive statistics and graphs, probability distribution, random sampling, independence, significance tests, design of experiments, regression, time series analysis, statistical process control, and introduction to multivariate analysis.

(3-0-3)

CAE 524

Building Enclosure Design

Design of building exteriors, including the control of heat flow, air and moisture penetration, building movements, and deterioration. Study of the principle of rain screen walls and of energy conserving designs. Analytical techniques and building codes are discussed through case studies and design projects.

Prerequisite(s): [(CAE 513)]
(3-0-3)

CAE 525

Advanced Steel & Composite Structures

Torsion and web openings. Behavior and design of rigid and semi rigid 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 considerations 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.

Prerequisite(s): [(CAE 431*)] An asterisk (*) designates a course which may be taken concurrently.
(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(s): [(CAE 331) OR (CAE 513)]
(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 systems hardware: selection & sizing of sensors, actuators & controllers. Practical HVAC control systems; elementary local loop and complete control systems. Case studies. Computer applications.

Prerequisite(s): [(CAE 513) OR (CAE 531)]
(3-0-3)

CAE 528

Building Electrical Systems Design

Study of the analysis and design of electrical systems in buildings utilizing the National Electric Code. Topics include AC, DC, single phase and three-phase circuits, transients, branch circuits, panel boards, system sizing, fault calculations and overcurrent protection design. Also studies the design and specification of emergency power backup and alternative power systems.

(3-0-3)

CAE 529

Dynamics of Structures

Fundamentals of free, forced, and transient undamped and viscously damped vibration of single and multi-degree of freedom structures. Time, frequency, and approximate methods of analysis. Application of numerical methods in time and frequency domain. Response spectra, modes, coupling and modal space. Response history and response spectrum analyses and an introduction to earthquake engineering.

Prerequisite(s): [(CAE 411)]

(3-0-3)

CAE 530

Finite Element Method of Analysis

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(s): [(CAE 442)]

(3-0-3)

CAE 532

Analysis of Plates & 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.

Prerequisite(s): [(CAE 442*) OR (CAE 514*) OR (MMAE 501*)] An asterisk (*) designates a course which may be taken concurrently.

(4-0-4)

CAE 533

Theory & 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.

Prerequisite(s): [(CAE 442*) OR (CAE 514*) OR (MMAE 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

CAE 534

Computational Techniques in Finite Element Analysis

Survey of numerical methods as applied to FEM software. Database management, equation solvers, eigen value routines and schemes for direct integration (both implicit/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 super elements and sensitivity studies. Same as MAE 538.

Prerequisite(s): [(CAE 442*) OR (CAE 514*) OR (MMAE 501*)] An asterisk (*) designates a course which may be taken concurrently.

(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 MAE 539.

Prerequisite(s): [(CAE 442) OR (CAE 514) OR (MMAE 501)]

(3-0-3)

CAE 537

Homeland Security Concerns in Building Designs

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 concerns and procedures to minimize casualties. Analysis of post event fires and how to prevent them. Review of security measures 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 users to combine tabular information with maps, creating powerful spatial databases which 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 & 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.

(3-0-3)

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.

(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 & Flow Theory**

Studies of space and time distribution of speed and other traffic characteristics in the transportation network. Macro- and micro traffic 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.

(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.

(3-0-3)

CAE 549**Transportation Economics, Development & 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.

(3-0-3)

CAE 551**Prestressed Concrete**

Theory and design of prestressed concrete members and structure. Applications to both simple and continuous girder and frames subjected to stationary or moving loads. Prestressed cylindrical shells.

Prerequisite(s): [(CAE 432*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

CAE 553**Measurement & Instrumentation in Architectural Engineering**

Hands-on experience with energy and indoor air quality measurements in buildings including experimental design, data analysis, and experimental statistics. Measurements and techniques covered include: thermal performance (e.g., thermal conductivity and resistance, heat flux, and temperature); fluid flows and HVAC characteristics (e.g., velocity, pressure, and airflow); energy performance (e.g., current, voltage, and power draw); whole building diagnostics (e.g., blower door and duct blaster); and indoor air quality (e.g., tracer gas techniques for air exchange, particle measurements, and gas measurements). Course combines lectures and field measurements in buildings on campus.

Prerequisite(s): [(CAE 513)]

(3-0-3)

CAE 555**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.

(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 multi-story framed structures.

Prerequisite(s): [(CAE 431* and CAE 503*)] An asterisk (*) designates a course which may be taken concurrently.

(4-0-4)

CAE 561**Structural Reliability & 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(s): [(CAE 307)]

(3-0-3)

CAE 562**Engineering Behavior of Soil**

Soil mineralogy and soil fabric, soil-water electrolyte system, dispersive clay, stress and strain analyses, elastic equilibrium in soil masses, plastic equilibrium in soil masses, in situ and laboratory stress paths, shear strength of sands and clays, thermal properties of soils, critical state soil mechanics principles, nonlinear pseudo elastic and elastoplastic constitutive models.

Prerequisite(s): [(CAE 323 with min. grade of D)]

(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.

Prerequisite(s): [(CAE 323 with min. grade of D)] AND [(CAE 562*)] An asterisk (*) designates a course which may be taken concurrently.

(1-3-1)

CAE 564

Design of Foundations, Embankments & 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.

Prerequisite(s): [(CAE 323 with min. grade of D)] AND [(CAE 457)]

(4-0-4)

CAE 565

Rock Mechanics & 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(s): [(CAE 457)]

(4-0-4)

CAE 566

Earthquake Engineering & Soil Dynamics

Earthquakes and their intensity, influence of group motion, review of I-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.

Prerequisite(s): [(CAE 323 with min. grade of D)] AND [(CAE 420)]

(4-0-4)

CAE 567

Physiochemical Behavior of Soils

The nature of soils. Weathering and soil formulation 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.

Prerequisite(s): [(CAE 323 and ENVE 501)]

(3-0-3)

CAE 568

Transportation Asset Management

Processes and techniques for managing the preservation and expansion of highway transportation facilities such as pavements, bridges, and so forth, as well as system usage. Five component management systems are first examined: pavements, bridges, roadway maintenance, safety, and congestion. Finally, 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 and uncertainty modeling, and institutional issues.

(3-0-3)

CAE 570

Legal Issues in Civil Engineering

This course introduces students to the legal aspects of engineering and construction, contract documents, and contract clauses. Upon completion of this course, students will be able to do the following: (1) identify the elements of contract formation; (2) interpret contract clauses; (3) explain the rights and duties of the parties involved in design and construction; and (4) evaluate changes and their root causes. Students will also be able to objectively identify and analyze legal liabilities and the expected professional standard of architects, engineers, and contractors.

(3-0-3)

CAE 571

Lean Construction & Control

This course introduces students to lean principles and the lean project delivery system (LPDS) applied to the construction industry. Lean construction and lean project delivery embrace concepts and techniques originally conceived in the automobile manufacturing industry and adopted by the construction industry. In the manufacturing sector, lean production has revolutionized product manufacturing, resulting in significant gains in plant productivity, reliability, and reductions in defects. Specific concepts that will be covered in this course include Plan-Do-Check-Act continuous improvement, A3 reporting, value stream mapping, pull systems and pull planning, kanban, 5S, standardization, and the Choosing by Advantages Decisionmaking System.

(3-0-3)

CAE 572

Construction Cost Accounting & Control

Review of basic accounting principles 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 procedures. Project closeout. Class exercise using computer program.

(3-0-3)

CAE 573**Construction Management with Building Information Modeling**

Fundamentals and practical use of information technologies in the construction industry; basic concepts of building information modeling (BIM); review of software and technology available for BIM; practical use of BIM including design and clash detection; impact of BIM on construction management functions; construction scheduling and sequencing using BIM; cost estimating using BIM; facility management with BIM; integrated approach to navigate BIM as a multi-disciplinary design, analysis, construction, and facility management technology; class exercise to create a BIM model and to use it in scheduling, sequencing, cost estimating, management, and simulation of a construction project.

(3-0-3)

CAE 574**Economic Decision Analysis in Civil Engineering**

Basic economic concepts including interest calculations, economic comparison of alternatives, replacement decisions, depreciation and depletion, tax considerations, and sensitivity analysis. Evaluation of public projects, the effect of inflation, decision making under risk and/or uncertainty, economic decision models. Case studies from the construction industry.

(3-0-3)

CAE 575**Systems Analysis in Civil Engineering**

Management and system concepts, linear programming, graphical methods, Simplex, two-phase Simplex, the transportation problem, the assignment problem, integer programming, and sensitivity analysis. System modeling by activity networks; maximal-low flow, longest-path and shortest-path analyses, flow graphs, decision-tree analysis, stochastic-network modeling, queuing systems, and analysis of inventory systems. Case studies from the construction industry.

(3-0-3)

CAE 576**Legal Aspects of Real Estate & Development**

The objective of this course is to introduce civil engineering students to the legal aspects of real estate and the real estate development process. Students will learn the fundamentals of land, air, and water rights; legal interests of parties; purchase agreements, contractual relationships, and real estate contracts; closing real estate transactions; legal aspects of financing; government regulations that impact property transactions; and recent developments in green development law. This course will help civil engineering students learn legal skills that can be applied to real estate purchasing and development processes. This course is the second course in a two-course series on real estate and development. The first course is CAE 579: Real Estate Fundamentals, which is taught each fall semester.

Prerequisite(s): [(CAE 572)]

(3-0-3)

CAE 577**Construction Equipment Management**

Factors affecting the selection of construction 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, compaction and drilling equipment, pile driving equipment, pumps and crushers.

(3-0-3)

CAE 578**Construction Claims Management**

This course provides a basic explanation of construction contract claims by types such as delays, acceleration, and scope issues, the underlying legal theories of the contract construction and claims, elements required for each claims type defenses to the claim, prophylactic claims measures. The claims process within the contract and extra-contractual basis's for claims are examined. Resolution of claims by ADR techniques and the formal litigation process are explained. AIA, AGC, and federal claims provisions are described. In addition to construction contract claims other types of claims associated with construction projects are covered such as Surety bond claims and various insurance claims (CGL, Builder's Risk, workers comp, etc)

Prerequisite(s): [(CAE 473)]

(3-0-3)

CAE 579**Real Estate Fundamentals for Engineers & Architects**

The objective of this course is to introduce civil engineering students to the real estate process. Students will learn techniques and methodologies for evaluating real estate investment opportunities using engineering economic analysis principles. Students will use Time Value of Money analysis for evaluating real estate transactions, including how to carry out calculations using formulas, financial calculators, and spreadsheets. This course will help civil engineering students learn financial skills that can be applied to professional and personal investment decisions.

(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. A substantial amount of research and development activities have taken place over the last few years. This course will provide an introduction to the various aspects of ITS and will focus on ITS planning, technology, and evaluation. In addition, such topics as deployment, financing and management are also discussed. The course will include guest lectures and possible field visits.

(3-0-3)

CAE 581**Algorithms in Transportation**

Modeling and analysis of transportation network problems through the design, analysis, and implementation of algorithms. Emphasis on the use of quantitative techniques of operations research to model system performance. Covers fundamental data 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.

(3-0-3)

CAE 582**Structural Wind & 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 pseudo dynamic 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(s): [(CAE 420) OR (MMAE 406)]

(4-0-4)

CAE 583

Performance-Based Structural & Seismic Design of Buildings & Bridges

This course covers performance-based structural and seismic design (PBSSD) for buildings and bridges. The course will begin with brief reviewing and critical discussion on conventional code-based seismic design followed by the development of the concept and applicability of this new alternative and advanced PBSSD. Computer methods in linear dynamic, nonlinear static, and dynamic analyses will be surveyed and discussed as primary tools in PBSSD. Ample case studies from real-world projects are carried out throughout the course. These case studies include the PBSSD of special structures, tall buildings, and those that building code-based design is not applicable.

Prerequisite(s): [(CAE 410 with min. grade of D) OR (CAE 420 with min. grade of D) OR (CAE 582)]
(3-0-3)

CAE 584

Stormwater Management

Basic principles of storm water management; hydrology and hydraulics of excess water; excess water management and design; sewer system design and management, storm water detention systems; flood plain system design; risk based design of drainage systems; practical and case study problems.

Prerequisite(s): [(CAE 301)]
(3-0-3)

CAE 586

Seismic Design of Building & Bridge Structures

The course covers six topics, as listed in the course outline, on seismic design of steel and R/C building structures and bridges. In addition to offer fundamentals and experiences in seismic design through design examples, it is also assumed that structural engineers who are preparing for their Structural Engineer License Exam might find extremely helpful.

Prerequisite(s): [(CAE 431 and CAE 432)]
(3-0-3)

CAE 589

Groundwater Hydrology & 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.

Prerequisite(s): [(CAE 323 with min. grade of D) OR (ENVE 401 with min. grade of D)]
(3-0-3)

CAE 590

Geotechnical Landfill Design & 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(s): [(CAE 323)]
(3-0-3)

CAE 591

Research & Thesis for M.S. Degree

Research and Thesis for M.S. Degree.
(Credit: Variable)

CAE 593

Civil Engineering Seminar

Reports on current research. Graduate students are expected to register and attend.
(1-0-0)

CAE 594

Research Problems

Research.
(Credit: Variable)

CAE 597

Special Problems

Graduate course work in the problem subject matter. Subject matter will vary with the interests and background of students and instructor. Design or research problems may be assigned from the areas of architectural, construction, geotechnical, geoenvironmental, structural, or transportation engineering.

(Credit: Variable)

CAE 598

Special Topics

A special topic in civil or architectural engineering at the graduate level.

(Credit: Variable)

CAE 599

Graduate Workshop

Graduate workshop.
(0-0-0)

CAE 691

Research & Thesis for Ph.D. Degree

Research and Thesis for Ph.D. degree.
(Credit: Variable)

CAE 724

Introduction to Acoustics

This short course provides a brief introduction to the fundamentals of acoustics and the application to product noise prediction and reduction. The first part focuses on fundamentals of acoustics and noise generation. The second part of the course focuses on applied noise control.

(2-0-2)

Environmental Engineering

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.

(3-0-3)

ENVE 506

Chemodynamics

Processes that determine the fate and transport of contaminants in the environment. Upon successful completion of this course, students should be able 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.

(3-0-3)

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, stoichiometry, 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.

(3-0-3)

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 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(s): [(ENVE 501*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

ENVE 551

Industrial Waste Treatment

Industrial waste sources and characteristics, significance of industrial waste as environmental pollutants; applications of standard and special treatment processes, including physical, chemical and biological systems.

Prerequisite(s): [(ENVE 513*) OR (ENVE 542*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

ENVE 561

Design of Environmental Engineering Processes

Design of water and wastewater treatment systems. System economics and optimal design principles.

Prerequisite(s): [(ENVE 513*) OR (ENVE 542*)] An asterisk (*) designates a course which may be taken concurrently.

(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.

(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.

(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.

(3-0-3)

ENVE 578

Physical & 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.

(3-0-3)

ENVE 580

Hazardous Waste 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.

Prerequisite(s): [(ENVE 506*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

ENVE 590

Environmental Engineering Seminar

Current topics in environmental engineering featuring presentations by practitioners from a range of institutions such as academia, industry, consulting, research laboratories, or government.

(1-0-0)

ENVE 591

Research & Thesis M.S.

Graduate research.

(Credit: Variable)

ENVE 597

Special Problems

Independent study and project. (Variable credit)

(Credit: Variable)

ENVE 691

Research & Thesis Ph.D.

Graduate research.

(Credit: Variable)

Department of Computer Science

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Chair:

Xian-He Sun

Associate Chair:

Bogdan Korel

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:

- Business
- Computational Intelligence
- Cyber-Physical Systems
- Data Analytics
- Database Systems
- Distributed and Cloud Computing
- Education
- Finance
- Information Security and Assurance
- Networking and Communications
- Software Engineering

Master of Science in Computer Science

Doctor of Philosophy in Computer Science

With the Department of Applied Mathematics:

Master of Data Science

With the Department of Electrical and Computer Engineering:

Master of Telecommunications and Software Engineering

With the Department of Chemical and Biological Engineering:

Master of Science in Computer Science/Master of Chemical Engineering

Certificate Programs

Computational Intelligence

Cyber-Physical Systems

Data Analytics

Database Systems

Distributed and Cloud Computing

Information Security and Assurance

Networking and Communications

Software Engineering

Research Facilities

The department has research computing facilities that include several state of the art computer clusters and workstations. The equipment includes a large-scale Sun “ComputerFarm” consisting of 172 processors and 562 cores connected via a Linux-based IBM cluster, an Opteron cluster from Microsoft, and a Cray XD1 connected Management. An advanced technology Access Grid node has been installed by the department, which

allows researchers, teachers, and students at different locations worldwide too interact via a network multimedia environment. Research in Data-Intensive Distributed Systems is facilitated by a 12-node cluster with 118 cores, 382 GB RAM, and 32TB of harddisk space. Research labs in the department have advanced computer workstations with multicore servers.

Research Areas

Algorithms, data structures, artificial intelligence, computer architecture, computer graphics, computer networking and telecommunications, computer vision, database systems, distributed and parallel processing, I/O

systems, image processing, information retrieval, natural language processing, software engineering, and system software, machine learning, cloud computing.

Faculty

Agam, Gady, Associate Professor. B.S., M.S., Ph.D., Ben-Gurion University (Israel). Computer vision, computer graphics, image processing, pattern recognition, machine learning, geometric modeling, medical imaging, document imaging.

Argamon, Shlomo, Professor. B.S. Carnegie- Mellon University; M.S, Ph.D. Yale University. Machine Learning, computational linguistics, stylistics, information retrieval.

Bauer, Charles, Professor Emeritus. B.S., M.Ed., Loyola University. Computer Education, computers used in education, distance learning, computer-based educational technology, computer learning, teacher training.

Bauer, Matthew J., Senior Lecturer and Director of Undergraduate Academic Advising. B.S., M.S., Illinois Institute of Technology.

Beckman, Jr., A. Mattox, Senior Lecturer. B.S., Ph.D., University of Illinois, Urbana-Champaign.

Bilgic, Mustafa, Assistant Professor. B.S., University of Texas; M.S., Ph.D., University of Maryland. Data mining, machine learning, probabilistic graphical models, statistical relational learning, active learning, social network analysis, information visualization.

Burnstein, Ilene, Professor Emerita. 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.

Calinescu, Gruia, Associate Professor. M.S., University of Bucharest (Romania); Ph.D., Georgia Institute of Technology. Algorithms, approximation algorithms, optical and wireless, ad-hoc networks.

Chlebus, Edward, Industry Associate Professor. M.S., Ph.D., Cracow University (Poland). Network modeling, performance evaluation and tele-traffic analysis.

Culotta, Aron, Assistant Professor. B.S., Tulane University; M.S., Ph.D., University of Massachusetts. Social media analysis, information extraction, data mining, machine learning, natural language processing.

Evens, Martha, Professor Emerita. A.B., Bryn Mawr College; A.M., Radcliffe College; Ph.D., Northwestern University. Natural language processing, expert systems and intelligent tutoring/information systems.

Glavic, Boris, Assistant Professor. M.Sc., RWTH Aachen University (Germany); Ph.D., University of Zurich (Switzerland). Databases, data provenance, information integration.

Greene, Peter, Professor Emeritus. A.B., Amherst College; Ph.D., University of Chicago. Neural networks, feeling-based reasoning, artificial intelligence and robotics.

Hanrath, Jon, Senior Instructor. Ph.D., Michigan State University.

Hood, Cynthia, Associate Professor of Computer Science and Engineering. B.S., Rensselaer Polytechnic Institute; M.S., Stevens Institute of Technology; Ph.D., Rensselaer Polytechnic Institute. Network management, statistical signal processing, learning processing.

Jin, Dong, Assistant Professor. B.Eng., Nanyang Technological University (Singapore); M.S., University of Illinois, Urbana-Champaign. Cyber Security, Networks, Modeling and Simulation of Large-Scale Systems, Trustworthy Power Critical Infrastructures.

Kapoor, Sanjiv, Professor. Ph.D., University of Illinois, Urbana-Champaign. Computational geometry, graph algorithms, combinatorial optimization, graphics, data structures.

Korel, Bogdan, Associate Professor of Computer Science and Engineering and Associate Chair, Department of Computer Science. M.S., Technical University of Kiev (Ukraine); Ph.D., Oakland University. Software engineering, automated software testing and analysis.

Koutsogiannakis, George, Instructor. B.S., M.S., M.B.A., DePaul University; M.S. Illinois Institute of Technology.

Lan, Zhiling, Associate Professor. B.S. Beijing Normal University (China); M.S. Chinese Academy of Sciences; Ph.D., Northwestern University. Parallel and distributed computing, performance analysis and modeling.

Leung, Wu-Hon F., Industry Professor. Ph.D., University of California-Berkeley.

Li, Xiang-Yang, Professor. B.E., Tsinghua University; M.S., Ph.D., University of Illinois, Urbana-Champaign. Algorithm design and analysis, system design for wireless ad hoc and sensor networks, network information theory, security protocols, and computational geometry.

Raicu, Ioan, Assistant Professor. B.S., M.S., Wayne State University; M.S., Ph.D., University of Chicago. Distributed Systems, high-throughput and high-performance computing, efficient task dispatch and execution systems, resource provisioning, data management, scheduling, performance evaluations in distributed systems.

Reingold, Edward M., 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.

Ren, Shangping, Associate 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).

Roberson, Dennis A., Research Professor and Vice Provost for Research. B.S., Washington State University; M.S., Stanford University.

Saelee, Michael K., Senior Instructor. B.S., M.S., Illinois Institute of Technology.

Sasaki, James T., Senior Lecturer and Director of the Professional Master's Program in Computer Science. B.S., Illinois Institute of Technology; M.S., Ph.D., Cornell University.

Sun, Xian-He, Professor and Chair. Ph.D., Michigan State University. Distributed and parallel processing, software systems, I/O systems, performance evaluation, scientific computing.

Wan, Peng-Jun, Professor. B.S., Tsinghua University (China); Ph.D., University of Minnesota. Interconnection design, routing and resource management in optical networks, low-earth orbit satellite networks, wireless local area networks.

Winans, Vida J., Senior Instructor and Graduate Coordinator. B.A., Cornell University; M.S., Illinois Institute of Technology.

Zhang-Sun, Hong, Research Professor. B.S., Beijing Normal University; M.S., Ph.D., Michigan State University.

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 on or after Oct.1, 2011:

M.S.: 298 (quantitative + verbal), 3.0 analytical writing

M.A.S.: 292 (quantitative + verbal), 2.5 analytical writing

Ph.D.: 304 (quantitative + verbal), 3.5 analytical writing, with a minimum in the 70th percentile of the quantitative section

GRE minimum score for tests taken on or after Aug.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): 523/70*

PTE score (international students from non-English speaking countries): 47

IELTS score (international students from non-English speaking countries): 5.5

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 masters degree programs in computer science should hold a bachelors 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 523/70 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 bachelors degrees from accredited U.S. institutions with a minimum cumulative GPA of 3.0/4.0.) Applicants with bachelors 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 grades 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 bachelors degree and 3.5/4.0 for their M.S. degree, or a minimum GPA of 3.5/4.0 for their bachelors degree if they apply without a M.S. degree. For non-English speaking applicants without a U.S. degree, a minimum TOEFL score of 523/70 is required.

* Paper/internet-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:

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 at least one course in each of the three core areas (Programming, Systems, and Theory).

Programming Core Courses

- CS 511 Topics in Computer Graphics
- CS 512 Topics in Computer Vision
- CS 525 Advanced Database Organization
- CS 540 Syntactic Analysis of Programming Languages
- CS 541 Topics in Compiler Construction
- CS 546 Parallel and Distributed Processing
- CS 551 Operating System Design and Implementation
- CS 553 Cloud Computing

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 533 Computational Geometry
- CS 535 Design and Analysis of Algorithms
- CS 536 Science of Programming
- CS 538 Combinatorial Organization
- CS 539 Game Theory: Algorithms and Applications

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 508 Process Design Optimization
- CHE 536 Computational Techniques in Engineering
- CHE 560 Statistical Quality and Process Control

Master of Computer Science with Specialization in Business

33 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 three specialization courses from the Stuart School of Business:

Specialization Courses

BUS 510	Building an Innovative & Sustainable Business
BUS 550	Business Analytics for Competitive Advantage
MBA 501	Accounting for Strategic Decision Making
MBA 502	Emerging Issues in the Global Business Environment
MBA 504	Spreadsheet Modeling
MBA 506	Leading & Managing Knowledge-Intensive Organizations
MBA 509	Financial Management in a Globalized World
MBA 511	Creating, Communicating, & Delivering Customer Value

Note: Stuart School of Business tuition and fees apply to these courses. Applicants to the program are not required to take the GMAT.

Master of Computer Science with Specialization in Computational Intelligence

30 Credit Hours

This program is intended for students who are interested in ways in which computers may learn and adapt based on data so as to solve complex problems in various areas of computer science.

To qualify for the specialization in Computational Intelligence, students must satisfy general Master of Computer Science requirements and are also required to select one of the following specialization courses.

Specialization Courses

CS 480	Artificial Intelligence Planning & Control
CS 512	Topics in Computer Vision
CS 522	Data Mining
CS 583	Probabilistic Graphical Models
CS 584	Machine Learning
CS 585	Natural Language Processing

With department approval, a course not on the list above may be substituted for one of the five specialization courses.

Master of Computer Science with Specialization in Cyber-Physical Systems

30 Credit Hours

This program is intended for students who are interested in learning how to work with embedded controllers with integrated sensors and networking abilities and to utilize them for real-world applications.

To qualify for the specialization in Cyber-Physical systems, students must satisfy general Master of Computer Science requirements and are also required to select four of the following specialization courses.

Specialization Courses

CS 442	Mobile Applications Development
CS 552	Distributed Real-Time Systems
CS 553	Cloud Computing
CS 555	Analytic Models and Simulation of Computer Systems
CS 556	Cyber-Physical Systems: Languages and Systems
CS 557	Cyber-Physical Systems: Networking and Algorithms

Master of Computer Science with Specialization in Data Analytics

30 Credit Hours

Intelligent analysis of large amounts of data is a crucial component in supporting business decisions. The Master of Science with Specialization in Data Analytics is intended for students interested in learning how to discover patterns in large amounts of data in information systems and how to use these to draw conclusions.

To qualify for the specialization in Data Analytics, students must satisfy general Master of Computer Science requirements and are also required to select four of the following specialization courses.

Specialization Courses

CS 422 Data Mining
CS 522 Data Mining
CS 554 Data-Intensive Computing
CS 583 Probabilistic Graphical Models
CS 584 Machine Learning
CS 585 Natural Language Processing

Master of Computer Science with Specialization in Database 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 425 Database Organization
CS 520 Data Integration, Warehousing, and Provenance
CS 521 Object-Oriented Analysis and Design
CS 522 Data Mining
CS 525 Advanced Database Organization
CS 529 Information Retrieval
CS 553 Cloud Computing
CS 554 Data-Intensive Computing

Master of Computer Science with Specialization in Distributed and Cloud Computing

30 Credit Hours

The Master of Computer Science with a Specialization in Distributed and Cloud Computing is intended for students who are interested to learn about distributed systems and how they are applied to real world problems, as well as how emerging cloud computing technologies can be used to implement some of the world's most popular services and applications.

To qualify for the specialization in Distributed and Cloud Computing, students must satisfy general Master of

Computer Science requirements and are also required to select four of the following specialization courses. Below, CS 550 is also marked (Sys), because it also counts as a Systems core course.

Specialization Courses

CS 546 Parallel and Distributed Processing
CS 550 Advanced Operating Systems
CS 552 Distributed Real-Time Systems
CS 553 Cloud Computing
CS 554 Data-Intensive Computing
CS 570 Advanced Computer Architecture

Master of Computer Science with Specialization in Education

33 Credit Hours

The Master of Computer Science with a specialization in Education is designed to enable Computer Science students to further their technical education while opening a career path toward teaching computer science.

Courses for the MCS/Education degree program are taken from the Computer Science Department and the Department of Mathematics and Science Education (MSSED). In addition to satisfying General MCS degree requirements, the program of study must include 24

credit hours of CS/CSP courses and the following 3 MSSED courses, which are the first 3 required courses for a teaching certificate.

MSSED Required Courses

MSSED 300 Instructional Methods/Strategies I
MSSED 500 Analysis of Classrooms II (Practicum and Seminar)
MSSED 554 Middle and Secondary Level Science Curriculum
OR
MSSED 555 Middle and Secondary Level Mathematics Curriculum

Master of Computer Science with Specialization in Finance

33 Credit Hours

The Master of Computer Science with a specialization in Finance is designed to enable Computer Science students to further their technical education while opening a path toward a career in finance.

Courses for the MCS/Finance degree program are taken from the Computer Science Department and the Department of Finance in the IIT Stuart School of Business. In

addition to satisfying the General MCS Degree requirements, the program of study must include 24 credit hours of CS/CSP courses and the following 3 MSF courses (9 credit hours).

Required Finance Courses

MSF 504 Valuation and Portfolio Management
MSF 505 Futures, Options, and OTC Derivatives
MSF 506 Financial Statement Analysis

Master of Computer Science with Specialization in Information Security and Assurance

30 Credit Hours

Information security, privacy, and information assurance are of prime importance in modern computer systems where data can be accessed from nearly everywhere. The Master of Computer Science with Specialization in Information Security and Assurance is intended for students interested in aspects of security and assurance in modern e-commerce applications.

To qualify for the specialization in Information Security

and Assurance, students must satisfy general Master of Computer Science requirements and are also required to select four of the following specialization courses:

Specialization Courses

CS 458 Information Security
CS 525 Advanced Database Organization
CS 549 Cryptography and Network Security
CS 595 Topics in Computer Science
CSP 544 System and Network Security

Master of Computer Science with Specialization in Networking and Communications

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 455 Data Communications
CS 542 Computer Networks I: Fundamentals
CS 544 Computer Networks II: Network Services
CS 547 Wireless Networking
CS 548 Broadband Networks
CS 549 Cryptography and Network Security
CS 555 Analytic Models and Simulation of Computer Systems
CS 557 Cyber-Physical Systems: Networking and Algorithms

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. Note that CS 536 and CS 586 also count as Theory and Systems core courses respectively.

Specialization Courses

CS 487 Software Engineering I
CS 521 Object-Oriented Analysis and Design
CS 536 Science of Programming
CS 537 Software Metrics
CS 586 Software Systems Architectures
CS 587 Software Project Management
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 advisor.

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. If a thesis or project is included in the program, the student, with a faculty advisor, develops a program of study that specifies the supportive and elective program and describes the thesis or project. 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” below.)

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 at least one course from the Programming area, at least one course from the Systems area, and at least two courses from the Theory area. The list below contains the core course offerings in the M.S. program:

Programming Core Courses

- CS 511 Topics in Computer Graphics
- CS 512 Topics in Computer Vision
- CS 525 Advanced Database Organization
- CS 540 Syntactic Analysis of Programming Languages
- CS 541 Topics in Compiler Construction
- CS 546 Parallel and Distributed Processing
- CS 551 Operating System Design and Implementation
- CS 553 Cloud Computing

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 Architectures

Theory Core Courses

- CS 530 Theory of Computation
- CS 533 Computational Geometry
- CS 535 Design and Analysis of Algorithms
- CS 536 Science of Programming
- CS 538 Combinatorial Optimization
- CS 539 Game Theory: Algorithms and Applications

Master of Data Science

Collaborative Program with the Department of Applied Mathematics

33 credit hours

This Professional Master's degree program consists of 33 credit hours of coursework, including a practicum, in data science. The program is designed primarily for those with previous degrees or experience in computer science, statistics, mathematics, natural sciences, or business, who are interested in preparing for a career as a data science professional in business and industry. Enrolled full-time, the program can be completed in a year, including one summer.

Admission Requirements

A 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 304 and an analytic writing score of at least 3.0, 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), a data structures course at the level of CS 331, experience with database programming at the level of CS 425, linear algebra at the level of MATH 332, and probability and statistics at the level of MATH 474. Information on these courses is available in this catalog.

Students with insufficient background in computer science and/or mathematics will be required to take the relevant prerequisite courses and earn at least a B grade in each. These prerequisite courses do not count toward the 33 credit hour requirement.

Program Requirements

Coursework includes 18 credit hours of required core courses and 6 credit hours of CSP/MATH 572 Data Science Practicum. At least 9 credit hours must be taken of 500-level CS or CSP courses and 9 credit hours of 500-level MATH courses, not including the CSP/MATH 572 Data Science Practicum. Students must also take one semester of CSP/MATH 570 Data Science Seminar.

Data Science Core Courses

COM 523 Communicating Science
CS 587 Software Project Management

CS 584 Machine Learning

OR

MATH 569 Statistical Learning

CS 525 Advanced Database Organization

OR

CS 554 Data-Intensive Computing

MATH 564 Applied Statistics

MATH 571 Data Preparation and Analysis

Data Science Electives

Computational Fundamentals

CS 425 Database Organization
CS 450 Operating System
CS 535 Design and Analysis of Algorithms
CS 546 Parallel and Distributed Processing
CS 553 Cloud Computing
CS 589 Software Testing and Analysis

Computer Science Applications

CS 512 Topics in Computer Science
CS 529 Information Retrieval
CS 556 Cyber-Physical Systems: Languages and Systems
CS 557 Cyber-Physical Systems: Networking and Algorithms
CS 583 Probabilistic Graphical Models
CS 585 Natural Language Processing

Mathematics, Probability, and Statistics

MATH 532 Linear Algebra
MATH 540 Probability
MATH 542 Stochastic Processes
MATH 565 Monte Carlo Methods in Finance
MATH 567 Advanced Design of Experiments
MATH 574 Bayesian Computational Statistics

Mathematical and Scientific Computing

MATH 577 Computational Mathematics I
MATH 578 Computational Mathematics II
MATH 590 Meshfree Methods
BIOL 550 Bioinformatics
PHYS 440 Computational Physics

Master of Telecommunications and Software Engineering (M.T.S.E.)

Collaborative Program with the Department of Electrical and Computer 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 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 advisor 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

Program Requirement

The M.T.S.E. is a professional master's degree requiring a minimum of 30 credit hours of advisor-approved coursework. 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 Computer Networks (can be substituted with ECE 542)

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

CS 544 Computer Networks II: Network Services
CS 548 Broadband Networks
CS 555 Analytic Models and Simulation of Computer Systems
ECE 545 Advanced Computer Networks

III. Telecommunications

ECE 504 Wireless Communication System 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. advisor. Students with no background in communications or software engineering should consider including in their programs of study:

CS 450 Operating Systems
CS 455 Data Communications
CS 487 Software Engineering I
ECE 403 Digital and Data Communication 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.

Doctor of Philosophy

85 credit hours if without M.S. degree; 54 credit hours if with M.S. 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 in-

terests. 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 B.S. degree or an M.S. degree in related fields. The requirements of the Ph.D. program are described separately as follows.

Requirements for Students Entering With a B.S. Degree

85 credit hours

Qualifying exam

Comprehensive exam

Dissertation and oral defense

Admission Requirements

The Ph.D. (post B.S.) program (called the direct Ph.D. program) encourages bright and highly motivated students to participate in a research program immediately after the B.S. degree.

The applicants should have a 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.

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 score of 70 on the internet

based TOEFL or 523 on the paper based TOEFL; or 47 on the PTE; or 5.5 on the IELTS is required for admission consideration. Applicants must submit three letters of recommendation.

Doctor of Philosophy - continued

Program Requirements (for students with a B.S. degree)

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 CS 695 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-III described below and at least one course from each of two different groups from among Groups IV-VII. 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
CS 539 Game Theory: Algorithms and Applications

Group II: Systems

CS 546 Parallel and Distributed Processing
CS 550 Advanced Operating Systems
CS 570 Advanced Computer Architecture

Group III: Programming Languages

CS 536 Science of Programming
CS 540 Syntactic Analysis of Programming Languages
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

Group VII: Computational Intelligence

CS 512 Topics in Computer Vision
CS 583 Probabilistic Graphical Models
CS 584 Machine Learning
CS 585 Natural Language Processing

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.

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. Passing a relevant core course with "A" when registered in the PhD section of that course qualifies as passing the respective area examination. 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.

Doctor of Philosophy - continued

Program Requirements (for students with an M.S. degree)

If the student has an M.S. degree in computer science, the program requires the student to complete at least 54 advisor-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 CS 695 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 three core courses with at least one each from Groups I-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 CS 595 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 advisor. The credit hours of 500-level coursework must include five core courses with at least one each from Groups I-III described before and at least two courses from two different groups from among Groups IV-VII. 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. 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. Passing a relevant core course with "A" when registered in the PhD section of that course qualifies as passing the respective area examination. 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 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 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 advisor concerning the makeup of the committee.

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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 bachelors degree from an accredited college or university. The degree need not be in computer science.

Computational Intelligence Certificate

Nine hours from the following:

CS 480 Artificial Intelligence Planning & Control
CS 512 Topics in Computer Vision

CS 522 Data Mining
CS 583 Probabilistic Graphical Models
CS 584 Machine Learning
CS 585 Natural Language Processing

Cyber-Physical Systems Certificate

Nine hours from the following:

CS 442 Mobile Applications Development
CS 552 Distributed Real-Time Systems
CS 553 Cloud Computing

CS 555 Analytic Models and Simulation of Computer Systems
CS 556 Cyber-Physical Systems: Languages and Systems
CS 557 Cyber-Physical Systems: Networking and Algorithms

Data Analytics Certificate

Nine hours from the following:

CS 422 Data Mining
CS 522 Data Mining

CS 554 Data-Intensive Computing
CS 583 Probabilistic Graphical Models
CS 584 Machine Learning
CS 585 Natural Language Processing

Database Systems Certificate

Nine hours from the following:

CS 425 Database Organization
CS 520 Data Integration, Warehousing, & Provenance
CS 521 Object-Oriented Analysis and Design

CS 522 Data Mining
CS 525 Advanced Database Organization
CS 529 Information Retrieval
CS 553 Cloud Computing
CS 554 Data-Intensive Computing

Distributed and Cloud Computing Certificate

Nine hours from the following:

CS 451 Introduction to Parallel & Distributed Computing
CS 546 Parallel and Distributed Processing
CS 550 Advanced Operating Systems

CS 552 Distributed Real-Time Systems
CS 553 Cloud Computing
CS 554 Data-Intensive Computing
CS 570 Advanced Computer Architecture

Information Security and Assurance Certificate**Nine hours from the following:**

CS 458 Information Security

CS 525 Advanced Database Organization

CS 549 Cryptography and Network Security

CS 595 Topics in Computer Science: Information Security, Privacy, and Assurance

CSP 544 System and Network Security

Networking and Communications Certificate**Nine hours from the following:**

CS 455 Data Communications

CS 542 Computer Networks I: Fundamentals

CS 544 Computer Networks II: Network Services

CS 547 Wireless Networking

CS 548 Broadband Networks

CS 549 Cryptography and Network Security

CS 555 Analytic Models & Simulation of Computer Systems

Software Engineering Certificate**Nine hours from the following:**

CS 487 Software Engineering I

CS 521 Object-Oriented Analysis and Design

CS 536 Science of Programming

CS 537 Software Metrics

CS 586 Software Systems Architecture

CS 587 Software Project Management

CS 589 Software Testing and Analysis

Accelerated Programs

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 pro-

vide 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

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, Nonphotorealistic rendering Particle systems, Character animation, Physically based modeling and animation.

Prerequisite(s): [(CS 411)]
(3-0-3)

CS 512

Topics in 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(s): [(CS 430)]
(3-0-3)

CS 513

Geospatial Vision & Visualization

Geospatial information has become ubiquitous in everyday life as evidenced by on-line mapping services such as NOKIA Here Map, Microsoft Bing Map, the “place” features on social network websites such as Facebook, and navigation apps on smart phones. Behind the scenes is digital map content engineering that enables all types of location-based services. Course material will be drawn from the instructor’s research and development experience at NOKIA Location and Commerce (formerly NAVTEQ), the Chicago-based leading global provider of digital map, traffic, and location data. This course will provide a comprehensive treatment of computer vision, image processing and visualization techniques in the context of digital mapping, global positioning and sensing, next generation map making, and three-dimensional map content creations. Real world problems and data and on-site industry visits will comprise part of the course curriculum.

(3-0-3)

CS 520

Data Integration, Warehousing, & Provenance

This course introduces the basic concepts of data integration, data warehousing, and provenance. We will learn how to resolve structural heterogeneity through schema matching and mapping. The course introduces techniques for querying several heterogeneous datasources at once (data integration) and translating data between databases with different data representations (data exchange). Furthermore, we will cover the data-warehouse paradigm including the Extract-Transform-Load (ETL) process, the data cube model and its relational representations (such as snowflake and star schema), and efficient processing of analytical queries. This will be contrasted with Big Data analytics approaches that (besides other differences) significantly reduce the upfront cost of analytics. When feeding data through complex processing pipelines such as data exchange transformations or ETL workflows, it is easy to lose track of the origin of data. Therefore, in the last part of the course we cover techniques for representing and keeping track of the origin and creation process of data (its provenance).

The course emphasizes practical skills through a series of homework assignments that help students develop a strong background in data integration systems and techniques. At the same time, it also addresses the underlying formalisms. For example, we will discuss the logic based languages used for schema mapping and the dimensional data model as well as their practical application (e.g., developing an ETL workflow with rapid miner and creating a mapping between two example schemata). The literature reviews will familiarize students with data integration and provenance research.

Prerequisite(s): [(CS 425)]
(3-0-3)

CS 521

Object-Oriented Analysis & Design

This course describes a methodology that covers a wide range of software engineering 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, frame works, 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. (Credit will not be given for CS 521 if CS751 is taken)

Prerequisite(s): [(CS 445) OR (CS 487)]
(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(s): [(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 specialist, and the designers and developers of client/server and distributed systems. Focus is on transaction management, database structures and distributed processing.

Prerequisite(s): [(CS 425)]
(3-0-3)

CS 529**Information Retrieval**

The course covers the advanced topics in Information Retrieval. The topics such as Summarization, cross-lingual, Meta-Search, Question Answering, Parallel and distributed IR systems are discussed. The students get involved in research ideas, and get involved in individual and group projects.

Prerequisite(s): [(CS 429)]
(3-0-3)

CS 530**Theory of Computation**

Computability topics such as Turing machines, non-deterministic machines, undecidability, 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.

Prerequisite(s): [(CS 430)]
(3-0-3)

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(s): [(CS 430)]
(3-0-3)

CS 533**Computational Geometry**

This course covers fundamental algorithms and data structures for convex hulls, Voronoi diagrams, Delauney triangulation, Euclidean spanning trees, point location, and 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.

Prerequisite(s): [(CS 430)]
(3-0-3)

CS 535**Design & 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.

Prerequisite(s): [(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(s): [(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(s): [(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 matching, weighted matching, matroids. Prerequisite: CS 430 and a linear algebra course.

Prerequisite(s): [(CS 430)]
(3-0-3)

CS 539**Game Theory: Algorithms & Applications**

This course focuses on computational issues in the theory of games, economics, and network design. Interest in the algorithmic aspects of games is motivated by the computational issues of fundamental aspects of games and economic theory, e.g. Nash equilibrium and market equilibrium. Computing and approximating Nash equilibrium will be studied. Of considerable interest to the computer science community are problems that arise from the Internet and computer networks and are similar to issues that arise in traditional transport networks, e.g. Wardrop equilibrium.

Prerequisite(s): [(CS 430) OR (CS 530)]
(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.

Prerequisite(s): [(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, models of code generators, etc. The objective of the course is to provide an in-depth coverage of compiler optimization techniques, including both classical optimization and areas of current interest in compiler research.

Prerequisite(s): [(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(s): [(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.

Prerequisite(s): [(CS 542) OR (ECE 545)]
(3-0-3)

CS 545

Distributed Computing Landscape

Introduction to the theory of concurrent programming languages. Topics include formal models of concurrent computation such as process algebras, nets, and actors; high-level concurrent programming languages and their operational semantics; and methods for reasoning about correctness and complexity of concurrent programs.

Prerequisite(s): [(CS 450)]
(3-0-3)

CS 546

Parallel & Distributed Processing

This course covers general issues of parallel and distributed processing from a user's point of view which includes system architectures, programming, performance evaluation, applications, and the influence of communication and parallelism on algorithm design.

Prerequisite(s): [(CS 430 and 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 as regulations, 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 students' own choosing.

Prerequisite(s): [(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 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(s): [(CS 455)]
(3-0-3)

CS 549

Cryptography & Network Security

This course provides an introduction to the theory and 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(s): [(CS 430)]
(3-0-3)

CS 550

Advanced Operating Systems

Advanced operating system design concepts such as interprocess communication, distributed processing, replication and consistency, fault tolerance, synchronization, file systems. Study of systems highlighting these concepts.

Prerequisite(s): [(CS 450)]
(3-0-3)

CS 551

Operating System Design & Implementation

This course covers in detail the design and implementation of processes, interprocess communication, semaphores, monitors, message passing, scheduling algorithm, input/output, device drivers, memory management, file system design, security and protection mechanisms. The hardware-software interface and the user process-system call-kernel interface are examined in detail. Students modify and extend a multiuser operating system.

Prerequisite(s): [(CS 450)]
(3-0-3)

CS 552**Distributed Real-Time Systems**

With the advancement of computer hardware, embedded devices, and network technology, real-time applications have become pervasive, ranging from smart automobiles to automated traffic control. Different from general-purpose applications, correct executions of real-time applications depend on both functional correctness and temporal correctness. This course is to study the fundamentals of distributed real-time computing with the focus on its temporal aspects.

Prerequisite(s): [(CS 450)]

(3-0-3)

CS 553**Cloud Computing**

This course is a tour through various topics and technologies related to cloud computing. Students will explore solutions and learn design principles for building large network-based systems to support both compute-intensive and data-intensive applications across geographically distributed infrastructure. Topics include resource management, programming models, application models, system characterizations, and implementations. Discussions will often be grounded in the context of deployed cloud computing systems such as Amazon EC2 and S3, Microsoft Azure, Google AppEngine, Eucalyptus, Nimbus, OpenStack, Google's MapReduce, Yahoo's Hadoop, Microsoft's Dryad, Sphere/Sector, and many other systems. The course involves lectures, outside invited speakers, discussions of research papers, programming assignments, and a major project (including both a written report and an oral presentation).

Prerequisite(s): [(CS 450) OR (CS 455)]

(3-0-3)

CS 554**Data-Intensive Computing**

This course is a tour through various research topics in distributed data-intensive computing, covering topics in cluster computing, grid computing, supercomputing, and cloud computing. The course will explore solutions and learn design principles for building large network-based computational systems to support data-intensive computing. This course is geared for junior/senior-level undergraduates and graduate students in computer science.

Prerequisite(s): [(CS 450)]

(3-0-3)

CS 555**Analytic Models & Simulation of Computer Systems**

Analytic and simulation techniques for the performance analysis of computer architecture, operating systems and communication networks. Rigorous development of queuing models. Study of simulation languages and models.

Prerequisite(s): [(CS 450)]

(3-0-3)

CS 556**Cyber-Physical Systems: Languages & Systems**

Different from general-purpose and traditional computer applications, cyber-physical systems have both continuous and discrete components, hence requiring new methodologies to integrate traditional continuous control theory/systems with traditional discrete software systems. The focus of this course is to discuss and understand the challenges in emerging cyber-physical systems and to explore possible solutions from the perspectives of systems specification, system modeling, programming languages, systems designs, and software engineering. This course will focus on the languages and systems aspects of cyber-physical systems.

(3-0-3)

CS 557**Cyber-Physical Systems: Networking & Algorithms**

The goal of the course is to provide students with the necessary foundations to apply wireless sensor networking, scheduling theory, and algorithms in the field of computer science. The focus is to discuss and understand the challenges in emerging cyber-physical systems, open distributed real-time systems, and wireless sensor networks. The course will examine different perspectives of wireless networks such as various MAC protocols, routing protocols, scheduling protocols, localization, clock synchronization, data aggregation and data fusion, compressive and cooperative sensing, security, fault detection and diagnosis, online program, and networked control systems. The course will also examine the interaction of different systems.

(3-0-3)

CS 560**Computer Science in the Classroom**

Emphasis on how to organize a selected computer science course. Discussion of what to teach, the problems typically encountered in teaching, and how to best organize the concepts in a computer science course.

(3-0-3)

CS 561**The Computer & Curriculum Content**

Presentation techniques from white board to web-based instructional units using currently available software. Emphasis on incorporating the computer as a teaching tool in the presentation of class material. Single Concept Learning Modules (SCLM) are developed.

(3-0-3)

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(s): [(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 the use of computer in the classroom.

Prerequisite(s): [(CS 560 and CS 561)]

(1-4-3)

CS 570**Advanced Computer Architecture**

Computer system design and architecture such as pipelining and instruction-level parallelism, memory-hierarchy system, interconnection networks, multicore and multiprocessors, and storage architecture. Selected study on current experimental computer systems.

Prerequisite(s): [(CS 450 and CS 470)]

(3-0-3)

CS 572**Advanced Topics in Computer Architecture**

Current problems in computer architecture.

Prerequisite(s): [(CS 570)]

(3-0-3)

CS 579

Online Social Network Analysis

This course will explore the latest algorithms for analyzing online social networks, considering both their structure and content. Fundamentals of social graph theory will be covered including distance, search, influence, community discovery, diffusion, and graph dynamics. Fundamentals of text analysis will also be covered with an emphasis on the type of text used in online social networks and common applications. Topics include sentiment classification, information extraction, clustering, and topic modeling. Emphasis will be placed on the application of this technology to areas such as public health, crisis response, politics, and marketing.

Prerequisite(s): [(CS 430)]

(3-0-3)

CS 580

Topics in Machine Learning

This course covers advanced topics in machine learning. The exact course contents may change based on recent advances in the area and the instructor teaching it. Possible topics include active learning, reinforcement learning, online learning, non-parametric learning, inductive learning, statistical relational learning, dimensionality reduction, ensemble methods, transfer learning, outlier detection, specific application areas of machine learning, and other relevant and/or emerging topics.

(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(s): [(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 sensor, 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(s): [(CS 430)]

(3-0-3)

CS 583

Probabilistic Graphical Models

This course will cover probabilistic graphical models – powerful and interpretable models for reasoning under uncertainty. The generic families of models such as directed, undirected, and factor graphs as well as specific representations such as hidden Markov models and conditional random fields will be discussed. The discussions will include both the theoretical aspects of representation, learning, and inference, and their applications in many interesting fields such as computer vision, natural language processing, computational biology, and medical diagnosis.

(3-0-3)

CS 584

Machine Learning

Introduce fundamental problems in machine learning. Provide understanding of techniques, mathematical concepts, and algorithms used in machine learning. Provide understanding of the limitations of various machine learning algorithms and the way to evaluate performance of learning algorithms. Topics include introduction, regression, kernel methods, generative learning, discriminative learning, neural networks, support vector machines, graphical models, unsupervised learning, and dimensionality reduction.

Prerequisite(s): [(CS 430)]

(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(s): [(CS 430)]

(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(s): [(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(s): [(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(s): [(CS 487)]

(3-0-3)

CS 589**Software Testing & Analysis**

Concepts and techniques for testing and analysis of software. Software testing at the unit, subsystem, and 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(s): [(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: Instructor permission required.
(3-0-3)

CS 591**Research & Thesis of Masters Degree**

Instructor permission required.
(Credit: Variable)

CS 594**Research Problems**

Instructor permission required.
(Credit: Variable)

CS 595**Topics in Computer Science**

This course will treat a specific topic, varying from semester to semester, in which there is a particular student or staff interest. May be taken more than once.
(Credit: Variable)

CS 597**Reading & Special Problems**

May be taken more than once. (Credit: Variable) Instructor permission required.
(Credit: Variable)

CS 612**Topics in Computer Vision**

Covers advanced topics in computer vision to enhance 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(s): [(CS 512)]
(0-0-3)

CS 630**Advanced Topics in Algorithms**

Theoretical analysis of various types of algorithms. Topics vary, and may include approximation, quantum, on-line, distributed, randomized, and parallel algorithms. Requires CS 430. Instructor permission required.

Prerequisite(s): [(CS 430)]
(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(s): [(CS 542)]
(3-0-3)

CS 681**Topics in Computational Linguistics**

CS 585 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(s): [(CS 585)]
(3-0-3)

CS 689**Advanced Topics in Software Engineering**

Course content is variable and reflects the current trends in software engineering. Instructor permission required.
(3-0-3)

CS 691**Research & Thesis Ph.D.**

Instructor permission required.
(Credit: Variable)

CS 695**Doctoral Seminar**

Doctoral seminar.
(1-0-1)

CS 750**Computer Aided Software Engineering**

This course presents the state-of-the-art of computer-aided software engineering technologies. CASE encompasses a collection of automated tools and methods that provide automated support to the software specification, design, development, testing, maintenance, and management of large and complex software systems. Students will develop working understanding of CASE methodologies and tools.

Prerequisite(s): [(CS 487)]
(2-0-2)

CS 763**Automated Software Testing**

This course will examine both the state-of-the-art and the state-of-practice in automated software testing on a system level and an unit level. Relevant issues include theoretical foundations of automated testing, automation tools and techniques, empirical studies and industrial experience. Key topics include, but are not limited to: Fundamentals of automated software testing, automated test design, modeling and generation, automated test execution, automated test management, automated test metrics, automated tools, automated feature and regression testing Environments to support cost-effective automated software testing, discussions on the barriers to industrial use of automated testing.

Prerequisite(s): [(CS 487)]
(2-0-2)

Computer Science Professional Master

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(s): [(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(s): [(CS 455)]
(3-0-3)

CSP 542

Internet Design & Analysis

This course examines the principles for 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(s): [(CS 455)]
(3-0-3)

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.

Prerequisite(s): [(CS 455)]
(3-0-3)

CSP 544

System & 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.

Prerequisite(s): [(CS 430 and CS 455)]
(3-0-3)

CSP 545

Wireless Networking Technologies & Applications

This course will present the foundation of wireless technologies and examine state-of-the-art wireless systems, services, network technologies, and security.

Prerequisite(s): [(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(s): [(CS 450)]
(3-0-3)

CSP 551

Advanced UNIX Programming

This course provides a hand-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.

Prerequisite(s): [(CS 450)]
(3-0-3)

CSP 570

Data Science Seminar

This required seminar course surveys current applications of data science, bringing in lecturers from industry and academia to discuss real-world problems and how they are addressed within a data analytic framework. Students are required to attend all lectures and to give a short presentation or paper on one of the topics at the end of the semester. Permission is required from the instructor or department. Open only to Data Science majors.

(1-0-0)

CSP 571

Data Preparation & Analysis

Surveys industrial and scientific applications of data analytics with case studies including exploration of ethical issues via case studies. Students will work with a variety of real world data sets and learn how to prepare data sets for analysis by cleaning and reformatting. We will also cover a variety of data exploration techniques including summary statistics and visualization methods. Open only to Data Science majors.

(3-0-3)

CSP 572

Data Science Practicum

Students will work in small groups to solve real-world data analysis problems for actual scientific or industrial clients. Innovation and clarity of presentation will be key elements of evaluation. Students will also have an option to fulfill course requirements through a data analytics internship with an industry partner. Open only to Data Science majors.

(0-0-6)

CSP 581

Applied Artificial Intelligence 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(s): [(CS 440)]
(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(s): [(CS 445)]
(3-0-3)

CSP 586**Software Modeling 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.

Prerequisite(s): [(CS 445) OR (CS 487)]
(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(s): [(CS 487)]
(3-0-3)

CSP 595**Topics in Computer Science Professional Master**

Topics in CS.
(3-0-3)

Undergraduate Courses Available to Graduate Students

Note: Students may take up to an approved number of the following courses.

CS 411**Computer Graphics****CS 422****Data Mining****CS 425****Database Organization****CS 429****Information Retrieval****CS 430****Information Retrieval****CS 440****Programming Languages and Translators****CS 441****Programming Languages and Translators****CS 445****Object Oriented Design and Programming****CS 447****Distributed Objects****CS 450****Operating Systems****CS 455****Data Communications****CS 458****Information Security****CS 470****Computer Architecture****CS 480****Artificial Intelligence Planning and Control****CS 485****Computers and Society****CS 487****Software Engineering I**

Institute of Design

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Dean:

Patrick F. Whitney

A Legacy of Experimenting and Responding to Change

The Institute of Design has continuously explored emerging ideas about how design interacts with society. At its founding as the New Bauhaus in 1937, the faculty and students experimented with new visual languages and use of new media and material. The school was renamed the Institute of Design (ID) in 1944 and merged with Illinois Institute of Technology in 1949. In the mid-1950s, while the main stream of design focused on visual embellishment of communications and products, ID faculty recognized design could be useful in the large-scale problems facing business and society and were the first to incorporate approaches from the social sciences with the design process. In the 1960s, two decades before it was common, ID pioneered the use of computers to support analysis and synthesis in design. In the late 1980s, ID faculty noticed an increasing need for organizations to link their strategy to a deeper understanding of people. Thus, ID created tracks of study in strategic design planning and human-centered design to complement traditional specialties like communication design and product design. As design addressed larger problems and increased its influence in various parts of organizations, it became evident that design needed a more formal body of knowledge. To help increase the rigor and speed of the development of new theories and methods in design, and with the support of the GE Foundation, ID created the first Ph.D. program in design in the United States. Today, ID is focused on using design methods to address complex problems that confront organizations and society at large.

ID Today

IIT Institute of Design attracts students and faculty from around the world who want to create and learn new design methods to address major challenges of organizations and society at large. The 200-person community of graduate students, full-time and adjunct faculty, staff, and visiting researchers are very diverse yet share a common goal.

The diversity at ID comes from the interesting people who join. Entering students, on average, have six years of professional experience in design or in other fields including the social sciences, engineering, business, and the arts. Some are recent graduates from the best universities in the world while others may have thirty

years of work experience or graduate degrees in a variety of fields. About forty percent come from outside the United States. ID consistently has gender balance amongst the student body. Twelve full-time and forty adjunct faculty members represent a phenomenal range of experiences from academic research to leadership within design firms and centers of innovation at large companies. Visiting researchers come from government agencies and other universities around the world, representing a variety of fields such as design, law, and business.

Those who join ID share the goal of using design methods to help define and solve challenges facing companies, governments, and civic organizations. They have noticed that standard ways to plan for next-generation products, messages, and services lack efficacy because the nature of business and the lives of users are more complex, ambiguous, and fast changing than before. They believe structured design methods can define and explore strategic options to make organizations more productive and improve the daily life of people.

ID Degree Programs

ID's programs are markedly different from other graduate design programs because we teach rigorous methods, focus on complex problems, and link strategy to a human-centered viewpoint.

The Master of Design (M.Des.) program is for students who want to achieve mastery of advanced design. Students can take a variety of classes to form one or more specialties. These include communication design, interaction design, product design, strategic planning, user research, design methods, and systems design. This full-time program has a two-year duration for those holding degrees in industrial or communication design and a three-year duration for those with degrees in other fields.

The M.Des./M.B.A. program allows a student to earn a Master of Business Administration degree (through IIT Stuart School of Business) while concurrently earning the Master of Design degree.

The Master of Design Methods (M.D.M.) program is for mid-career professionals from a variety of backgrounds who want to augment their current abilities by learning advanced design methods. Students may have backgrounds from design or other fields and should have at least ten years of experience leading projects in either design or innovation. The M.D.M. can be earned full-time over two semesters or part-time (attending a modified weekend format) over four semesters.

The Ph.D. program is for researchers who seek to contribute to theories and methods core to the field of design.

Degrees Offered

Master of Design (M.Des.)
Master of Design Methods (M.D.M.)

Master of Design/Master of Business Administration
(M.Des./M.B.A.)
Doctor of Philosophy (Ph.D.)

Faculty Research

Full-time and adjunct faculty represent specific areas of expertise critical to the field, like product design, communication design, information design, design planning, the history of design, interactive diagrams, cognitive psychology, anthropology, semantics of form, imaging, and computer science. The faculty at ID conducts various types of research supported by foundations, companies, govern-

ment agencies, and individuals. In general, the research intends to add to the body of knowledge in design while at the same time demonstrates how design can be applied to a variety of problems that often seem extremely complicated or vexingly ambiguous. See id.iit.edu for more information.

Faculty

Alexis, Jeremy, Senior Lecturer and Director of Interprofessional Projects (IPRO). B.Arch., Illinois Institute of Technology; M.Des., IIT Institute of Design.

Basapur, Santosh, Lecturer of Design and Planning Coordinator for Human Factors and Systems.

Erwin, Kim, Assistant Professor. B.A., Loyola University; M.Des., IIT Institute of Design.

Forlano, Laura E., Assistant Professor. B.A., Skidmore College; Diploma, John Hopkins University; Master of International Affairs, M.Phil., Ph.D., Columbia University.

Ichikawa, Tomoko, Senior Lecturer. B.A., International Christian University (Japan); M.S., Illinois Institute of Technology.

Kumar, Vijay, Professor. B.S., National Institute of Design (India); M.S., Illinois Institute of Technology.

MacTavish, Thomas J., Assistant Professor. B.A., Central Michigan University; M.A., University of Iowa; M.A., University of Michigan.

Mathew, Anijo, Associate Professor. B.Arch., Birla Institute of Technology (India); M.Des. Harvard University.

Mayfield, Matthew, Senior Lecturer and Assistant Dean, Academics. B.S., Illinois Institute of Technology; M.C.S., University of Chicago.

Ruecker, Stan, Associate Professor. B.A., B.Sc., University of Regina; M.Des., Ph.D., University of Alberta (Canada).

Sato, Keiichi, Charles Owen Professor. B.S., M.S., Osaka Institute of Technology (Japan); M.S., IIT Institute of Design.

Thaler, Martin, Senior Lecturer. B.F.A., Rhode Island School of Design; M.F.A., Royal College of Art (England).

Whitney, Patrick F., Steelcase/Robert C. Pew Professor of Design and Dean. B.F.A., University of Alberta (Canada); M.F.A., Cranbrook Academy of Art.

Admission Requirements

Admission to all degree programs at ID is highly competitive. Meeting the minimum requirements does not guarantee admission. Test scores and GPA are just two of several important factors considered.

Master of Design

For admission to the Master of Design (M.Des.) and Master of Design / Master of Business Administration (M.Des./M.B.A.) programs, an applicant must hold a baccalaureate degree from an accredited educational institution with a minimum cumulative GPA of 3.0/4.0, have a strong record of academic achievement, and be highly recommended. Applicants should have a minimum of two years of professional experience. Applicants from countries whose native language is not English must submit scores for TOEFL (100 minimum) or IELTS (7 minimum). Portfolios are required for applicants who possess design degrees. Applicants without design degrees are encouraged to apply to the MDes program. All applicants without an undergraduate degree in industrial or communication design must submit GRE (310 minimum) or GMAT (600 minimum) scores. Regardless of previous degrees, students may be required to complete prerequisite design courses before starting their MDes requirements.

Master of Design Methods

In addition to the requirements for Master of Design, applicants to the Master of Design Methods program should have at least ten years of professional experience in leading teams creating novel, effective products, communications or services. A document or portfolio representing this work is required along with three letters of recommendation from professional colleagues. For those without design degrees, the quality of this professional work substitutes for GRE/GMAT test scores.

Doctor of Philosophy

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. Depending on the applicant's academic background and intended area of study, other prerequisite courses may also be required.

Master of Design

54 credit hours

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. The program does not require the formal selection of a concentration area or a final thesis project. Students may construct their own curriculum after taking a core of methods courses focused on understanding users, analyzing complex information, and exploring and prototyping

alternative solutions. Examples of individual courses of study include communication design, interaction design, product design, strategic planning, user research, design methods research, and systems design.

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

54 credit hours (84 if foundation courses are necessary)

Required Courses

7.5 credit hours

IDN 504 Introduction to Observing Users
IDN 530 Introduction to Design Planning
IDX 508 Human Factors in Design
IDX 542 Techniques in Design Analysis

Foundation Courses

30 credit hours

These courses are prerequisite for students without an undergraduate degree in industrial or communication design and must be completed prior to proceeding with any other M.Des. requirements.

IDN 481 Introduction to Design 1
IDN 482 Introduction to Design 2
IDN 483 Introduction to Communication Design 1
IDN 484 Introduction to Communication Design 2
IDN 485 Introduction to Product Design 1
IDN 486 Introduction to Product Design 2
IDN 487 Introduction to Photography
IDN 488 Introduction to Digital Media

Elective Courses

46.5 credit hours

Students select a series of courses to meet the objectives of the student's professional goals. Choices will be made in consultation with the student's advisor and will count for at least 40.5 credit hours of the required program. Up to 6.0 credits may be taken outside of ID with the approval of the student's advisor.

IDN 502 Making the User Centered Case
IDN 506 Research Planning and Execution
IDN 508 Principles and Methods of User Research
IDN 510 Research Photography

IDN 512 Interview Methods
IDN 514 Experience Modeling
IDN 516 Cultural Probes
IDN 518 Survey Methods
IDN 520 Co-Design and Participatory Research Methods
IDN 522 Coding and Analysis
IDN 524 Ethical and Responsible Research
IDN 526 Online Research Methods
IDN 528 Collecting and Using Video Data
IDN 532 Business Frameworks and Strategy
IDN 534 Business Models and Value Webs
IDN 536 Introduction to Portfolio Planning
IDN 538 Design Planning Workshop
IDN 540 Planning Implementation
IDN 542 Behavioral Economics
IDN 543 Communication Methods
IDN 544 Diagram Development
IDN 546 Metaphor and Analogy in Design
IDN 548 Advanced Diagramming
IDN 550 Communication Design Workshop
IDN 552 Fundamentals of Visual Communication
IDN 554 Theories of Communication
IDN 556 Communication in the Planning Process
IDN 558 Innovation Narratives
IDN 560 Writing as Sketching
IDN 562 Modeling Complexity
IDN 564 Information Structuring and Management
IDN 566 Systems Approach to Design
IDN 568 Service Systems Workshop
IDN 570 Structured Planning Workshop
IDN 572 Platform-Based Design Strategy
IDN 574 Design Process and Knowledge
IDN 576 Systems Modeling and Prototyping
IDN 578 Human System Integration

Master of Design - continued

Elective Courses

IDX 502	New Product Definition	IDX 528	Prototyping Interactions
IDX 504	Prototyping Methods	IDX 530	Interaction Design for Immersive Systems
IDX 506	Form and Materials	IDX 532	Interaction Design for Embedded Systems
IDX 510	Design Development and Implementation	IDX 534	Interactive Space
IDX 512	Product Design Workshop	IDX 536	Extensions of Media and Technology
IDX 514	Product Architecture and Platforms	IDX 538	Networked Cities
IDX 516	Advanced Product Design	IDX 540	Networked Objects
IDX 518	Interaction Design Methods	IDX 544	Techniques in Design Synthesis
IDX 520	History of Interaction Design	IDX 546	Intellectual Property in Design
IDX 522	Persuasive Interaction Design	IDX 548	Innovation Methods
IDX 524	Interaction Design Workshop	IDX 550	Building and Understanding Context
IDX 526	Digital Development Workshop	IDX 594	Faculty Research
		IDX 597	Special Topics

Master of Design Methods

30 credit hours

The Master of Design Methods (M.D.M.) is a nine-month full-time (or four-semester part-time) executive master's degree for exceptional design, management, engineering, and other professionals who wish to acquire robust design methods and frameworks and apply them to the development of products, communications, services, and systems. M.D.M. courses cover design methods and frameworks in areas such as user observation and research; prototyping 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) with a minimum of 15 credit hours each semester or over four semesters (part-time), attending an alternate modified-weekend format, with a minimum of 7.5 credit hours each semester.

Curriculum

30 hours

Required Courses

7.5 hours

- IDN 504 Introduction to Observing Users
- IDN 530 Introduction to Design Planning
- IDX 508 Human Factors in Design
- IDX 542 Techniques in Design Analysis

Elective Courses

22.5 hours

Students select a series of courses from the available studios and lectures to meet the objectives of the student's professional goals. Choices will be made in consultation with the student's advisor and will count for at least 22.5 hours of the program. Students select from the same pool of elective classes as found under the Master of Design description (M.D.M. part-time program may include additional pre-determined electives).

Master of Design/Master of Business Administration

44 Institute of Design Credits

36 Stuart School of Business Credits

Required Courses

7.5 Credit Hours from Institute of Design

- IDN 504 Introduction to Observing Users
- IDN 530 Introduction to Design Planning
- IDX 508 Human Factors in Design
- IDX 542 Techniques in Design Analysis

30 Credit Hours from Stuart School of Business

- BUS 510 Building an Innovative and Sustainable Business
- BUS 550 Business Analytics for Competitive Advantage
- BUS 590 Business Innovation in the Next Economy
- MBA 501 Accounting for Strategic Decision Making
- MBA 505 Contemporary Economic Analysis & Game Theory
- MBA 506 Leading and Managing Knowledge Intensive Organizations
- MBA 509 Financial Management in a Globalized World
- MBA 511 Creating, Communicating, & Delivering Customer Value
- MBA 513 Operations & Technology Management

Elective Courses

36.5 credit hours - Institute of Design

3 credit hours - Stuart School of Business

The program director or academic advisor will develop a curriculum plan when the student begins the dual-degree program. Students select a series of courses from the available studios and lectures to meet the objectives of the student's professional goals. Students select from the same pool of elective classes as found under the Master of Design description.

Typically, students will reduce the overall credit requirements of typical individual degree programs because M.B.A. will double count 6 M.Des. credits towards general electives and 6 credits towards the design leadership concentration, and M.Des. will double count 6 M.B.A. credits towards electives. The program director may make exceptions to this plan depending upon the student's individual situation.

Doctor of Philosophy

107 credit hours
Language examination
Comprehensive examination
Dissertation

The Ph.D. in design at IIT Institute of Design is an exemplary program of coursework and academic research in an international environment for supporting top candidates in the field. We have an outstanding record of achievement by our alumni, many of who are engaged at the highest levels of research and teaching. The Ph.D. leads to a dissertation that will extend the body of knowledge in design theory and process.

Requirements

The Ph.D. candidate must have a master's degree in an area relevant to design. The program requires a minimum of three years of study beyond the master's degree. For the first four semesters, students must be enrolled at a minimum of 12 credit hours at the Institute of Design. Satisfactory reading knowledge of German, Japanese, French, or Russian must be met before the student applies to take the comprehensive examination.

Schedule

The program begins with three or four semesters primarily of coursework with some research credit hours, followed by a qualifying exam based on the courses. After passing the qualifying exam, the student continues to work on a research proposal that demonstrates sufficient understanding of the research area, a novel significant concept as a basis for Ph.D. research, and well-organized research methods and processes. A Ph.D. examination committee will then be formed to approve the proposal during the comprehensive exam. Upon completion of the dissertation, the Ph.D. candidate will present the research results to the examination committee for the degree to be granted by the university.

Curriculum

Total: 107 credit hours
Coursework: 59 credit hours (including maximum 32 credit hours transferrable from master's program)
Dissertation research: 48 credit hours

Research

48 credit hours
The research component starts small and grows as the student progresses through his or her candidacy. The dissertation created from this work is intended to create a substantial and original contribution to design knowledge. Typically, 12 credits are earned over the first three terms; the remainder is earned over, at minimum, three additional terms.

Coursework

59 credit hours
Course work includes credit hours transferrable from the master's program. The maximum credit hours transferrable is 32. Classes include full- or half- semester courses selected from the university's course offerings to complement objectives of the student's program. They include 15 credit hours of required courses and 12 credit hours of elective courses as determined by the advisor. Most course work credits are earned within the first three terms of enrollment.

Required courses (15 credit hours)

IDN 574	Design Process and Knowledge
IDN 576	Systems Modeling and Prototyping
IDN 685	Ph.D. Principles and Methods of Design Research
IDN 687	Ph.D. Philosophical Context of Design Research
IDN 689	Ph.D. Research Seminar (taken twice)
PSYC 545	Graduate Statistics 1 (or equivalent)

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.

IDN 502

Making the User-Centered Case

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.
(3-0-1.5)

IDN 504

Introduction to Observing Users

This class will introduce students to theory and methods of behavioral observation, description, and analysis.
(0-3-3)

IDN 506

Research Planning & Execution

This course examines research methods used throughout the design and development process from process, financial, and results standpoints with a focus on planning research activities.
(3-0-1.5)

IDN 508

Principles & Methods of User Research

This course is a survey of the research methods commonly used in design research and gives an overview of distinctions between primary and secondary research, quantitative and qualitative research, and online and in-person research in order to prepare students for research-intensive projects.
(0-3-3)

IDN 510

Research Photography

This course aims to give design researchers the knowledge and tools to consistently make the right decisions when capturing and selecting photographs to use in storytelling.
(3-0-1.5)

IDN 512

Interview Methods

The focus of this course is to gain familiarity with an underlying set of the principles and practices of ethnographic interviewing.
(3-0-1.5)

IDN 514

Experience Modeling

This course is intended to familiarize students with the methods and practice of experience modeling. It entails a deep understanding of people in naturalistic, everyday settings and interpretive methods of analysis to create representations of the organization of everyday life.
ERR!

IDN 516

Cultural Probes

This course examines methods that aim to understand the cultural meaning that artifacts have to people.
(3-0-1.5)

IDN 518

Survey Methods

This class aims to familiarize designers with the tools and techniques that are commonly used by quantitative researchers such as surveys and statistical analysis. Students will learn how to design, understand, and evaluate surveys and other quantitative research tools and techniques as well as how to use online survey tools in their own work.
(3-0-1.5)

IDN 520

Co-Design and Participatory Research

This course will introduce students to co-design methods including when to use co-design methods, what are the advantages and disadvantages of co-design methods, and how to create engaging co-design workshops.
(3-0-1.5)

IDN 522

Coding & Analysis

This course will allow students to gain rigorous training in how to develop coding schemes, code qualitative data, and gain a deeper analysis of users based on field research.
Prerequisite(s): [(IDN 504)]
(0-1.5-1.5)

IDN 524

Ethical & Responsible Research

This course will prepare students to conduct ethnical and responsible research in both academic and industry settings. This includes understanding the Institutional Research Board process, creating protocols for informed consent by users, understanding what can and cannot be done in terms of data collection, and understanding data management and storage.
(3-0-1.5)

IDN 526

Online Research Methods

This class covers methods and tools used in online research with a focus on the design of research objectives, implementation of their study protocol, and moderation of study participants.
(3-0-1.5)

IDN 528

Collecting & Using Video Data

This course will introduce students to the use of video data including when to collect video data, what are the advantages and disadvantages of using video data, and how to use video data for storytelling in presentations.
(3-0-1.5)

IDN 530

Introduction to Design Planning

Introduces students to the broad 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.
ERR!

IDN 532

Business Frameworks & Strategy

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)

IDN 534**Business Models & Value Webs**

This course will consider the relationship between theories and practice in the two very different realms of economics and design.

(3-0-1.5)

IDN 536**Introduction to Portfolio Planning**

This course is an introduction to the techniques and processes involved in portfolio planning. We will explore the role of portfolio planning in typical organizations and how it relates to other processes like strategy and specific product development.

(3-0-1.5)

IDN 538**Design Planning Workshop**

This course covers the application of design planning methods and theory to real-world challenges. With a team-based, hands-on approach, students will tackle all stages of problem solving from initial framing to final solution proposals. Students may take this class multiple times, non-concurrently, for a maximum of 12 credits towards their degree.

Prerequisite(s): [(IDN 530)]

(0-3-3)

IDN 540**Planning Implementation**

Introduces frameworks and methods for effectively implementing change in organizations. Using cases, students will identify principles, actions, and measures that mitigate risk, improve implementation success, and inform stronger designs.

(3-0-1.5)

IDN 542**Behavioral Economics**

This course will introduce how concepts from the field of behavioral economics can be thought of as another kind of “human factor” and ways in which they can help inform the process of design thinking.

(3-0-1.5)

IDN 543**Communication Methods**

This class introduces students to key concepts and methods to communicate design work. This includes a conceptual shift from communication as transmission of content to collaborative construction to better engage and align stakeholders in design work.

(3-0-1.5)

IDN 544**Diagram Development**

Explores the language of diagrams as a communication means to represent different types of abstract, relational information. Students will be introduced to design principles of developing effective diagrams and multiple types of diagrams.

(3-0-1.5)

IDN 546**Metaphor & Analogy in Design**

This class explores metaphor for its utility as a powerful thinking and communication tool drawing from research in academic fields such as cognitive linguistics and visual communications. Students will consider metaphors and analogies (as well as similes, allegories, metonymies, and other visual/verbal devices) for their power open up new thinking, frame change and suggest action – all critical communication milestones in design planning.

(3-0-1.5)

IDN 548**Advanced Diagramming**

This class focuses on the study and development of visualizations to expand information presentation by using dynamic, interactive properties. Explorations to include data narratives, data visualization, time-based visualizations, analyzing motion, narration, transitions, and other visual properties that can enhance comprehension.

(3-0-1.5)

IDN 550**Communication Design Workshop**

A project-oriented workshop focusing on applying design principles to link theoretical methods to practice in the area of human-centered communication design. Students may take this class multiple times, non-concurrently, for a maximum of 12 credits towards their degree.

(0-3-3)

IDN 552**Fundamentals of Visual Communication**

Discusses pictures, abstract symbols, text, numbers, diagrams, three-dimensional form, and other sign systems in the context of communicating a designed offering. Additional teachings include the basics of visual communication principles to aid in developing effective communications.

(3-0-1.5)

IDN 554**Theories of Communication**

This class introduces students to theories of communication from other academic fields for application in design. It explores broadly the conception of communication to include relevant perspectives from education, social psychology, phenomenology and knowledge management.

(3-0-1.5)

IDN 556**Communication in the Planning Process**

This class teaches students how to use communication as a design method to accelerate synthesis and give tangible form to valuable information throughout the development process. Students are introduced to relevant theories of language, visual perception, visual representation, and communication.

Prerequisite(s): [(IDN 483) OR (IDN 552)]

(3-0-1.5)

IDN 558**Innovation Narratives**

In this course, students utilize the Hero's Journey as a framework to build consumer empathy, branded innovations, and meaningful experiences. This course will teach a short introduction to the Hero's Journey followed by a series of individual and team exercises.

(3-0-1.5)

IDN 560**Writing as Sketching**

Building on the foursquare model of abstraction, this class will explore writing as a tool. It uses sketching as its guiding metaphor and will take students on a journey from a simple line through techniques that add depth and perspective to one's writing. Classes will include discussion and in-class writing activities that will encourage students to practice and iterate through feedback and critique.

(0-3-3)

IDN 562**Modeling Complexity**

How does one visually capture and represent complex systems, topics, and activities that are too large to conceptualize using memory and cognition alone? Modeling complexity is a visual approach to large-scale problem definition that seeks to represent the full picture of a system by applying theories of visual perception and known techniques for representing relationships in data.

(3-0-1.5)

IDN 564**Information Structuring & Management**

The class introduces the basic principles and methods for structuring complex information for effective understanding, identifying problems, and guiding solution development. Graph theory, definitions of relations, and structural patterns of relations are introduced as foundation. Examples of information structuring and management include basics of Structured Planning, Semantic Net, and Interpretive Structural Modeling.

(3-0-1.5)

IDN 566**Systems Approach to Design**

Introduces concepts, principles, and methods for defining, understanding, and designing complex design problems using systems concepts and approaches. Particularly, various forms of system modeling methods are used to represent the overall domain of interest, design concepts for revealing complex, non-inceptive relationships. Important topics include systems theory and methodologies, modeling, causality, and formalisms.

(3-0-1.5)

IDN 568**Service Systems Workshop**

This workshop introduces concepts of services, design principles, and methods that are needed for the design of service systems. Topics include the nature of services, customer acquisition and retention, value propositions in service business, service prototyping and pilot testing, stakeholder management, infrastructure, and operational and implementation issues. Students may take this class multiple times, non-concurrently, for a maximum of 12 credits towards their degree.

(0-3-3)

IDN 570**Structured Planning Workshop**

Introduces structured planning methodology and applies it to complex design problems at the system level. Team techniques are emphasized, and formatted information handling and computer-supported structuring processes are used through the design process from project definition to information development, structuring, concept development, and communication. Students may take this class multiple times, non-concurrently, for a maximum of 12 credits towards their degree.

(0-3-3)

IDN 572**Platform-Based Design Strategy**

Platform is an innovation strategy that provides a common set of standards to enable a variety of offerings to be built on top of it, creating higher value for all stakeholders involved. This course explores how platforms provide a base to accommodate many options that can support diverse contexts and user needs.

(3-0-1.5)

IDN 574**Design Process & Knowledge**

Introduces basics of design methodologies concerning design process models and knowledge representation and management. It discusses multiple viewpoints and aspects of design in order to address complexity of information required to implement human-centered approaches and interdisciplinary collaboration as well as developing and managing effective design processes, methods, and organizations for enabling innovative design.

(3-0-1.5)

IDN 576**Systems Modeling & Prototyping**

This workshop class introduces system modeling methods for representing different types and aspects of systems including continuous models, discrete models, probabilistic models, and structural models. System modeling and simulation software packages are used to understand and predict the system behavior. Various forms of physical prototyping are also applied as complementary methods to understand, analyze, explore, and evaluate systems through the development process.

(0-3-3)

IDN 578**Human System Integration**

This course teaches students the principles of socio-technical system design. Today's complex systems need to be designed as a whole system rather than piece-meal components. Hence, this course introduces students to the perspectives and principles that can be used when designing complex systems with people and technical subsystems.

(3-0-1.5)

IDN 685**Ph.D. Principles & 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)

IDN 687**Ph.D. 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)

IDN 689**Ph.D. 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)

IDN 691**Research & Thesis for Ph. D. Degree**

Research and thesis writing.

(Credit: Variable)

IDX 502**New Product Definition**

This course introduces students to the professional and theoretical aspects of the product definition process. It covers the process of creating a new product definition in detail, the characteristics of new product definition documents, aspects of organizational structure and dynamics as they relate to developing new product definitions, and sources of innovation.

(0-3-3)

IDX 504**Prototyping Methods**

Prototyping is a key method that designers use to navigate the design development process. Although prototyping is often thought of as coming at the end of the process to verify a design solution, our approach maintains that prototyping needs to happen throughout the process from initial research to storytelling to concept generation and lastly to refine and improve the selected direction.

(3-0-1.5)

IDX 506**Form & Materials**

In this course students will examine what, how, and why product form happens. Topics include the relationship between a product's form and corporate identity, visual trends, new materials, manufacturing techniques, semantics, product architecture, and ergonomics.

(3-0-1.5)

IDX 508**Human Factors in Design**

Analysis of issues involved in a design project with a human factors perspective is an important step during user research and the design development process. Knowing the basic concepts and principles of human factors will enable students to be user centered in their approach.

(3-0-1.5)

IDX 510**Design Development & Implementation**

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)

IDX 512**Product Design Workshop**

This course is an opportunity for students to exercise their design muscles throughout an entire product development experience from framing through ideation to final concepts. Students may take this class multiple times, non-concurrently, for a maximum of 12 credits towards their degree.

(0-3-3)

IDX 514**Product Architecture & Platforms**

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)

IDX 516**Advanced Product Design**

This course is an opportunity for students to further explore the entire product development experience from framing through ideation to final concepts.

Prerequisite(s): [(IDX 512)]

(0-3-3)

IDX 518**Interaction Design Methods**

This course introduces methods for effectively describing the dynamic nature of interaction and applies them to different types of design cases.

(3-0-1.5)

IDX 520**History of Interaction Design**

This course examines thought leaders in interaction design, their innovations, and the technology and business contexts that shaped the environment for their work. Students will review designs to better understand the elements that led to significant design breakthroughs.

(3-0-1.5)

IDX 522**Persuasive Interaction Design**

This course examines interactive media and focuses on design methods and techniques for improved engagement between the entity providing the offering (e.g., product or service provider) and the entity consuming the offering (e.g., users, stakeholders, and purchasers).

(3-0-1.5)

IDX 524**Interaction Design Workshop**

This workshop offers students the opportunity to practice methods for design research, concept development, interaction design, and rapid prototyping.

(0-3-3)

IDX 526**Digital Development Workshop**

This course introduces different tools and platforms for the development of interactive systems. Students will employ the different platforms to translate a concept from concept to prototypes for evaluation and communication. Students may take this class multiple times, non-concurrently, for a maximum of 12 credits towards their degree.

(0-3-3)

IDX 528**Prototyping Interactions**

This course introduces different methods and tools for the prototyping of interactive systems. Students will employ the different methods to translate a concept from ideation to installation through multiple layers of sketches, prototypes, and interactive peripherals.

(0-3-3)

IDX 530**Interaction Design for Immersive Systems**

This course explores issues in design for interactions that are enabled by affordances available in ubiquitous computing, mixed reality, and virtual reality environments.

(3-0-1.5)

IDX 532**Interaction Design Embedded Systems**

This course explores interaction design principles, opportunities, and issues for embedded systems. It includes evaluating and creating product concepts for vertical markets and various levels of computing performance, modalities, affordances, and constraints.

(3-0-1.5)

IDX 534**Interactive Space**

This seminar will look at different variations of interactive and reactive spaces. The seminar will concentrate on the theory and construction of, identities and characteristics of actors embedded in, and the technology employed in the design of such spaces.

(3-0-1.5)

IDX 536**Extensions of Media & Technology**

This seminar is designed to engage students in a critical discussion about contemporary media and technology and the socio-cultural contexts in which they are situated. Theoretical notions as well as contemporary critique of media, technology, and their appropriations will be explored through lecture and discussion sessions.

(3-0-1.5)

IDX 538**Networked Cities**

This course will explore the relationship between technologies – new media, urban screens, mobile and wireless technology, and ubiquitous computing – and cities and urban public spaces.

(0-3-3)

IDX 540**Networked Objects**

This workshop will explore the relationship between digital technologies – new media, urban screens, sensors and radio-frequency identification chips (RFID), mobile and wireless technology, and ubiquitous computing – as they are embedded into physical products/artifacts, spaces, and environments as well as architecture and buildings, which is commonly referred to as the “internet of things.”

(0-3-3)

IDX 542**Techniques in Design Analysis**

Design analysis teaches you methods to analyze data you will likely encounter as part of a design project.

(3-0-1.5)

IDX 544**Techniques in Design Synthesis**

This class covers the activities involved in determining what something should be. This process moves beyond the traditional end state of most analysis processes (making high level recommendations) and suggests clear, concrete solutions.

(3-0-1.5)

IDX 546**Intellectual Property in Design**

This course introduces the principles and methods for securing intellectual property rights. Topics covered include utility and design patents, trademark, copyright, and trade dress.

(3-0-1.5)

IDX 548**Innovation Methods**

The course will present an overview of some of the key principles that drive design innovation followed by a broad look at the design innovation process, various methods, and frameworks.

IDX 550**Building & Understanding Context**

This course will improve critical thinking skills when wrestling with the wide variety of input and insight that often accompanies design initiatives. The course will include basic overviews of argumentation, secondary research, and group-based discussion methods.

(0-3-3)

IDX 552**Managing Interdisciplinary Teams**

This class will teach methods and tools that focus a team’s creativity and analysis on the right deliverables and explore how the basic functional methods of the business world (such as schedules, budgets, emails, and meetings) can be informed by design thinking to be more effective for teams composed of multiple disciplines.

(0-3-3)

IDX 594**Faculty Research**

Classes, workshops, and seminars revolving around faculty specific research. Instructor permit only. Instructor will define requirements for enrollment. Students may take this class multiple times for a maximum of 24 credits toward their degree.

(Credit: Variable)

IDX 595**Internship**

Supervision of participation in curricular practical training (CPT).

(0-0-0)

IDX 597**Special Topics**

Classes that cover special and contemporary topics in design. Students may take this class multiple times for a total of 24 credits toward their degree.

(Credit: Variable)

Department of Electrical and Computer Engineering

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Chair:

Ashfaq Khokhar

Associate Chair:

Jafar Saniie

The Department of Electrical and Computer Engineering offers academic programs in advanced study to graduates with technical backgrounds 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 backgrounds 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 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 almost 20 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 Biomedical Imaging and Signals
Master of Electrical and Computer Engineering

Master of Network Engineering
Master of Power Engineering
Master of VLSI and Microelectronics
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 the Center for Financial Markets:
Master of Electricity Markets

Interdisciplinary Programs

Master of Science in Electrical Engineering with
specialization in Energy/Environment/Economics (E³)
Master of Electrical and Computer Engineering with
specialization in Energy/Environment/Economics (E³)

Certificate Programs

Advanced Electronics
Applied Electromagnetics
Communication Systems
Computer Engineering
Control Systems

Electricity Markets
Power Electronics
Power Engineering
Signal Processing
Wireless Communications Engineering

Research Centers and Facilities

The department operates research laboratories for work in CAD (Computer-Aided Design), for VLSI (Very-Large-Scale Integration), and SoC (System-on-Chip) circuit design, communications, computer networking, wireless networks, network security, cloud computing, cyber physical systems, embedded computing, image processing, medical imaging, data mining, microwave electronics, power systems, smart grids, 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 Medical Imaging Research Center conducts research in numerous forms for imaging and data analysis, and includes the Advance X-ray Imaging Laboratory (AXIL), which is developing new types of x-ray devices. The department also collaborates with and utilizes the research resources of the Pritzker Institute of Biomedical Science and Engineering and nearby national laboratories.

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, computer clusters for both CPU and GPU (Graphics Processing Unit) based computing, running the Windows/Unix/Linux/OS X 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, CUDA, Open CL, 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, (wired and wireless), 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 communications systems, wireless networks, computer systems, computer networks, wireless security,

cloud computing and micro-electronics; electromagnetics and electronics; power and control systems; signal and image processing.

Faculty

Anjali, Tricha, Associate Professor of Electrical and Computer Engineering. B.S., M.S., Indian Institute of Technology; Ph.D., Georgia Institute of Technology. Wireless networks, network security, network routing, multipath routing, network optimization, remote education.

Arzbacher, Robert, Emeritus Professor of Electrical and Computer Engineering. Ph.D., University of Illinois, Urbana-Champaign. Instrumentation, signal processing and control.

Atkin, Guillermo E., Associate Professor of Electrical and Computer Engineering. B.S., Universidad F. Santa Maria (Chile); Ph.D., University of Waterloo (Canada). Modulation and coding, digital mobile and wireless communication, spread spectrum and optical communication systems.

Borkar, Suresh, Senior Lecturer of Electrical and Computer Engineering. B. Tech Indian Institute of Technology (India); M.S., Ph.D., Illinois Institute of Technology. Wireless and wireline telecommunications, operating systems, architecture, and performance of computer and network systems.

Brankov, Jovan G., Associate Professor of Electrical and Computer Engineering. Diploma, University of Belgrade (Serbia); M.S., Ph.D., Illinois Institute of Technology. Medical imaging, image sequence processing, pattern recognition and data mining.

Brown, Ian, Assistant Professor of Electrical and Computer Engineering. B.S., Swarthmore College; M.S., Ph.D., University of Wisconsin-Madison. Design and modeling of electric machines, adjustable speed drives, and power electronics applied to renewable energy systems and energy efficient power conversion.

Cheng, Yu, Associate Professor of Electrical and Computer Engineering. B.E., M.E., Tsinghua University (China); Ph.D. University of Waterloo (Canada). Wireless networks, network security, network measurement, and wireless/wireline interworking.

Choi, Kyuwon, Associate Professor of Electrical and Computer Engineering. B.S., M.S., KyungHee University (Korea); Ph.D., Georgia Institute of Technology. VLSI design and automation for low power.

El Rouayheb, Salim, Assistant Professor of Electrical and Computer Engineering. Dipl., Lebanese University; M.S., American University of Beirut; Ph.D., Texas A&M University. Information theory, coding theory, coding for distributed data storage systems, data security, wireless communications.

Flueck, Alexander J., Associate Professor of Electrical and Computer Engineering. B.S., M.E., Ph.D., Cornell University. Power systems, high performance computing, autonomous agent-based control.

Khokhar, Ashfaq A., Professor of Electrical and Computer Engineering and Chair. B.Sc., University of Engineering and Technology (Pakistan); M.S., Syracuse University; Ph.D., University of Southern California, Los Angeles. High performance computing, big data analytics, wireless networks, embedded systems, multimedia systems.

Kim, Joohee, Assistant Professor of Electrical and Computer Engineering. B.S., M.S., Yonsei University (Korea); Ph.D., Georgia Institute of Technology. Multimedia signal processing, multimedia communications and networking, computer vision.

Kirshnamurthy, Mahesh, Associate Professor of Electrical and Computer Engineering. B.E., Amrawati University (India); M.S., University of Missouri-Rolla; Ph.D., University of Texas-Arlington. Power electronics, electric machines, adjustable speed drives and energy storage, systems for renewable energy, and automotive applications.

Li, Zuyi, Professor of Electrical and Computer Engineering and Associate Director of the Galvin Center for Electricity Innovation. B.S., Shanghai Jiaotong University; M.S., Tsinghua University; Ph.D., Illinois Institute of Technology. Market operation of electric power system and integration of renewable energy, smart grid, power system protection.

Modir Shanechi, Hassan, Senior Lecturer of Electrical and Computer Engineering. B.S., M.S., Tehran University (Iran); Ph.D., Michigan State University. Nonlinear and intelligent systems, power system dynamics and security.

Oruklu, Erdal, Associate Professor of Electrical and Computer Engineering. 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.

Saletta, Gerald F., Emeritus Professor of Electrical and Computer Engineering. B.S., M.S., University of Notre Dame; Ph.D., Illinois Institute of Technology. Electronics, digital systems.

Saniie, Jafar, Filmer Professor of Electrical and Computer Engineering and Associate Chair. 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.

Shahidehpour, Mohammad, Bodine Professor of Electrical and Computer Engineering, Director of the Galvin Center for Electricity Innovation, and Associate Director of the Wanger Institute for Sustainable Energy Research (WISER). 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.

Shen, Zheng John, Grainger Professor of Electrical and Computer Engineering. B.S., Tsinghua University (China); M.S., Ph.D., Rensselaer Polytechnic Institute.

Stark, Henry, Emeritus Professor of Electrical and Computer Engineering. 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.

Wang, Jia, Associate Professor of Electrical and Computer Engineering. B.S., Tsinghua University (China); M.S., Ph.D., Northwestern University. VLSI, design automation, and algorithm design.

Weber, Erwin W., Emeritus Professor of Electrical and Computer Engineering. B.S., M.S., Ph.D., Illinois Institute of Technology. Electromagnetics, RF electronics, antenna theory.

Wernick, Miles, Motorola Professor of Electrical and Computer Engineering and Director of Medical Imaging. B.A., Northwestern University; Ph.D., University of Rochester. Medical imaging, image processing, and pattern recognition.

Williamson, Geoffrey A., Professor of Electrical and Computer Engineering and Associate Dean for Analytics in the Armour College of Engineering. B.S., M.S., Ph.D., Cornell University. Parameter estimation and system identification, adaptive signal processing and control, control systems.

Wong, Thomas Tang Yum, Professor of Electrical and Computer Engineering. B.S., University of Hong Kong; M.S., Ph.D., Northwestern University. Applied electromagnetics, microwave and terahertz measurements, nanoscale structures and devices.

Xu, Yang, Associate Professor of Electrical and Computer Engineering. B.S., M.S., Fudan University (China); Ph.D., Carnegie Mellon University. RFIC design for digital communications and wireless medical technology.

Yang, Yongyi, Harris Perlstein Professor of Electrical and Computer Engineering and Biomedical Engineering. B.S.E.E., M.S.E.E., Northern Jiatong University (China); M.S., Ph.D., Illinois Institute of Technology. Image and signal processing, data compression, applied mathematical and statistical methods.

Zhou, Chi, Associate Professor of Electrical and Computer Engineering. B.S., Tsinghua University (China), M.S., Ph.D., Northwestern University. Wireless sensor networks for smart grid application, scheduling for OFDM/MIMO systems, network coding for wireless mesh networks, integration of optical and wireless networks.

Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0

1. GRE score: M.S./MAS: 1100 (quantitative + verbal) 3.5 (analytical writing)
2. New GRE score: M.S./MAS: 304 (quantitative + verbal) 3.5 (analytical writing)
1. GRE score: Ph.D.: 1100 (quantitative + verbal) 3.5 (analytical writing)
2. New GRE score: Ph.D.: 304 (quantitative + verbal) 3.5 (analytical writing)

TOEFL minimum score: 550/213/80*

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, power engineering, biomedical images and signals, VLSI and microelectronics, 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 profi-

ciency 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 advisor 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/internet-based test score.

Master of Science in Electrical Engineering

32 credit hours

Thesis option

The purpose of this degree is to prepare students for advanced study 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 advisor. Areas of study include communication and signal processing; computers and microelectronics; and power and control systems. The program is normally completed in three semesters of full-time study.

The admission requirements for this degree follow the existing admission requirements for Master's degrees in the ECE department. 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 Elec-

tronics), 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 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. Up to six credits of ECE short courses may be applied to the degree.

Students, with advisor approval, select courses appropriate to their needs and interests. The program of study must include a minimum of four courses within one of the electrical engineering (EE) areas of concentration listed on the next page and a minimum of two courses from the other areas. An M.S.E.E. candidate may, with permission of a thesis advisor, 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.

EE Areas of Concentration

I. Communications and Signal Processing

ECE 401 Communication Electronics
ECE 403 Digital and Data Communication Systems
ECE 405 Digital and Data Communication Systems with Laboratory
ECE 406 Introduction to Wireless Communication Systems
ECE 421 Microwave Circuits and Systems
ECE 423 Microwave Circuits and Systems 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 507 Imaging Theory and Applications
ECE 508 Video Communications
ECE 509 Electromagnetic Field Theory
ECE 511 Analysis of Random Signals
ECE 513 Communication Engineering Fundamentals
ECE 514 Digital Communication Principles
ECE 515 Modern Digital Communications
ECE 516 Coding for Distributed Storage Systems
ECE 519 Coding for Reliable Communications
ECE 522 Electromagnetic Compatibility
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 576 Antenna Theory
ECE 578 Microwave Theory

II. Computers and Microelectronics

ECE 407 Introduction to Computer Networks with Laboratory
ECE 408 Introduction to Computer Networks
ECE 415 Solid-State Electronics
ECE 425 Analysis and Design of Integrated Circuits
ECE 429 Introduction to VLSI Design
ECE 441 Microcomputers
ECE 443 Introduction to Computer Security
ECE 446 Advanced Logic Design
ECE 449 Object-Oriented Programming and Computer Simulation
ECE 485 Computer Organization and Design
ECE 502 Basic Network Theory
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 529 Advanced VLSI Systems 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 544 Wireless and Mobile Networks
ECE 545 Advanced Computer Networks
ECE 546 Wireless Network Security
ECE 547 Wireless Networks Performance Analysis
ECE 571 Nanodevices and Technology
ECE 575 Electron Devices
ECE 583 High Speed Computer Arithmetic
ECE 584 VLSI Architectures for Signal Processing and Communication Systems
ECE 585 Advanced Computer Architecture
ECE 586 Fault Detection in Digital Circuits
ECE 587 Hardware/Software Codesign
ECE 588 CAD Techniques for VLSI Design
ECE 589 Computer-Aided Design of Analog IC

III. Power and Control

ECE 411 Power Electronics
ECE 412 Electric Motor Drives
ECE 417 Power Distribution Engineering
ECE 418 Power Systems Analysis
ECE 419 Power Systems Analysis with Laboratory
ECE 420 Analytical Methods in Power Systems
ECE 438 Control Systems
ECE 505 Applied Optimization for Engineers
ECE 506 Analysis of Nonlinear Systems
ECE 531 Linear System Theory
ECE 535 Discrete Time Systems
ECE 538 Renewable Energies
ECE 539 Computer Aided Design of Electric Machines
ECE 540 Reliability Theory and System Implementation
ECE 548 Energy Harvesting
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 System 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
ECE 580 Elements of Sustainable Energy
ECE 581 Elements of Smart Grid
ECE 582 Microgrid Design and Operation

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 or industrial practice 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 advisor. 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.

The admission requirements for this degree follow the existing admission requirements for master's degrees in the ECE Department. 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), 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 21 credit hours of ECE coursework. A minimum of 20 credit hours must be taken at the 500-level or higher. Up to six credits of ECE short courses may be applied to the degree. Students, with advisor approval, 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 advisor, 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

I. 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 429 Introduction to VLSI Design

ECE 441 Microcomputers

ECE 446 Advanced Logic Design

ECE 485 Computer Organization and Design

ECE 529 Advanced VLSI Systems 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

ECE 589 Computer Aided Design of Analog IC

II. Computer Systems Software

Core Courses

CS 550 Comparative Operating Systems

CS 551 Operating System Design and Implementation

Elective Courses

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 550 Advanced Operating Systems

CS 551 Operating System Design and Implementation

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

III. Networks and Telecommunications

Core Courses

ECE 407 Introduction to Computer Networks with Laboratory

OR

ECE 408 Introduction to Computer Networks

ECE 541 Performance Evaluation of Computer Networks

ECE 542 Design and Optimization of Computer Networks

ECE 545 Advanced Computer Networks

Elective Courses

ECE 407 Introduction to Computer Networks with Laboratory

ECE 408 Introduction to Computer Networks

ECE 443 Introduction to Computer Security

ECE 504 Wireless Communication System Design

ECE 508 Video Communications

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 543 Computer Network Security

ECE 544 Wireless and Mobile Networks

ECE 545 Advanced Computer Networks

ECE 546 Wireless Network Security

ECE 547 Wireless Networks Performance Analysis

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

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 fields 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 advisor.

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 usually completed in four semesters of full-time study.

Admission requirements for the M.S.CP.E./E.E. 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 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 307 (Electrodynamics), ECE 308 (Signals and Systems), 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), 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 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 the following:
 - (a) Two core courses in a CPE major area, chosen from among the CPE areas of concentration.
 - (b) Two elective courses in the CPE major area, chosen from among the CPE areas of concentration.
 - (c) One core course from each of the two remaining areas of CPE concentration.
 - (d) Four (or more) courses within an EE major area, chosen from among the EE areas of concentration (Areas I, II, and III).
 - (e) A minimum of two courses from two EE minor areas, chosen from among Areas I, II, and III outside the major.
 - (f) Additional coursework approved by the academic advisor.
2. A GPA of at least 3.0/4.0 (excluding prerequisites and proficiencies).

The CPE/EE program is subject to the following restrictions: a minimum of 30 credit hours course work at the 500-level or higher; at least 30 credit hours of ECE courses, excluding short courses; 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 advisor.

Each regular (matriculated) graduate student is assigned an academic advisor, indicated in his/her formal letter of admission to the master's program.

Students should consult with their academic advisor to file a program of study meeting these requirements within three months after initial registration for full-time students, and prior to enrolling beyond 12 credits for part-time students.

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 degree follow the existing admission requirements for other professional master's degrees in the 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), MATH 252 (Introduction to Differential Equations), and MATH 474 (Probability and Statistics). 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, including at least two ECE and one BME elective courses.

Curriculum

Required Courses

ECE 481 Image Processing

AND/OR

ECE 565 Computer Vision and Image Processing

ECE 437 Digital Signal Processing I

AND/OR

ECE 569 Digital Signal Processing II

ECE 511 Analysis of Random Signals

BIOL 430 Animal Physiology

OR

BME 450 Animal Physiology

Imaging Elective Courses (1 course minimum)

ECE 507 Imaging Theory and Applications

BME 430 Concepts of Medical Imaging

BME 532 Medical Imaging Science

BME 535 Magnetic Resonance Imaging

BME 537 Introduction to Molecular Imaging

BME 538 Neuroimaging

Signals Elective Courses (2 courses minimum)

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 501 Biomedical Instrumentation

BME 551 Physiological Signal Processing & Control Theory I

BME 552 Control Systems for Biomedical Engineers

With advisor's approval, students may take up to two senior (400 level) or graduate level courses in Engineering, Math, or Science.

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 fields 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.

The admission requirements for this degree follow the existing admission requirements for a Master's degree in the ECE department. Student's whose accredited B.S. degree is not in electrical 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). A student may demonstrate proficiency by successfully completing the courses or by demonstrating satisfactory performance in one or more special departmental 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 six credits of ECE short courses may be applied to the degree. Students arrange their program of study with their advisor's approval 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, power electronics, electromagnetics, electronics, VLSI and microelectronics, power systems, and signal and image processing.

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 M.N.E. is a focused professional master's degree requiring a minimum of 30 credit hours of advisor approved coursework. The program offered by the Department of Electrical and Computer Engineering (ECE) can be completed in one year of full-time study.

The admission requirements for this degree follow the existing admission requirements for master's degree in the ECE department. 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 251 (Multivariate and Vector Calculus), MATH 252 (Introduction to Differential Equations), and MATH 474 (Probability). 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. program of study 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 6 credit hours of advisor approved elective courses. At least 18 credit hours of the courses must be at the 500 level. A maximum of 6 credit hours may be taken from ECE 700 level short courses.

Curriculum

Required Courses (12 credit hours)

Both of the following:

- ECE 511 Analysis of Random Signals
- ECE 513 Communication Engineering Fundamentals

One of the following:

- ECE 407 Introduction to Computer Networks with Laboratory
- ECE 408 Introduction to Computer Networks
- ECE 545 Advanced Computer Networks

One of the following:

- ECE 541 Performance Evaluation of Computer Networks
- 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 faculty advisor. A maximum of 6 credit hours of ECE short courses can be included in the M.N.E. program of studies.

ECE 403 Digital and Data Communication Systems

OR

ECE 405 Digital and Data Communication Systems with Laboratory

ECE 406 Introduction to Wireless Communication Systems

ECE 437 Digital Signal Processing I

ECE 436 Digital Signal Processing I with Laboratory

ECE 443 Introduction to Computer Security

ECE 485 Computer Organization and Design

ECE 504 Wireless Communication System Design

ECE 508 Video Communications

ECE 514 Digital Communication Principles

ECE 515 Modern Digital Communications

ECE 516 Coding for Distributed Storage Systems

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 544 Wireless and Mobile Networks

ECE 545 Advanced Computer Networks

ECE 546 Wireless Network Security

ECE 547 Wireless Networks Performance Analysis

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 548 Broadband Networks

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 this degree follow the existing admission requirements for other professional master's degrees in the 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 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.

Curriculum

Core Courses (3 courses minimum)

ECE 411 Power Electronics
ECE 412 Electric Motor Drives
ECE 420 Analytical Methods in Power Systems
ECE 551 Advanced Power Electronics

One of the following:

ECE 418 Power Systems Analysis
ECE 419 Power Systems Analysis with Laboratory

Elective Courses in Power Systems (2 courses minimum)

ECE 417 Power Distribution Engineering
ECE 553 Power System Planning
ECE 554 Power System 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
ECE 580 Elements of Sustainable Energy
ECE 581 Elements of Smart Grid
ECE 582 Microgrid Design and Operation
CHE 543 Energy, Environment, and Economics

Elective Courses in Power Electronics and Motor Drives (2 courses minimum)

ECE 437 Digital Signal Processing I
ECE 438 Control Systems
ECE 531 Linear System Theory
ECE 538 Renewable Energies
ECE 539 Computer Aided Design of Electric Machines
ECE 548 Energy Harvesting
ECE 549 Motion Control Systems Dynamics
ECE 550 Power Electronic Dynamics and Control
ECE 552 Adjustable Speed Drives
ECE 764 Vehicular Power Systems
CHE 541 Renewable Energy Technologies

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.

The admission requirements for this degree follow the existing admission requirements for other professional master's degrees in the 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.

The program of study includes a minimum of 30 credit hours of acceptable coursework. 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 6 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.

Curriculum

Core Courses (4 courses minimum)

ECE 415 Solid-State Electronics

AND/OR

ECE 575 Electron Devices

ECE 425 Analysis and Design of Integrated Circuits

ECE 429 Introduction to VLSI Design

ECE 529 Advanced VLSI Systems Design

Elective Courses in Computer Engineering (1 course minimum)

ECE 429 Introduction to VLSI Design

ECE 485 Computer Organization and Design

ECE 529 Advanced VLSI Systems 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 Co-design

ECE 588 CAD Techniques for VLSI Design

ECE 589 Computer Aided-Design of Analog IC

Elective Courses in Electronics (1 course minimum)

ECE 401 Communication Electronics

ECE 425 Analysis and Design of Integrated Circuits

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 575 Electron Devices

ECE 578 Microwave Theory

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. The M.T.S.E. is a professional master's degree requiring a minimum of 30 credit hours of advisor-approved coursework.

Admission requirements for this degree follow the existing admission requirements for master's degrees in the ECE department. 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 Accelerated Introduction to Computer Science (i.e., CS 115 and CS 116 combined, Object-Oriented Programming I-II)

Electrical and Computer Engineering Prerequisites

ECE 211 Circuit Analysis I
ECE 213 Circuit Analysis II
ECE 308 Signals and Systems
MATH 251 Multivariate and Vector Calculus
MATH 252 Introduction to Differential Equations
MATH 474 Probability and Statistics

The M.T.S.E. program of studies must include a minimum of 15 credit hours of ECE coursework 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.

Curriculum

Required Courses

ECE 513 Communication Engineering Fundamentals
CS 586 Software Systems Architecture
CS 587 Software Project Management

One of the following:

ECE 407 Introduction to Computer Networks with Laboratory
ECE 408 Introduction to Computer Networks
ECE 545 Advanced Computer Networks

One of the following:

ECE 541 Performance Evaluation of Computer Networks
ECE 542 Design and Optimization of Computer Networks

Elective Categories

I. Software Engineering

ECE 449 Object-Oriented Programming and Computer Simulation
CS 521 Object-Oriented Analysis and Design
CS 537 Software Metrics
CS 589 Software Testing and Analysis

II. Telecommunication Systems

ECE 443 Introduction to Computer Security
ECE 543 Computer Network Security
ECE 544 Wireless and Mobile Networks
ECE 546 Wireless Network Security
ECE 547 Wireless Network Performance Analysis
CS 544 Computer Networks II: Network Services
CS 548 Broadband Networks
CS 555 Analytic Models and Simulation of Computer Systems

III. Communications

ECE 504 Wireless Communication System Design
ECE 508 Video Communications
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 faculty advisor. Students without a background in communications or software engineering would be best prepared by including:

ECE 403 Digital and Data Communication Systems
ECE 405 Digital and Data Communication Systems with Laboratory
ECE 406 Introduction to Wireless Communication Systems
CS 450 Operating Systems
CS 455 Data Communications
CS 487 Software Engineering I

Other recommended courses include:

ECE 436 Digital Signal Processing I with Laboratory
ECE 437 Digital Signal Processing II
ECE 511 Analysis of Random Signals
ECE 516 Coding for Distributed Storage Systems
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 advisor approval, the M.T.S.E. program of studies can include up to four credit hours of ECE short courses.

Master of Electricity Markets

30 credit hours

Restructuring of electricity delivery brings major changes to the electric power industry. Electricity is traded as a commodity in financial markets which affect the way electric power grids are controlled and operated. Today's electrical engineers are compelled to understand both the technical and business sides of such changes in order to address the needs of the electric power industry.

IIT's Department of Electrical and Computer Engineering and the Stuart School of Business have teamed up to offer a master's degree in electricity markets. Combining courses from graduate programs in electrical engineering and in finance, the Master of Electricity Markets degree program provides graduate-level education in electricity suitable for electric power engineers. A background in finance is not required.

The admission requirements for this degree follow the existing admission requirements for other professional master's degrees in the ECE department. Students whose accredited B.S. degree is not in electrical engineering may pursue this 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 graduate coursework, with a minimum of 15 credit hours from the area of engineering, and a minimum of 6 credit hours from the area of finance. A student can take MSF 502 or MSF 503, but only one can be counted toward the degree program. Six additional credit hours of electives are chosen from graduate coursework in the ECE department.

Curriculum

ECE Courses (minimum of 5)

ECE 417 Power Distribution Engineering
ECE 418 Power Systems Analysis
ECE 419 Power Systems Analysis With Laboratory
ECE 420 Analytical Methods in Power Systems
ECE 553 Power System Planning
ECE 555 Power Market Operations
ECE 556 Power Market Economics and Stability
ECE 557 Fault Tolerant Power Systems
ECE 558 Power System Reliability
ECE 561 Deregulated Power Systems
ECE 562 Power System Transaction Management
ECE 564 Control and Operation of Electric Power Systems
ECE 580 Elements of Sustainable Energy
ECE 581 Elements of Smart Grid
ECE 582 Microgrid Design and Operation

Finance Courses (minimum of 2)

MSF 502 Statistical Analysis in Financial Markets
MSF 503 Financial Modeling
MSF 504 Valuation and Portfolio Management
MSF 505 Futures, Options, and OTC Derivatives
MSF 524 Models for Derivatives
MSF 526 Computational Finance
MSF 534 Corporate Finance
MSF 554 Market Risk Management
MSF 564 Financial Theory
MSF 584 Equity and Equity Derivatives Trading

Energy/Environment/Economics (E³)

32 credit hours

The Energy/Environment/Economics (E³) 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 and sustainability issues and economic forces that drive technology choice.

The E³ specialization requires an interdisciplinary thesis in an E³ area of research for M.S. and Ph.D. degrees, and an interdisciplinary graduate project or additional energy and sustainability courses for professional master's

degrees. Graduate students in E³ should also be enrolled in fundamental courses related to the topics of energy, environment, and economics. E³ is designed primarily for students majoring in 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, of sustainability issues related to energy extraction, conversion, and utilization, and of the impact of sustainability principles on the design and operation of energy systems. Furthermore, students will gain sufficient knowledge of sustainability and regulatory issues to enable them to make more viable technology choices.

Master of Electrical and Computer Engineering with (E³) Specialization

32 credit hours

This program has the same requirements as the M.E.C.E. degree program, except that students are required to register for three to six credits of special project research

(ECE 594 or ECE 597), plus CHE 543, two courses from the electrical engineering courses listed in Group A, one course from Group B (listed below), and two power and control courses. At least 24 ECE credits are required.

Master of Science in Electrical and Computer Engineering with (E³) Specialization

32 credit hours

Thesis

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 and one course from Group B (listed below). 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 are also required to register for six to eight credit hours of M.S. thesis research (ECE 591) in an interdisciplinary E³ 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 advisor's approval.

Doctor of Philosophy in Electrical Engineering with (E³) Specialization

84 credit hours

Qualifying exam

Comprehensive exam

Dissertation and oral defense

Students interested in the Ph.D. program in electrical engineering are required to take at least 84 credit hours beyond the B.S. degree requirements, including CHE 543, and at least five E³ courses (from Groups A and/or

B). Registration for approximately 32 hours of Ph.D. thesis research in E³ areas of study is also required. Candidates must pass written qualifying and comprehensive examinations and must defend their thesis in an oral examination. The Ph.D. committee for E³ students must include at least one professor with specialization in an energy and sustainability area from outside the student's department.

E³ Courses

See descriptions under the respective department's course listings.

Group A

CHE 541

Renewable Energy Technologies

CHE 542

Fluidization and Gas-Solids Flow Systems

CHE 565

Fundamentals of Electrochemistry

CHE 567

Fuel Cell Fundamentals

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 System Relaying

ECE 555

Power Market Operations

ECE 556

Power Market Economics & 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 564

Control and Operation of Electric Power Systems

MMAE 522

Nuclear, Fossil-Fuel, and Sustainable Energy Systems

MMAE 523

Fundamentals of Power Generation

MMAE 524

Fundamentals of Combustion

Group B

EMS 500

Fundamentals of Environmental Science

EM 503

Environmental Pollution Prevention and Control Strategies

EM 504

Industrial Ecology and Systems Thinking

ENVE 501

Environmental Chemistry

ENVE 506

Chemodynamics

ENVE 542

Physiochemical Processes in Environmental Engineering

ENVE 551

Industrial Waste Treatment

ENVE 561

Design of Environmental Engineering Processes

ENVE 570

Air Pollution Meteorology

ENVE 577

Design of Air Pollution Control Devices

ENVE 578

Physical and Chemical Processes for Industrial Gas Cleaning

ENVE 580

Hazardous Waste Engineering

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 coursework 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 advisor and the department's graduate program director on the basis of relevance of course content, rather than along a predetermined sequence announced by the de-

partment. 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 advisor, 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 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 specialization. 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 advisor, 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 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 advisor 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.

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 advisor, who may 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. studies. This is a written examination covering 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 advisor, 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.

Certificate Programs

Certificate programs provide a student with post baccalaureate 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 (choose four)

ECE 411 Power Electronics

ECE 425 Analysis and Design of Integrated Circuits

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 529 Advanced VLSI Systems 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 509 Electromagnetic Field Theory

AND one of the following:

ECE 421 Microwaves Circuits and Systems

ECE 423 Microwave Circuits and Systems with Laboratory

Elective Courses (choose two)

ECE 522 Electromagnetic Compatibility

ECE 571 Nanodevices and Technology

ECE 576 Antenna Theory

ECE 578 Microwave Theory

Communication Systems

This certificate program is for those who want to become proficient in communication system principles and applications. The student will take the two fundamental courses and two courses from a large number of electives, 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 (choose two)

ECE 405 Digital and Data Communication Systems with Laboratory

ECE 508 Video Communication

ECE 514 Digital Communication Principles

ECE 515 Modern Digital Communications

ECE 516 Coding for Distributed Storage Systems

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 544 Wireless and Mobile Networks

ECE 545 Advanced Computer Networks

ECE 546 Wireless Network Security

ECE 547 Wireless Network Performance Analysis

Computer Engineering

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 585 Advanced Computer Architecture

AND one of the following:

ECE 429 Introduction to VLSI Design

ECE 529 Advanced VLSI Systems Design

Elective Courses (choose two)

ECE 441 Microcomputers

ECE 443 Introduction to Computer Security

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 544 Wireless and Mobile Networks

ECE 545 Advanced Computer Networks

ECE 546 Wireless Network Security

ECE 547 Wireless Networks Performance Analysis

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

ECE 589 Computer-Aided Design of Analog IC

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 (choose two)

ECE 438 Control Systems

OR

ECE 506 Analysis of Nonlinear Systems

ECE 550 Power Electronic Dynamics and Control

Electricity Markets

This program is an introduction to both the technical and business sides of a deregulated electric power industry. Students complete two courses from among power system electives and two courses from among finance electives.

Power System Courses (choose two)

ECE 555 Power Market Operations

ECE 556 Power Market Economics and Security

ECE 561 Deregulated Power Systems

ECE 562 Power System Transaction Management

Finance Courses (choose two)

MSF 504 Valuation and Portfolio Management

MSF 505 Futures, Options and OTC Derivatives

MSF 554 Market Risk Management

MSF 584 Equity and Equity Derivatives Trading

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 is useful to managers, engineers, and students who are seeking a position in power electronics related industry.

Required Courses (choose two)

ECE 411 Power Electronics
ECE 550 Power Electronic Dynamics and Control
ECE 551 Advanced Power Electronics
ECE 552 Adjustable Speed Drives

Elective Courses (choose two)

ECE 437 Digital Signal Processing I
ECE 438 Control Systems
ECE 531 Linear System Theory
ECE 535 Discrete Time Systems
ECE 538 Renewable Energies
ECE 539 Computer Aided Design of Electric Machines
ECE 548 Energy Harvesting
ECE 575 Electron Devices

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.

Core Course (choose one)

ECE 411 Power Electronics
ECE 412 Electric Motor Drives
ECE 418 Power Systems Analysis
ECE 419 Power Systems Analysis with Laboratory
ECE 420 Analytical Methods in Power Systems

Elective Courses (choose three)

ECE 417 Power Distribution Engineering
ECE 538 Renewable Energies
ECE 539 Computer Aided Design of Electric Machines
ECE 540 Reliability Theory and System Implementation
ECE 548 Energy Harvesting
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 System 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
ECE 580 Elements of Sustainable Energy
ECE 581 Elements of Smart Grid
ECE 582 Microgrid Design and Operation

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 507 Imaging Theory and Applications
ECE 508 Video Communications
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 Communication 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)

ECE 514 Digital Communication Principles
ECE 515 Modern Digital Communications
ECE 519 Coding For Reliable Communications
ECE 544 Wireless and Mobile Networks
ECE 546 Wireless Network Security
ECE 547 Wireless Networks Performance Analysis
ECE 576 Antenna Theory

Course Descriptions

ECE 502

Basic Network Theory

Steady-state analysis of linear networks. Introduction to topology and the derivation of mesh, nodal & terminal pair relations using topological concepts with applications to computer-aided analysis of networks. Numerical techniques for network analysis and optimization.

(3-0-3)

ECE 504

Wireless Communication System Design

Fundamentals of first (1G), second (2G), third (3G), and future generation cellular communication systems. This course covers the transition from 1G to 3G systems. Topics included are speech and channel encoders, interleaving, encryption, equalization, modulation formats, multi-user detection, smart antennas, technologies that are used in these transitions, and future generations of cellular systems. Compatibility aspects of digital cellular systems are discussed along with a review of the standards for the industry. TDMA and CDMA systems are covered in detail.

Prerequisite(s): [(ECE 513)]

(3-0-3)

ECE 505

Applied Optimization for Engineers

Principles of optimization for practical engineering problems, linear programming, nonlinear unconstrained optimization, nonlinear constrained optimization, dynamic programming.

(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.

(3-0-3)

ECE 507

Imaging Theory & Applications

Image formation methods including optical (photography), tomography, image formation with arrays of sensors, interferometry, and surface imaging. Technologies of image acquisition including digital cameras, radar/sonar and medical imaging techniques such as magnetic resonance imaging, computed tomography, positron emission tomography, optical imaging, electroencephalography, and magnetoencephalography. Throughout the semester, the course will also focus on the reconstruction of images based on the raw data obtained from various imaging techniques.

(3-0-3)

ECE 508

Video Communications

This course covers the fundamentals of video coding and communications. The principles of source coding for the efficient storage and transmission of digital video will be covered. State-of-the-art video coding standards and error-resilient video coding techniques will be introduced. Recent technologies for robust transmission of video data over wired/wireless networks will be discussed. A detailed overview of architectural requirements for supporting video communications will be presented. Error control and cross-layer optimization techniques for wireless video communications will be covered.

Prerequisite(s): [(ECE 437 and 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(s): [(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.

Prerequisite(s): [(ECE 308 and MATH 474)]

(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.

Prerequisite(s): [(ECE 403 and MATH 474)]

(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. Channel coding and introduction to trellis coded modulation.

Prerequisite(s): [(ECE 511 and 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. Multiple access systems, time-division multiple access, code-division multiple access, and frequency-division multiple access. Advanced communications systems.

Prerequisite(s): [(ECE 511 and ECE 513)]

(3-0-3)

ECE 516

Coding for Distributed Storage Systems

Distributed storage systems, such as data centers, are becoming a vital infrastructure of today's society by allowing to store reliably large amounts of data and make it accessible anywhere and anytime. The goal of this course is to train students with the different mathematical and engineering tools that are needed when studying and designing codes and algorithms for data reliability and security in these large-scale systems. The course will cover relevant topics in information theory, coding theory, graph theory, and wireless communications in addition to the active on-going research in this area.

Prerequisite(s): [(ECE 511)]

(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.

Prerequisite(s): [(MATH 474)]
(3-0-3)

ECE 520**Information Theory & Applications**

Definition of information; coding of information for transmission over a noisy channel including additive Gaussian noise channels and waveform channels; minimum rates at which sources can be encoded; maximum rates at which information can be transmitted over noisy channels. Information theoretic security. Modern applications of information theory in communications, networking, and other fields.

Prerequisite(s): [(ECE 511)]
(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(s): [(ECE 307)]
(3-0-3)

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.

Prerequisite(s): [(ECE 307)]
(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.

Prerequisite(s): [(ECE 309 and 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 applications, bandwidth estimation, and stability analysis techniques. RF IC team design projects. Requires senior standing.

Prerequisite(s): [(ECE 312)]
(3-0-3)

ECE 526**Active Filter Design**

Analysis and design of linear active filters with emphasis on realizations using operational amplifiers. Sensitivity analysis. Switched capacitor filters.

Prerequisite(s): [(ECE 308 and 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 intermodulation, cross-modulation, harmonics, gain compression, desensitization, spurious, etc. Noise effects including thermal, shot, 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. Requires senior standing.

Prerequisite(s): [(ECE 312)]
(3-0-3)

ECE 529**Advanced VLSI Systems Design**

Advanced design and applications in VLSI systems. The topics of this course include design tools and techniques, clocking issues, complexity management, layout and floor planning, array structures, testing and testability, advanced arithmetic circuitry, transcendental function approximations, architectural issues, signal processing architecture and sub-micron design. Design projects are completed and fabricated by student teams.

Prerequisite(s): [(ECE 429)]
(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 tradeoffs, 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.

Prerequisite(s): [(ECE 429)]
(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(s): [(ECE 308)]
(3-0-3)

ECE 535**Discrete Time Systems**

Discrete systems. Sampling and reconstruction procedures. Transform techniques of analysis and synthesis. State space techniques. Discrete controllability, observability and stability. Compensation and digital controllers.

Prerequisite(s): [(ECE 438)]
(3-0-3)

ECE 538**Renewable Energies**

Various renewable energy sources such as solar systems, wind powered systems, ocean tides, ocean waves, and ocean thermal are presented. Their operational principles are addressed. Grid connected interfaces for such systems are explained. Research and Simulation mini-projects with emphasis on either machine design, or power electronic circuit analysis, design, and controls, or grid connected renewable systems are assigned to student groups.

Prerequisite(s): [(ECE 311)]
(3-0-3)

ECE 539**Computer Aided Design of Electric Machines**

Fundamentals of energy conversion will be discussed, which are the foundation of efficient design and operation of motors & generators in modern day automotive, domestic and renewable energy systems. It will further investigate the principles of structural assessment, electromagnetic analysis, dimensional and thermal constraints. Finite Element Analysis (FEA) software-based design projects will be used to model the performance and operation of electric machines.

(3-0-3)

ECE 540**Reliability Theory & 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.

Prerequisite(s): [(ECE 308 and MATH 474)]
(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 from 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(s): [(ECE 407 and MATH 474)]
(3-0-3)

ECE 542**Design & 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(s): [(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(s): [(ECE 407) OR (ECE 408)]
(3-0-3)

ECE 544**Wireless & Mobile Networks**

This course provides an overview of different wireless and mobile network standards and systems. The topics covered include cellular networks, satellite networks, wireless local area networks, wireless personal area networks, mobile IP, ad hoc networks, sensor networks, wireless mesh networks and wireless network security.

Prerequisite(s): [(ECE 407) OR (ECE 408)]
(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, switches and gateways. Routing in data networks. Network and protocol design to support multimedia and multicasting connections. Network application security.

Prerequisite(s): [(ECE 407) OR (ECE 408)]
(3-0-3)

ECE 546**Wireless Network Security**

This course focuses on selected research topics current interest in wireless network security. This course will cover security and privacy issues in wireless systems, including cellular networks, wireless LAN, mobile ad hoc networks (MANET), wireless mesh networks, sensor networks, vehicular networks, RFID, and ubiquitous computing.

Prerequisite(s): [(ECE 543)]
(3-0-3)

ECE 547**Wireless Networks Performance Analysis**

This course deals with the performance analysis techniques for the main types of wireless networks used today including cellular communication networks, wireless local area networks (WLAN), zigbee wireless networks, and wireless mesh networks. The course not only discusses the details of the related IEEE standards but also focuses on mathematical modeling and analysis to compute the quality of service metrics as well as resource utilization efficiency. Key topics include cellular system design, mobility management, conflict-free medium access, contention-based medium access, Markov chain modeling for 802.11, fixed-point based analysis, 802.15.4 modeling and analysis, and wireless mesh network capacity analysis.

Prerequisite(s): [(ECE 544)]
(3-0-3)

ECE 548**Energy Harvesting**

Various harvesting techniques such as solar, ocean tides, vibration, linear motion, radio frequency, passive and active human power generation are presented. Their operational principles are addressed. Research and simulations mini-projects with emphasis on power electronic circuit analysis, design, and controls are assigned to student groups.

Prerequisite(s): [(ECE 311)]
(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.

Prerequisite(s): [(ECE 438)]
(3-0-3)

ECE 550**Power Electronic Dynamics & Control**

Modeling an 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(s): [(ECE 411)]
(3-0-3)

ECE 551**Advanced Power Electronics**

Advanced power electronic converters, techniques to model and control switching circuits, resonant 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(s): [(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 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(s): [(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(s): [(ECE 418) OR (ECE 419)]
(3-0-3)

ECE 554**Power System Relaying**

Principles of relay protection for faults on transmission lines and in transformers, rotating machines and other equipment. Use of over current, 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(s): [(ECE 418) OR (ECE 419)]
(3-0-3)

ECE 555**Power Market Operations**

Market Design in Restructured Power Systems, Short-term Load Forecasting, Electricity Price Forecasting, Price Based Unit Commitment, Arbitrage in Electricity Market, Market Power Analysis, Asset Valuation and Risk Analysis, Security Constrained Unit Commitment, Ancillary Services Auction Market Design, Power Transmission Pricing, Regional Transmission Organizations.

Prerequisite(s): [(ECE 418) OR (ECE 419)]
(3-0-3)

ECE 556**Power Market Economics & 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.

Prerequisite(s): [(ECE 420)]
(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(s): [(ECE 418) OR (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(s): [(ECE 418) OR (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(s): [(ECE 418) OR (ECE 419)]
(3-0-3)

ECE 560**Power Systems Dynamics & Stability**

The transient stability problem, acceleration equations, stability criteria, two-machine and multimachine problems. Perturbation analysis, eigenvalue sensitivity, Liapunov theory and application to power systems stability.

Prerequisite(s): [(ECE 418) OR (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, and RTO.

Prerequisite(s): [(ECE 418) OR (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), transaction information system (TIS), tagging calculator (IDC), congestion management, transmission loading relief (TLR).

Prerequisite(s): [(ECE 418) OR (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, and advanced engineering applications.

(3-0-3)

ECE 564

Control & 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(s): [(ECE 418) OR (ECE 419)]
(3-0-3)

ECE 565

Computer Vision & Image Processing

Multidimensional 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(s): [(ECE 437 and MATH 474)]
(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 likelihood and MAP. Linear discriminant analysis. Perception algorithm and its extensions. Feature extraction algorithms. Clustering algorithms. Introduction to neural nets. Hopfield, Hamming, feed forward models. Training of neural nets.

Prerequisite(s): [(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.

Prerequisite(s): [(ECE 511 and 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.

Prerequisite(s): [(ECE 437 and 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.

Prerequisite(s): [(ECE 437 and MATH 474)]
(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.

Prerequisite(s): [(ECE 307 and ECE 312)] AND [(ECE 403)]
(3-0-3)

ECE 571

Nanodevices & 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. Prerequisite: Knowledge in 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.

Prerequisite(s): [(ECE 307 and 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.

Prerequisite(s): [(ECE 307) OR (ECE 421) OR (ECE 423)]
(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(s): [(ECE 421) OR (ECE 423)]
(3-0-3)

ECE 580**Elements of Sustainable Energy**

This course covers cross-disciplinary subjects on sustainable energy that relate to energy generation, transmission, distribution, and delivery as well as theories, technologies, design, policies, and integration of sustainable energy. Topics include wind energy, solar energy, biomass, hydro, nuclear energy, and ocean energy. Focus will be on the integration of sustainable energy into the electric power grid, the impact of sustainable energy on electricity market operation, and the environmental impact of sustainable energy.

Prerequisite(s): [(ECE 418) OR (ECE 419)]
(3-0-3)

ECE 581**Elements of Smart Grid**

This course covers cross-disciplinary subjects on smart grid that relates to energy generation, transmission, distribution, and delivery as well as theories, technologies, design, policies, and implementation of smart grid. Topics include: smart sensing, communication, and control in energy systems; advanced metering infrastructure; energy management in buildings and home automation; smart grid applications to plug-in vehicles and low-carbon transportation alternatives; cyber and physical security systems; microgrids and distributed energy resources; demand response and real-time pricing; and intelligent and outage management systems.

Prerequisite(s): [(ECE 418) OR (ECE 419)]
(3-0-3)

ECE 582**Microgrid Design & Operation**

Microgrids are the entities that are composed of at least one distributed energy resource and associated loads which not only operates safely and efficiently within the local power distribution network but also can form intentional islands in electrical distribution systems. This course covers the fundamentals of designing and operating microgrids including generation resources for microgrids, demand response for microgrids, protection of microgrids, reliability of microgrids, optimal operation and control of microgrids, regulation and policies pertaining to microgrids, interconnection for microgrids, power quality of microgrids, and microgrid test beds.

Prerequisite(s): [(ECE 418) OR (ECE 419)]
(3-0-3)

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 at the gate level. 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..

Prerequisite(s): [(ECE 446) OR (ECE 485)]
(3-0-3)

ECE 584**VLSI Architecture for Signal Processing & Communication Systems**

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 transform. 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(s): [(ECE 429 and ECE 437)]
(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 Iterations.

(3-0-3)

ECE 586**Fault Detection in Digital Circuits**

Essential elements in testing and testability of digital designs. Automatic tests generation algorithms and fault-simulation methods. Design methodologies to increase testability and decrease test generation costs. Techniques for built-in testing.

Prerequisite(s): [(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.

Prerequisite(s): [(CS 201 and ECE 441)]
(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(s): [(ECE 429)]

(3-0-3)

ECE 589**Computer-Aided Design of Analog IC**

Analog IC design optimization algorithm such as equation-based optimization and simulation-based optimization algorithms, design automation tools such as harmonic balance, projection-based surface response estimation, shooting methods, etc. will be introduced. Research and mini-projects with emphasis on analog integrated circuit design and optimization algorithms using state-of-the art tools are assigned to student groups.

(3-0-3)

ECE 591**Research & Thesis for Masters Degree**

(Credit: Variable)

ECE 593**Masters Electrical & Computer Engineering Seminar**

Seminar course for Master students.

(1-0-0)

ECE 594**Special Projects**

Special projects.

(Credit: Variable)

ECE 597**Special Problems**

Special problems.

(Credit: Variable)

ECE 600**Continuation of Residence**

Continuation of residence.

(0-0-1)

ECE 691**Research & Thesis for Ph.D.**

Research & Thesis for Ph.D.

(Credit: Variable)

ECE 693**Doctoral Electrical & Computer Engineering Seminar**

Seminar course for Ph. D. students.

(1-0-0)

ECE 708**Technologies for Long-Term Evolution of Wireless Communications Networks**

The course discusses technologies used in long-term evolution (LTE) wireless communications systems. Fundamentals of multiple-input/multiple-output (MIMO) wireless communication systems and orthogonal frequency division modulation (OFDM) are covered. Transmission diversity concepts and principles of space-time coding are introduced. The fundamentals of space-time block and trellis coded modulation (STBCM and STTCM) are introduced along with performance analysis, code design, and simulation results. A comparison of various design techniques in different propagation environments is presented. Applications to MIMO/OFDM systems are discussed.

Prerequisite(s): [(ECE 513)]

(2-0-2)

ECE 719**Theory & Applications of Linear Optimization in Wireless Networks**

This short course covers both the fundamental of linear optimization and applications in wireless networking research, emphasizing not only the optimization methodology but also the underlying mathematical structures. In addition to the fundamental contents of simplex method, duality theory, and network flow problems, this course also covers the integer programming techniques. This course discusses the applications of linear optimization in the wireless network, including wireless mesh networks, multi-radio multi-channel networks, and cognitive radio networks.

Prerequisite(s): [(ECE 407) OR (ECE 408)] AND [(MATH 477)]

(2-0-2)

ECE 721**Introduction to Wireless Cooperative Communications & Applications**

The course gives an introduction to wireless cooperative communication networks from the perspective of the channel and physical layer. It discusses cooperative networks protocols and application of these. It will deal with wireless channels and relay networks. Transparent and regenerative physical layer algorithms will be discussed to facilitate the analysis of different architectures. Use of distributed space time codes, multiplexing, and orthogonal frequency division multiplexing will be analyzed to achieve multi-dimensional diversity (path, frequency, and time), reduced interference, and improved QoS.

Prerequisite(s): [(ECE 403)]

(2-0-2)

ECE 735**Cellular Long Term Evolution**

Cellular Long Term Evolution (LTE) is a key wireless broadband technology considered as the primary path towards the next generation networks (NGNs). It is generally considered as the dominant wireless technology meeting the seamless, mobile Internet access needs of the upcoming Quadruple Play applications. This short course covers the applications, requirements, architecture, radios and antennas, protocols, network operations and management, and evolution for the LTE technology. Key topics include the functions and interfaces of the protocol layers, Quality of Service (QoS), security, network signaling, infrastructure, user equipment, spectrum, throughput, and coverage. Discussion includes the modulation schemes, frame structure, antenna and radio, and subcarrier and bandwidth allocation methods. End-to-end scenarios on connection setup, interworking with existing 3G cellular, WiFi, and WiMAX networks, and handovers are discussed. Testing and integration issues, limitations, and challenges are also mentioned. Comparative analysis with respect to WiMAX and ultra mobile broadband (UMB) are covered. The likely migration paths from current wireless and wireline networks to LTE and related HSOPA and SAE architectures are discussed.

(1-0-1)

ECE 738**Information Technology**

Probability and Random Process Information theory addresses information theoretic limits on data compression and reliable data communications in the presence of noise. It has fundamental contribution in communications, networking, statistical physics, computer science, statistical inference, and probability and statistics. It covers entropy, mutual information, fundamental limits on data compression, Huffman codes, channel capacity, and channel coding.

(2-0-2)

ECE 739**Broadband Access – Options & Analysis**

This short course deals with requirements, options, architecture, and issues relating to the Next Generation broadband networks. The focus is on the key wireline and wireless access options with specific emphasis on its applicability to multimedia applications. The requirements placed by upcoming services on access are introduced. For the major access options, the key topics include capabilities, architectures, protocol structures, Quality of Service (QoS), security, user equipment, spectrum, throughput, and coverage. The associated signaling and modulation schemes, transport technologies and characteristics, end-to-end scenarios, and interworking are addressed. Comparative analysis in terms of various application profiles involving voice, data, and video are carried out. The modeling techniques for analyzing the interplay and technology and market relevance of xDSL, cable/coax, fiber, WiFi, WiMAX, and cellular wireless options are covered. The likely migration paths for these options towards the Next Generation Networks (NGNs) are mentioned.

(2-0-2)

ECE 740**Telecommunication Networks: Requirements to Deployment**

The ever-increasing customer demand for new and advanced services and the associated complexities of designing, deploying, optimizing, and managing telecom networks require advanced end to end technology and process expertise. This short course deals with the key concepts of requirements development, design processes, architecture finalization, system design, site testing, performance optimization, and network operations and management of current and upcoming Telecom networks. It provides an overview on how the process works from an idea or concept to productization and will give a view on associated complexities and challenges. Key advances in tools and techniques needed with these major steps are covered. Practical examples of the current and upcoming features which will make telecom networks competitive are addressed. Aspects of customer management, strategies for decision making, and the migration towards future networks are also addressed. Practical examples of networks of selected service providers and how they meet the local and global needs are mentioned.

(2-0-2)

ECE 742**Digital System-on-Chip Design**

This short course covers digital design techniques and hardware/software realization concepts in embedded computing systems using VHDL. Topics include: basics principles of VHDL programming; designing with FPGA; design of arithmetic logic unit; VHDL models for memories and busses; CPU design; system-on-chip design; efficient hardware realizations of FFT, DCT, and DWT.

(2-0-2)

ECE 743**Signal & Data Compression with Embedded Systems**

This short course deals with data compression techniques and hardware/software realization concepts in embedded computing systems. Key topics: fundamentals of random signal processing and information theory, compression and decompression processes, lossy and lossless compression methods, compression standards for video and audio, modeling and signal parameter estimation, transform techniques including FFT, DCT, and DWT. Hardware realizations of compression algorithms.

(2-0-2)

ECE 744**Embedded Digital Systems for Time-Frequency Distribution, Signal Modeling, & Estimation**

This short course deals with time-frequency distribution, signal modeling and estimation, and hardware/software realization concepts in embedded computing systems. Key topics include fundamentals of signal processing and random processes, short-time Fourier transform, split-spectrum processing, Gabor transform, Wigner distribution, Hilbert transform, wavelet transform, cosine transform, chirplet signal decomposition, matching pursuit, parametric time-series frequency estimation, hardware/software codesign and realizations of time-frequency distributions, and signal modeling algorithms.

(2-0-2)

ECE 750

Synchrophasors for Power System Monitoring & Control

The course gives an introduction to synchrophasor technology from the perspective of power system monitoring and control. It discusses the fundamentals of measurements and synchrophasor estimation. It covers the IEEE Standard C37.118. Several synchrophasor estimation algorithms will be discussed as they relate to measurement and estimation errors. Various synchrophasor applications will be presented including situational awareness, event detection, model validation, oscillation detection, WAMS, and WAMPAC.

Prerequisite(s): [(ECE 419)]

(2-0-2)

ECE 752

Industrial Applications of Power Electronics & Motor Drives

Practical topologies of different types of power electronic converters are covered including industrial high-voltage and high-current applications, protection, and cooling. Common industrial motor drives are examined with popular control techniques, simplified modeling, and worst-case design. Regulating and stabilizing methods are applied to switching power supplies, power conditioning systems, electronic ballasts, and electronic motors.

(2-0-2)

ECE 755

Power System Protection

This course provides basic understanding of the role of protective relaying in the power system. It also delves into the needs of today's power systems for protection that is robust and tolerant to heavily loaded transmission systems. The students are challenged to be a part of the solution going forward including the role of wide area system protection.

(2-0-2)

ECE 756

Power System Maintenance Scheduling

This short course is aimed at providing an in-depth introduction to optimal generation and transmission maintenance in the regulated and restructured power systems. The basic principles of systems operation and economics related to maintenance scheduling will be discussed along with current practices and solution methods for the electric power industry.

Prerequisite(s): [(ECE 419 and ECE 420)]

(2-0-2)

ECE 764

Vehicular Power Systems

Conventional electrical power systems of land, sea, air, and space vehicles are detailed along with the scope for improvement. New electrical loads and advanced distribution system architectures of electric and hybrid electric vehicles are presented. Current trends in the vehicular industry, such as 42V automotive systems and more electric aircraft, are explained.

(2-0-2)

Undergraduate Courses Available to Graduate Students

Note: Students may take up to an approved number of the following courses.

ECE 401

Communication Electronics

ECE 403

Digital and Data Communication Systems

ECE 405

Digital and Data Communication Systems with Laboratory

ECE 407

Introduction to Computer Networks with Laboratory

ECE 408

Introduction to Computer Networks with Laboratory

ECE 411

Power Electronics

ECE 412

Power Electronics

ECE 417

Power Distribution Engineering

ECE 418

Power Distribution Engineering

ECE 419

Power Distribution Engineering

ECE 420

Power Distribution Engineering

ECE 421

Power Distribution Engineering

ECE 423

Microwave Circuits and Systems with Laboratory

ECE 425

Analysis and Design of Integrated Circuits

ECE 429

Introduction to VLSI Design

ECE 436

Digital Signal Processing I with Laboratory

ECE 437

Digital Signal Processing I with Laboratory

ECE 438

Digital Signal Processing I with Laboratory

ECE 441

Microcomputers

ECE 446

Advanced Logic Design

ECE 449

Object-Oriented Programming and Computer Simulation

ECE 481

Image Processing

ECE 485

Computer Organization and Design

Energy/Environment/Economics (E³)

Faculty Directors

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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 (E³) 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.

E³specialization requires an interdisciplinary thesis in an E³area of research for M.S. and Ph.D. degrees, and an interdisciplinary graduate project for professional master's degrees. Graduate students in E³ should also be enrolled in fundamental courses related to the topics of energy, environment, and economics. E³ 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 E³specialization
M.S. in Chemical Engineering with E³specialization
Master of Electrical and Computer Engineering with E³specialization
M.S. in Electrical Engineering with E³specialization (thesis and non-thesis options)
Master of Environmental Engineering with E³specialization
M.S. in Environmental Engineering with E³specialization

Master of Mechanical and Aerospace Engineering with E³specialization
M.S. in Mechanical and Aerospace Engineering with E³specialization
Ph.D. in Chemical Engineering with E³specialization
Ph.D. in Environmental Engineering with E³specialization
Ph.D. in Electrical Engineering with E³specialization
Ph.D. in Mechanical and Aerospace Engineering with E³specialization

Research Centers, Facilities, and Areas

Students should consult descriptions in the respective departments:

Chemical and Biological Engineering
Electrical and Computer Engineering
Mechanical, Materials, and Aerospace Engineering

Admission Requirements

Students should consult listings in the respective departments:

Chemical and Biological 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 E³ specialization courses. The following section details the E³ 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 E³ undergraduate courses may be substituted for graduate courses with the approval of the designated advisor, 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 Biological 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 E³ Specialization

32 credit hours
Project

This program has the same requirements as the M.S. degree program, except that, in place of six to 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 E³ courses with the approval of their advisor.

Master of Science in Chemical Engineering with E³ Specialization

32 credit hours
Thesis

Students pursuing the M.S. in Chemical Engineering with E³ specialization are required to take CHE 543 and select at least one course from Group A and one course from Group B (listed in the E³ course section of this bulletin), and register for up to eight credit hours

of M.S. thesis preparation (CHE 591) in an interdisciplinary E³ area. In addition, the students are required to take all required core courses for the M.S. in Chemical Engineering degree.

Students may apply up to 12 credit hours of 400-level courses to the M.S. degree requirements with their advisors approval.

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 advisor.

Master of Science in Environmental Engineering with E³ Specialization

32 credit hours

Thesis

Candidates for the M.S. in Environmental Engineering with E³specialization 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 (listed in the E³course section of this bulletin).

Students are also required to register for up to eight credit hours of M.S. thesis research (ENVE 591) in an interdisciplinary E³area. Students may apply up to two 400-level courses to the M.S. degree requirements with their advisor's approval.

Master of Mechanical and Aerospace Engineering with E³ Specialization

30 credit hours

Candidates for the Master of Mechanical and Aerospace Engineering with E³specialization are required to take CHE 543 and the following three courses:

MMAE 501 Engineering Analysis I

MMAE 520 Advanced Thermodynamics

MMAE 523 Fundamentals of Power Generation

In addition, the E³specialization under MMAE requires a course emphasizing numerical methods, 2 courses selected from the following Group A courses, and one Group B course, in the E³course section of this bulletin.

MMAE 521 Statistical Thermodynamics

MMAE 524 Fundamentals of Combustion

MMAE 525 Fundamentals of Heat Transfer

MMAE 526 Heat Transfer: Conduction

MMAE 527 Heat Transfer: Convection and Radiation

Master of Science in Mechanical and Aerospace Engineering with E³ Specialization

32 credit hours Thesis

Candidates for the M.S. in Mechanical and Aerospace Engineering with E³specialization are required to take CHE 543 and two courses: MMAE 501 (Engineering Analysis I) and MMAE 502 (Engineering Analysis II). Also required under the thermal sciences area of MMAE are MMAE 520 (Advanced Thermodynamics), MMAE 523 (Fundamentals of Power Generation) and any two of the following Group A courses:

MMAE 521 Statistical Thermodynamics

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 eight credit hours of MMAE 591 (Thesis).

Master of Electrical and Computer Engineering with E³ 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 register for three to six credits of special project research

(ECE 594 or ECE 597), plus CHE 543, two courses from the electrical engineering courses listed in Group A, one course from Group B (listed in the E³course section of this bulletin), and two power and control courses. At least 24 ECE credits are required.

Master of Science in Electrical Engineering with E³ 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 and one course from Group B (listed in the E³ course section of this bulletin). 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 are also required to register for six to eight credit hours of M.S. thesis research (ECE 591) in an interdisciplinary E³ 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 advisor's approval.

Doctor of Philosophy with E³ Specialization

84 credit hours

Qualifying exam

Comprehensive exam

Dissertation and oral defense

Students interested in the Ph.D. program in all disciplines (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

E³ courses (four from both groups A and B; see course listings below) upon the recommendation of their thesis advisor. Registration for approximately 32 hours of Ph.D. thesis research in E³ areas of study is also required. Candidates must pass written qualifying and comprehensive examinations and must defend their thesis in an oral examination. The Ph.D. committee for E³ students must include at least one E³ professor from outside the student's department.

E³ Courses

See descriptions under the respective department's course listings.

Group A

CHE 503

Thermodynamics

CHE 536

Computational Techniques in Engineering

CHE 541

Renewable Energy Technologies

CHE 542

Fluidization and Gas-Solids Flow Systems

CHE 565

Fundamentals of Electrochemistry

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 System Relaying

ECE 555

Power Market Operations

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

MMAE 517

Computational Fluid Dynamics

MMAE 520

Advanced Thermodynamics

MMAE 521

Statistical Thermodynamics

MMAE 522

Nuclear, Fossil-Fuel, and Sustainable Energy Systems

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 Elmnt Anlys

Group B

CHE 541
Renewable Energy Technologies

CHE 560
Statistical Quality and Process Control

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
Physiochemical Processes in Environmental Engineering

ENVE 545
Environmental Regulations and Risk Assessment

ENVE 551
Industrial Waste Treatment

ENVE 561
Design of Environmental 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 Waste Engineering

ENVE 585
Groundwater Contamination and Pollutant Transport

Department of Food Science and Nutrition

Institute for Food Safety and Health
IIT Moffett Campus
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IIT Vice President, IFSH Director, and Interim Chair:
Robert Brackett

IFSH Associate Director, Professor, and Associate Chair:
Jason Wan

Graduate Program Manager:
Renee McBrien

The Department of Food Science and Nutrition (FdSN) at the School of Applied Technology and the Institute for

Food Safety and Health (IFSH), with IIT faculty, U.S. Food and Drug Administration (FDA) scientists, and food industry experts, provides a unique training ground for individuals seeking graduate education in food safety and technology and food process engineering.

The master's degree programs in Food Safety and Technology (FST) and Food Process Engineering (FPE) are designed to educate food technologists and engineers in aspects relating to food processing and safety. Students can specialize in food processing and packaging, food microbiology and safety, compositional safety of food (chemistry), and food for health (nutrition). Graduates of the program will be prepared to assume responsible positions in food manufacturing operations, research and development, food safety, compliance and regulatory affairs, and quality assurance in the processing, retail, and food service segments of the food industry. Other career options include positions with federal, state, or local health and agri-food agencies, and in policy-making, regulatory, or research roles with organizations associated with food manufacturing operations.

Degrees Offered

Master of Science in Food Safety and Technology
(Thesis Option)
Master of Food Safety and Technology
(Non-Thesis Option)
Master of Food Safety with Specialization in Business
(Non-Thesis Option)

Master of Food Safety and Technology with
Specialization in Industrial Management
(Non-Thesis Option)
Master of Science in Food Process Engineering
(Thesis Option)
Master of Food Process Engineering
(Non-Thesis Option)

Certificate Programs

Food Safety and Technology
Food Process Engineering
Food Processing Specialist

Facilities

The IFSH facilities include 40,000 square feet of research laboratories, office and meeting space, 26,000 square feet of industrial scale pilot plant facility, 3,000 square feet of food processing plant (GMP) and 3,000 square feet of Biosafety Level-3 (BSL-3) Laboratory and Biocontainment Pilot Plant (BCPP). The research laboratory facilities at Moffett Campus include numerous laboratories for microbiology, virology, molecular biology, chemistry, biochemistry, nutrition and engineering. A 5,000 square feet Clinical Nutrition Research Facility is also located at the IIT Main Campus. The pilot plant at IFSH houses state of the art equipment such as computer-controlled retorts, high temperature-short time plate pasteurizer, 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 processors, homogenizers, and high power ultrasound. The BSL-3 and BCPP provide an opportunity to conduct studies on control of pathogenic microorganisms using pilot-scale equipment. Further, microbiological, food engineering, chemical, and packaging laboratories support the pilot plant facilities. IFSH's food science and technology library provides both physical and systems access to current and retrospective research and technical publications. The 25,000 square feet of laboratories and facilities of the FDA Division of Food Processing Science and Technology physically located in the same building are also available to FdSN collaborative research projects.

Faculty

Brackett, Robert E., Professor of Food Science, Vice President, Director of the Institute for Food Safety and Health (IFSH), and Interim Chair of Food Science and Nutrition. B.S., M.S., Ph.D. University of Wisconsin-Madison. Microbiological food safety; growth and survival of psychrotrophic pathogens in foods; physical/chemical controls for pathogens in foods; and microbial ecology of plant products.

Burton-Freeman, Britt, Associate Professor of Food Science and Nutrition and Director of the Center for Nutrition Research at the Institute for Food Safety and Health. B.S. California State University; M.S., Ph.D. University of California-Davis. Appetite and obesity management and vascular disease. Research emphasizes on the effect of bioactive food components on mechanistic and behavioral processes of food intake and body weight regulation. Properties of fibers, micro- and macro-molecule interactions, and food matrix effects in the gut to alter metabolic and endocrine system. Effects of dietary constituents on vascular diseases including evaluation of endothelium function, platelet activation, inflammatory and oxidative stress responses during acute and chronic interventions. The research approach includes human and basic science methodologies.

Cappozzo, Jack, Adjunct Industry Professor of Food Science and Nutrition, Director of Chemistry at the Institute for Food Safety and Health. M.S., Illinois Institute of Technology. Analytical chemistry with emphasis on separation science using high performance liquid chromatography (HPLC) coupled to mass spectrometry (MS). Interest has been on new methods of analysis using high resolution HPLC-MS to detect ultra-low levels of vitamins, anthocyanins, and other phenolic antioxidants in foods and clinical samples to support clinical trials. In addition, core work is also performed in the areas of allergen cleaning and analytical methods.

Diel, Todd, Adjunct Industry Professor of Food Science and Nutrition, Project Coordinator, Institute for Food Safety and Health. B.S. University of Illinois, M.B.A. Michigan State University. Organizational administration; project management; research project planning, coordination and risk assessment; occupational health and environmental safety, specializing in laboratory safety and training; quality assurance management.

Edirisinghe, Indika, Assistant Professor of Food Science and Nutrition and Manager, Center for Nutrition Research at the Institute for Food Safety and Health. B.Sc., University of Delhi (India); M.Phil., Ph.D., University of Peradeniya (Sri Lanka). Effect of polyphenolic compounds on endothelial function, blood pressure regulation, platelet function, insulin resistance, inflammatory and oxidative stress responses during acute and chronic interventions. The research approach includes human cell culture, animal models and human clinical trials.

Grasso, Elizabeth M., Research Assistant Professor of Food Science and Nutrition, Research Scientist at the Institute for Food Safety and Health. B.S. Pennsylvania State University; M.S., Ph.D. The Ohio State University. Microbial food safety; microbial cross-contamination; processing conditions and their effect on pathogen inactivation; sanitation of food-contact surfaces; survival and thermal inactivation of pathogens in low water activity foods; and effects of inoculation on microbial survival and inactivation in food matrices.

Grove, Stephen, Assistant Professor of Food Science and Manager of Industry Projects at the Institute for Food Safety and Health (IFSH). B.App.Sci., B.App.Sci.(Hons.), RMIT University (Australia); Ph.D., University of Tasmania (Australia). Microbial food safety; fresh produce and sprout safety; cross-contamination, inactivation and detection of enteric viruses during food processing and handling; use of novel processing and sanitation techniques for fresh-cut produce; and survival and inactivation of bacterial pathogens in low moisture foods.

Krishnamurthy, Kathiravan, Assistant Professor of Food Science and Nutrition and Research Engineer at the Institute for Food Safety and Health. B.E. (Ag), Tamil Nadu Agriculture University (India), M.S., Ph.D., Pennsylvania State University. Food engineering, novel and emerging food processing technologies, simulation and modeling of food processes, food safety, thermal processing technologies.

Lee, Alvin, Associate Professor of Food Science and Nutrition and Director of the Center for Processing Innovation at the Institute for Food Safety and Health (IFSH). B. App.Sci. (Hons), Ph.D., RMIT University (Australia). Microbial food safety, food virology, molecular detection and quantification of enteric pathogens; molecular characterization of virulence mechanisms, cell culture, intervention strategies for foodborne pathogens.

Paradis, Armand, Adjunct Industry Professor of Food Science and Nutrition and Director of Business Development at the Institute for Food Safety and Health (IFSH). B. S. in Biology, Northwestern University; M.S. Food Science and Nutrition, M.S. Food Engineering, University of Massachusetts. Product and process development, stage gate processes, novel technology assessment, industrial gas applications for food product microbial safety and stability, including carbon dioxide, nitrogen, and ozone, modified atmosphere packaging, hazard analysis of critical control points, lipid oxidation, and edible oil quality analysis.

Sui, Qian, Research Assistant Professor of Food Science and Nutrition and Special Projects Leader. B.E., China Agricultural University; Ph.D., The University of Melbourne (Australia).

Tompkin, Bruce, Adjunct Industry Professor at the Institute for Food Safety and Health and Retired, Vice President-Product Safety, ConAgra Refrigerated Foods, Inc. Currently a Food Safety Advisor. B.S., Ohio University; M.S., Ph.D., The Ohio State University. Microbial food safety and quality, food safety management.

Wan, Jason, Professor and Associate Chair of Food Science and Nutrition and Associate Director at the Institute for Food Safety and Health (IFSH). B.S., Hunan Agricultural University (China); M.S., Northeast Agricultural University (China); Ph.D., Deakin University (Australia). Molecular microbiology including development of DNA-based methods for detection, differentiation and tracking of foodborne pathogens in food systems and environment. Emerging non-thermal processing technologies, including high pressure processing (HPP), pulsed electric field (PEF), ultrasound, UV and non-thermal plasma, for microbial inactivation, shelf-life extension and food safety enhancement. Dairy processing, protein chemistry, and development and evaluation of bioactive dairy ingredients for functional food applications.

Wasan, Darsh T., Distinguished Motorola Professor of Chemical Engineering and Vice President for International Affairs. B.S., University of Illinois, Urbana-Champaign; Ph.D., University of California-Berkeley. Thin liquid films, foams, emulsions and nanoparticle suspensions, film rheology and applications, wetting, spreading and adhesion of nano-fluids on solid surfaces, environmental technologies, food colloids.

Zhang, Wei, Associate Professor of Food Science and Nutrition and Principal Scientist at the Institute for Food Safety and Health (IFSH). B.S., M.S., Huazhong Agricultural University (China); Ph.D., Pennsylvania State University. Molecular detection, genotyping, epidemiology, virulence and pathogenesis of foodborne bacteria; microbiology, biotechnology.

Admission Requirements

Bachelor's degree in chemistry, biology, food science, nutrition, or chemical, agricultural, food or environmental engineering, or a related field.

Cumulative undergraduate GPA minimum: 3.0/4.0

1. GRE of 304 (verbal and quantitative) for Master of Science, Food Safety and Technology or Food Process Engineering (Thesis)

2. GRE of 295 for Master of Food Safety and Technology, Master of Food Safety and Technology with Specialization in Business, Master of Food Safety and Technology with Specialization in Industrial Management, and Master of Food Processing Engineering (Non-Thesis)

Students applying for the master's academic program (non-thesis option) with an undergraduate degree from a major U.S. university with a cumulative GPA of 3.0/4.0 or higher may not be required to submit a GRE score.

3. TOEFL minimum: 550/213/80
(paper based/computer-based test score)

Note: Certificate Programs do not require GRE and TOEFL scores.

Master of Science in Food Safety and Technology

32 credit hours

Thesis required

Candidates are required to take a total of 32 credit hours, 18 of which must be selected from the core food safety and technology courses listed below, 6-8 credit hours must be in research and thesis work and 6-8 credit hours from electives. Courses are offered at the IIT Main Campus or via internet with the exception of FST 506.

Core Course Requirements (18 credit hours)

FST 505 Food Microbiology
FST 506 Food Microbiology Laboratory
FST 507 Food Analysis
FST 521 Food Process Engineering
FST 524 Fundamentals of Food Science and Technology
FST 541 Principles of Food Packaging

Core Research Thesis Requirement (6-8 credit hours)

FST 591 Research and Thesis for M.S. Degree

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, FdSN/FDA scientists, and the food industry scientists. The final thesis examination consists of submission of a written thesis followed by an oral presentation open to all FdSN/IFSH staff and the university community. As a part of the

thesis, the student is expected to contribute scholarly article(s) to one or more high quality peer-reviewed journals. The student is also encouraged to present the research at a national professional society meeting.

Electives (6-8 credit hours)

FST 501 Nutrition, Metabolism, and Health
FST 502 Research Project: Design, Delivery, and Dissemination
FST 504 Food Biotechnology
FST 511 Food Law Regulations
FST 531 HACCP Planning and Implementation
FST 593 Seminar on Food Safety and Technology
FST 594 Special Projects
FST 597 Special Problems (dependent upon number of thesis credits taken, please consult FdSN Academic Advisor)

Students may enroll in FST 594 and FST 597 up to a maximum of 2 credit hours between both courses when enrolled in 6 credits of thesis; or 1 credit hour when enrolled in 7 credit hour of thesis. However, if the 597 is used as a short course, the student can register up to 4 credits in 597 with FdSN advisor approval. Students may not enroll in FST 594 or 597 when using 8 credits of thesis unless 597 is used as a short course.

Students must have a minimum grade point average of 3.0/4.0. In addition to the core courses required and electives, further courses may be selected from other departments with the approval of the FdSN advisor, to fit the background and needs of the individual student.

Master of Food Safety and Technology

32 credit hours
No thesis required

Candidates are required to take a total of 32 credit hours, 18 credit hours of which must be selected from the core food safety and technology courses listed below, and 14-17 credit hours must be selected from electives. Courses are offered at the IIT Main Campus or via internet with the exception of FST 506.

Core Courses (18 credit hours)

- FST 505 Food Microbiology
FST 506 Food Microbiology Laboratory
(Required unless the student has enough professional background or laboratory experience to substitute, decision will be made by the FdSN Graduate Program Director)
FST 507 Food Analysis
FST 521 Food Process Engineering
FST 524 Fundamentals of Food Science and Technology
FST 541 Principles of Food Packaging

Electives (14-17 credit hours)

- FST 501 Nutrition Metabolism and Health
FST 502 Research Project: Design, Delivery and Dissemination
FST 504 Food Biotechnology
FST 511 Food Law Regulations
FST 522 Advanced Food Process Engineering
FST 531 HACCP Planning and Implementation
FST 593 Seminar on Food Safety and Technology
FST 594 Special Projects
FST 597 Special Problems

Students can enroll in FST 594 and 597 with a maximum of 6 credit hours total between both courses with an FdSN advisor approval. However, when 597 is used as a short course, the total credit hours must not exceed 8 between 594 and 597 combined. The student must have a minimum grade point average of 3.0/4.0. In addition to the core courses required and electives, further courses may be selected from other departments with the approval of the FdSN advisor, to fit the background and needs of the individual student.

Master of Food Safety and Technology with Specialization in Business

32 credit hours

This program is designed to help Food Safety and Technology degree students extend their food science technical and practical knowledge of the field while introducing them to core topics in modern business practices to prepare them for careers in the industry. To complete the program, students must satisfy the Master of Food Safety and Technology requirements and Stuart School of Business specialization, totaling 32 credit hours. Courses are offered at the IIT Main Campus or via internet with the exception of FST 506.

Note: Stuart School of Business tuition and fees apply to these courses. Applicants to the program are not required to take the GMAT.

Specialization Core Course Requirement: (3 credit hours)

- BUS 510 Building an Innovative and Sustainable Business

Specialization Electives: (6 credit hours) Choose two from the following

- MBA 501 Accounting for Strategic Decision Making
MBA 509 Financial Management on a Globalized World
MBA 511 Creating, Communicating, & Delivering Customer Value
MBA 513 Operations & Technology Management

Master of Food Safety and Technology with Specialization in Industrial Management

32 credit hours

This program is designed to help Food Safety and Technology degree students extend their food science technical and practical knowledge of the field while introducing them to core topics and providing up-to-date knowledge of the technologies and modern management approaches used in world-class industrial companies. To complete the program, students must satisfy the Master of Food Safety and Technology requirements and Industrial Technology and Management specialization requirements, totaling 32 credit hours.

Specialization Electives: (9 credit hours) Choose three from the following

- INTM 508 Cost Management
INTM 511 Industrial Leadership
INTM 515 Advanced Project Management
INTM 518 Industrial Risk Management
INTM 520 Applied Strategies for the Competitive Enterprise

Master of Science in Food Process Engineering

32 credits hours

Thesis and oral defense required

Candidates are required to take a total of 32 credit hours, 18 of which are the required courses listed below, 6-8 credit hours in Research and Thesis, 5-6 credit hours must be taken from Chemical and Biological Engineering Department courses, and the remaining 1-3 credit hours can be taken from FPE electives, if needed.

Core Courses Requirements (18 credit hours)

FPE 505 Food Microbiology
FPE 506 Food Microbiology Laboratory
FPE 521 Food Process Engineering
FPE 522 Advanced Food Process Engineering
FPE 524 Fundamentals of Food Science and Technology
FPE 541 Principles of Food Packaging

Core Research Thesis Requirements (6-8 credits)

FST 591 Research and Thesis

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, FdSN/FDA scientists, and the food industry scientists. The final thesis examination consists of submission of a written thesis, followed by an oral presentation open to all IFSH staff and the university community. 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.

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.

Elective Requirements (5-6 credit hours)

Students must take two courses from the following group of chemical and biological engineering courses:

CHE 426 Statistical Tools for Engineers
CHE 439 Numerical and Data Analysis
CHE 494 Process Design I
CHE 560 Statistical Quality and Process Control
CHE 577 Bioprocess Engineering
ENVE 513 Biotechnological Processes in Environmental Engineering
ENVE 542 Physiochemical Processes in Environmental Engineering

FPE Electives (1-3 credit hours)

FPE 501 Nutrition, Metabolism and Health
FPE 502 Research Project: Design, Delivery and Dissemination
FPE 504 Food Biotechnology
FPE 507 Food Analysis
FPE 511 Food Law Regulations
FPE 520 Low-Acid Canned Food Regulations and Microbiology*
FPE 523 Food Engineering Process Delivery*
FPE 526 Engineering Principles of Food*
FST 531 HACCP Planning and Implementation
FST 593 Seminar on Food Safety and Technology
FST 594 Special Projects
FST 597 Special Problems

Students may enroll in a ChBE course that is not listed above, with FdSN Advisor approval.

*Courses are designed specifically for the Food Processing Specialist Certificate Program

Master of Food Process Engineering

32 credits hours
No thesis required

Candidates are required to take a total of 32 credit hours, 18 of which must be from the core courses listed below, 8-11 credit hours must be selected from elective courses, and 5-6 credit hours must be selected from the Chemical and Biological Engineering Department Courses. Courses are offered at the IIT Main Campus or via internet with the exception of FPE 506.

Core Course Requirements (18 credit hours)

FST 505 Food Microbiology
FST 506 Food Microbiology Laboratory*
FST 521 Food Process Engineering
FST 522 Advanced Food Process Engineering
FST 524 Fundamentals of Food Science and Technology
FST 541 Principles of Food Packaging

*FPE 506 is required unless the student has enough professional experience to allow a substitute class, the decision will be made by the FdSN Program Director.

Electives (8-11 credit hours)

At least two of the following:

FST 501 Nutrition Metabolism and Health
FST 502 Research Project: Design, Delivery and Dissemination
FST 504 Food Biotechnology
FST 507 Food Analysis
FST 511 Food Law Regulations
FST 531 HACCP Planning and Implementation
FST 593 Seminar on Food Safety and Technology
FST 594 Special Projects
FST 597 Special Problems

Students can enroll in FPE 594 and 597 with a maximum of 6 credit hours total between both courses with FdSN Advisor approval. However, when 597 used as a short course, the total credit hours must not exceed 8 between 594 and 597.

At least two of the following: (5-6 credit hours)

CHE 426 Statistical Tools for Engineers
CHE 439 Numerical and Data Analysis
CHE 494 Process Design I
CHE 560 Statistical Quality and Process Control
CHE 577 Bioprocess Engineering
ENVE 513 Biotechnological Processes in Environmental Engineering
ENVE 542 Physiochemical Processes in Environmental Engineering

Students may enroll in a ChBE course that is not listed above, with FdSN Advisor approval.

Food Safety and Technology Certificate Programs

Food Safety and Technology (FST)

12 credit hours

The certificate program provides students with post baccalaureate knowledge of food safety and technology and its applications in the food industry, and in federal and state public health agencies. This program requires 12 credit hours for completion. Students who are admitted to FdSN master's degree programs may apply coursework previously taken in a FdSN certificate program towards the requirements for the master's degree with 3.0/4.0 GPA. Courses are offered at the IIT Main Campus or via internet with the exception of FST 506.

Four from the following:

FST 501 Nutrition Metabolism and Health
FST 504 Food Biotechnology
FST 505 Food Microbiology
FST 506 Food Microbiology Laboratory
FST 507 Food Analysis
FST 521 Food Process Engineering
FST 524 Fundamentals of Food Science and Technology
FST 531 HACCP Planning and Implementation
FST 541 Principles of Food Packaging

Food Process Engineering Certificate Programs

Food Process Engineering (FPE)

12 credit hours

This program provides an introduction to the field of food engineering, with applications of chemical engineering principles to food manufacturing and food safety. Students must complete four courses (12 credit hours) for completion. Students who are admitted to FdSN master's degree programs may apply coursework previously taken in a FdSN certificate program towards the requirements for the master's degree with 3.0/4.0 GPA. Courses are offered at the IIT Main Campus or via internet with the exception of FPE 506.

Required Courses

FPE 521 Food Process Engineering
FPE 522 Advanced Food Process Engineering

And two of the following:

FPE 504 Food Biotechnology
FPE 505 Food Microbiology
FPE 506 Food Microbiological Laboratory
FPE 507 Food Analysis
FPE 511 Food Law Regulations
FPE 524 Fundamentals of Food Science and Technology
FPE 531 HACCP Planning and Implementation
FPE 541 Principles of Food Packaging

Food Processing Specialist

12 credit hours

This program provides a broad working knowledge of technical elements of thermal processing systems (with understanding of alternative technologies) to qualify at an intermediate level as a recognized Food Processing Specialist. Students must complete four courses (12 credits). Students who are admitted to FdSN FPE master's degree program may apply coursework previously taken in this certificate program towards the requirements for the FPE master's degree with 3.0/4.0 GPA. Courses are offered at the IIT Main Campus or via internet with the exception of FPE 506.

Required Courses

FPE 520 Low-Acid Canned Food Regulations and Microbiology
FPE 522 Advanced Food Process Engineering
FPE 523 Food Engineering Process Delivery
FPE 526 Engineering Principles of Food

Department of Food Science and Nutrition Courses

FST/FPE 501

Nutrition, Metabolism, & Health

Study of structures, types, and metabolism of carbohydrates, lipids, and proteins. Discussion of the biological roles of vitamins and minerals. Application and integration of metabolic knowledge with health promotion and chronic disease.

(3-0-3)

FST/FPE 502

Research Project: Design, Delivery, & Dissemination

This course is an introduction to designing, conducting, and reporting on scientific research. Topics will include defining a problem and creating a research proposal, experimental design, data collection and analysis, and a written and oral presentation of results. Same as FPE 502.

(3-0-3)

FST/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 production, genomic map construction, and 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/FPE 505

Food Microbiology

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. Core course. Prerequisite: Introductory Microbiology or Food Science.

(3-0-3)

FST/FPE 506

Food Microbiology Lab

Introductory Microbiology. Basic microbiological techniques and safe laboratory practices. Introductory Food Microbiology. Isolation pathogenic bacteria. Spoilage microorganisms. Fermentation. Environmental Monitoring. Rapid Identification tests. Sporeformers. Prerequisite: Microbiology or Food Science.

(0-3-3)

FST/FPE 507

Food Analysis

Techniques for analyzing food toxins, food constituents of public health concern, intentional and unintentional food additives, modern separation and analytic techniques.

(2-3-3)

FST/FPE 511

Food Law Regulations

Legal and scientific issues in regulating the nation's food supply and nutritional status. Roles 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 520

Low-Acid Canned Food Regulations & Microbiology

Regulatory requirements for the U. S. Food and Drug Administration and the broad microbial issues associated with low-acid canned foods (LACF) products. Topics will include the U. S. Food Drug & Cosmetic (FD&C) Act, Emergency Permit Control, 21 Code of Federal Register (CFR) parts 108, 113, and 114, record requirements, sources of microbial contamination, characteristics of clostridium botulinum, mesophilic sporeformers, indicator organisms, and introduction to microbial heat resistance. Students must have background in microbiology, food science, and biochemistry. Instructor permission is required.

(3-0-3)

FST/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, and alternative methods of food processing.

(3-0-3)

FST/FPE 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. Instructor permission is required.

Prerequisite(s): [(FPE 520) OR (FPE 521) OR (FST 521)]

(3-0-3)

FPE 523

Food Engineering Process Delivery

Requirements for the U. S. Food and Drug Administration food canning regulations, including system design, process establishment, operational, and inspection records. Operations and calibration requirements of thermal processing equipment. Process design, documentation of process deviation, and calculation of process delivery. Instructor permission is required.

Prerequisite(s): [(FPE 522)]

(3-0-3)

FST/FPE 524

Fundamentals in Food Science & 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, and 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)

FPE 526

Engineering Principles of Food

Methods for conducting seal integrity examinations, spoilage diagnosis, and traceability, defining and classifying package defects. Types of packaging materials, including metal, glass, plastics, flexible and composite containers, and their closure and sealing systems. Aseptic and alternative process delivery systems. Instructor permission is required.

Prerequisite(s): [(FPE 523)]

(3-0-3)

FST/FPE 531**HACCP Planning & Implementation**

Examination of the Hazard Analysis and Critical Control Point (HACCP) principles; microbiological and process overviews; generic HACCP models, Good Manufacturing Practices (GMP); monitoring of critical control points (CCPs), process control and implementation.
(3-0-3)

FST/FPE 541**Principles of Food Packaging**

Type and application of packaging materials. Migration theories and food package interaction, package testing to ensure safety, and recycling of package materials.
(3-0-3)

FST/FPE 591**Research & Thesis**

Research and thesis for master of science students. Minimum 6 credits required.
(Credit: Variable)

FST/FPE 593**Seminar on Food Safety & 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)
(1-0-1)

FST/FPE 594**Special Projects**

Advanced projects involving analysis of food safety processing, packaging and biotechnology systems. (Credit: 1-6 hours).
(Credit: Variable)

FST/FPE 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 four credit hours. (Credit: 1-6)
(Credit: Variable)

FST/FPE 600**Continuing of Residence**

Continuing of residence.
(1-0-1)

FST/FPE 772**Design & Development of Food Products**

Methodologies for designing and developing food products, assessment of alternatives for low-fat, low-calorie food product alternatives, substitute ingredients, market evaluation, process modification. Development of prototypes, process optimization and evaluating consumer acceptance. Impact of microbiology, sanitation and nutrition on product development.
(3-0-3)

Department of Humanities

Program in Technology and the Humanities

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Chicago, IL 60616
312.567.3465
humoffice@gmail.com
www.iit.edu/csl/hum/programs/grad

Chair:

Maureen Flanagan

Director, Graduate Studies:

Karl Stolley
kstolley@iit.edu

The Department of Humanities' Graduate Program in Technology and Humanities prepares students for careers in emerging forms of technology-driven human communication, collaboration, and learning. Students have the opportunity to pursue a course of study and participate in faculty-led research projects in areas such as user experience design, web development, social networks, and content strategy. With programmatic roots in technical communication and a growing faculty in diverse areas broadly representative of the digital humanities, the Graduate Program in Technology and Humanities produces graduates who are skilled communicators as well as agile, innovative members and leaders of twenty-first century private, public, and academic workplaces.

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
Technical Communication

Research Facilities

The department supports a Usability Testing and Evaluation Center; an editing center, Edit IIT; the Collaboration and Social Media Lab @ IIT (CaSM Lab); Gewgaws Lab, a physical and virtual design production lab focused on open source; and a Speech Analysis Lab for applied research on natural and synthesized speech.

IIT's Galvin Library subscribes to more than 120 electronic databases with more than 25,000 full-text journals and is part of CARLI, which through I-Share provides access to more than 32 million items across Illinois academic library collections. Students have access to computer labs across the IIT campus, some of which also serve as classrooms for technical communication courses.

Research Areas

Humanities department faculty conduct research in a wide range of areas. Among those especially relevant to technical communication are aesthetics; document and online design; ethics in the professions; history of art and architecture; humanizing technology; information seek-

ing and retrieval; instructional design; intellectual property; knowledge management; linguistics; philosophy of science; rhetorical theory; social media; text analysis; and usability testing.

Faculty

Bauer, Matthew J., Associate Professor of Linguistics. B.A., University of Minnesota-Duluth; M.S., Ph.D., Georgetown University.

Dabbert, James, Senior Lecturer of English, Director of Humanities Writing Center, and Associate Director for ESL Programs. B.A., M.S., Indiana University.

Davis, Michael, Professor of Philosophy. B.A., Western Reserve University; M.A., Ph.D., University of Michigan.

Flanagan, Maureen A., Professor of History and Chair of the Department of Humanities. B.A., Dominican College; Ph.D., Loyola University of Chicago.

Hemphill, Libby, Assistant Professor of Communication and Information Sciences. A.B., University of Chicago; M.S., Ph.D., University of Michigan.

Hicks, Marie, Assistant Professor of History. A.B., Harvard University; M.A., Ph.D., Duke University.

Hildt, Elisabeth, Professor of Humanities.

Kocurek, Carly A., Assistant Professor of Digital Humanities and Media Studies. B.A., Rice University; M.A., Ph.D., University of Texas.

Power, Margaret, Professor of History and Chair of the Pre-Law Advisory Committee. B.A., Georgetown University; M.A., San Francisco State University; Ph.D., University of Illinois.

Pulliam, Gregory J., Senior Lecturer of Communication, Rhetoric, and Linguistics, Associate Chair, Director for ESL Programs, and Undergraduate Advisor in the Department of Humanities. B.A., Memphis State University; M.A., Ph.D., University of Missouri.

Schmaus, Warren S., Professor of Philosophy. A.B., Princeton University; M.A., Ph.D., University of Pittsburgh.

Snapper, John W., Associate Professor of Philosophy and Academic Policy Coordinator. B.A., Princeton University; M.A., Ph.D., University of Chicago.

Stolley, Karl A., Associate Professor of Digital Writing and Rhetoric and Director of Graduate Studies, Department of Humanities. B.A., Millikin University; M.A., Ph.D., Purdue University.

Waters, Michael J., Senior Lecturer. B.F.A., University of Illinois, Urbana-Champaign; M.Arch., University of Virginia.

Weil, Vivian M., Professor of Ethics and Director of the Center for the Study of Ethics in the Professions. A.B., M.A., University of Chicago; Ph.D., University of Illinois.

Admission Guidelines (Master's Degrees)

Applicants to the master's program come from a 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 technical or scientific background and learn to enhance their communication skills. The program's goal is to help students build upon existing strengths and develop new areas of expertise.

Applicants must have a bachelor's degree from an accredited four-year institution, with a minimum cumulative GPA of 3.0/4.0.

In addition to the application form, the applicant must submit the following:

1. Professional statement discussing the applicant's academic or professional goals and plans for graduate study
2. Two letters of recommendation from faculty or supervisors who can evaluate the applicant's potential for graduate-level work
3. Official transcripts, or certified copies thereof, of all academic work at the college level or above
4. Required test scores

All applicants are required to submit Graduate Record Exam (GRE) scores with a minimum combined score of 1000 quantitative + verbal (with a minimum score of 500 in each area) and 3.0 (analytical writing). Students taking the revised GRE (2012 and later) must have a minimum scores of 144 in quantitative reasoning and 153 in verbal reasoning, and an analytical writing score of at least 4.0.

International students must submit TOEFL scores unless they are exempt as specified in the International Applicant Requirements section of this bulletin. The minimum TOEFL score is 95, with minimum section scores of 20 each in the Listening, Reading, and Writing sections. Students submitting IELTS scores must have a minimum score of 7.0.

Note: Enrolling in courses does not guarantee later acceptance into a degree program, nor does meeting the minimum admission requirements. Students who enter as non-degree or certificate students should first discuss their plans with one of the co-directors of graduate studies.

Admission Guidelines (Ph.D. Program)

The doctoral program in technical communication at IIT prepares students for careers in research and teaching at the postsecondary level, 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.

Students enter the Ph.D. program from a wide range of fields, but should have substantial academic preparation or professional experience related to technical communication.

Applicants must have completed a bachelor's or master's degree in a field that, in combination with the 27-credit-hour technical core, would provide a solid basis for advanced academic work leading to original research in the field. The relevance of previous degrees to the doctoral program will be assessed by the department's graduate admissions committee.

In addition to the application form, the applicant must submit the following:

1. Professional statement discussing the applicant's research interests and plans for graduate study, research interests, and goals
2. Three letters of recommendation from faculty or supervisors who can evaluate the applicant's po-

tential for advanced academic work. At minimum, one letter must be from a university faculty member

3. Official transcripts, or certified copies thereof, of all academic work at the college level or above
4. Required test scores

All applicants are required to submit Graduate Record Exam (GRE) scores with a minimum combined score of 1000 quantitative + verbal (with a minimum score of 500 in each area) and 3.0 (analytical writing). Students taking the revised GRE (2012 and later) must have a minimum scores of 144 in quantitative reasoning and 153 in verbal reasoning, and an analytical writing score of at least 4.0.

International students must submit TOEFL scores unless they are exempt as specified in the International Applicant Requirements section of this bulletin. The minimum TOEFL score is 95, with minimum section scores of 20 each in the Listening, Reading, and Writing sections. Students submitting IELTS scores must have a minimum score of 7.0.

Note: Enrolling in courses does not guarantee later acceptance into a degree program, nor does meeting the minimum admission requirements. Students who enter as non-degree or certificate students should first discuss their plans with one of the co-directors of graduate studies.

Master of Science in Technical Communication and Information Design

33 Credit hours

TCID core (15 hours)

Electives (minimum of 15 hours)

Project or thesis (minimum of 3 hours)

Project review or Thesis exam

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.

Students preparing for careers as technical communicators are advised to take the project option, while students preparing for a Ph.D. may wish to take the thesis option. The exam committee for each option requires two Category 1 faculty members from the Humanities department, at least one of them from the Graduate Program in Technology and Humanities. 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 User Experience Research and Evaluation

COM 528 Document Design

COM 529 Technical Editing

COM 530 Standards-Based Web Design

COM 543 Publication Management

Electives

COM 428 Verbal and Visual Communication

COM 435 Intercultural Communication

COM 501 Introduction to Linguistics

COM 506 World Englishes

COM 508 Structure of Modern English

COM 509 History of the English Language

COM 515 Discourse Analysis

COM 531 Web Application Development

COM 532 Rhetoric of Technology

COM 535 Instructional Design

COM 536 Proposal and Grant Writing

COM 538 Entrepreneurship in Technical Communication

COM 541 Information Structure and Retrieval

COM 542 Knowledge Management

COM 545 Writing for Academic Publication

COM 553 Globalization and Localization

COM 561 Teaching Technical Communication

COM 571 Persuasion

COM 577 Communication Law and Ethics

COM 580 Topics in Communication

COM 585 Internship

COM 601 Research Methods and Resources

Other courses as approved by the student's advisor and one of the co-directors of graduate studies. No more than 9 hours of 400-level courses may be counted toward the degree.

Master of Science in Information Architecture

33 Credit hours

IARC core (18 hours)

Electives (minimum of 12 hours)

Project or thesis (minimum of 3 hours)

Project or Thesis

Project review or Thesis exam

The M.S. in Information Architecture enhances a technical communication core with specialized concepts, skills, and tools for designing, implementing, and managing websites and related digital media. This degree provides students with expertise for a number of tasks relevant to mid-level and advanced positions in the workplace: website design, website project management, information structure and retrieval, knowledge management, and usability testing and evaluation.

Students preparing for careers as technical communicators are advised to take the project option, while students preparing for a Ph.D. may wish to take the thesis option. The exam committee for each option requires two Category 1 faculty members from the Humanities department, at least one of them from the Graduate Program in Technology and Humanities. 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 User Experience Research and Evaluation

COM 528 Document Design

COM 530 Standards-Based Web Design

COM 541 Information Structure and Retrieval

COM 542 Knowledge Management

COM 543 Publication Management

Electives

COM 428 Verbal and Visual Communication

COM 435 Intercultural Communication

COM 501 Introduction to Linguistics

COM 506 World Englishes

COM 508 Structure of Modern English

COM 509 History of the English Language

COM 515 Discourse Analysis

COM 531 Web Application Development

COM 532 Rhetoric of Technology

COM 535 Instructional Design

COM 536 Proposal and Grant Writing

COM 538 Entrepreneurship in Technical Communication

COM 541 Information Structure and Retrieval

COM 542 Knowledge Management

COM 545 Writing for Academic Publication

COM 553 Globalization and Localization

COM 561 Teaching Technical Communication

COM 571 Persuasion

COM 577 Communication Law and Ethics

COM 580 Topics in Communication

COM 585 Internship

COM 601 Research Methods and Resources

Other courses as approved by the student's advisor and one of the co-directors of graduate studies. No more than 9 hours of 400-level courses may be counted toward the degree.

Doctor of Philosophy in Technical Communication

84 credit hours beyond the bachelor's degree, including

Technical communication core (30 credit hours)
Electives (minimum of 15 credit hours)
Dissertation research (minimum of 24 credit hours)
Additional electives or dissertation research (as needed to achieve total of 84)

Qualifying examination

Comprehensive examination

Dissertation proposal

Dissertation

Dissertation (final thesis) examination

Transfer Units

Students who have already earned master's 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).

Required Courses (30 credit hours)

COM 521 Key Concepts in Technical Communication
COM 525 User Experience Research and Evaluation
COM 529 Technical Editing
COM 541 Information Structure and Retrieval
COM 542 Knowledge Management
COM 543 Publication Management
COM 601 Research Methods and Resources

AND one of the following:

COM 528 Document Design
COM 530 Standards-Based Web Design
COM 535 Instructional Design

AND one of the following:

COM 501 Introduction to Linguistics
COM 506 World Englishes
COM 508 Structure of Modern English
COM 509 History of the English Language
COM 515 Discourse Analysis

AND one of the following:

COM 602 Qualitative Research Methods
COM 603 Quantitative Research Methods

Electives (at least 15 credit hours)

COM 501 Introduction to Linguistics
COM 506 World Englishes
COM 508 Structure of Modern English
COM 509 History of the English Language
COM 515 Discourse Analysis
COM 528 Document Design
COM 530 Standards-Based Web Design
COM 531 Web Application Development
COM 532 Rhetoric of Technology
COM 535 Instructional Design
COM 536 Proposal and Grant Writing
COM 538 Entrepreneurship in Technical Communication
COM 545 Writing for Academic Publication
COM 553 Globalization and Localization
COM 561 Teaching Technical Communication
COM 571 Persuasion
COM 577 Communication Law and Ethics
COM 580 Topics in Communication

Other courses as approved by the student's advisor and one of the co-directors of graduate studies. No more than 9 hours of 400-level courses may be counted toward the degree.

Dissertation Research

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 bachelor's 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.

Doctor of Philosophy in Technical Communication - continued

Examinations

The **Qualifying Examination** assesses a student's analytical ability, writing skills, and research potential. The exam must be taken by the end of the student's third semester in the Ph.D. program. Each student prepares (1) a brief statement of research interests and (2) a Qualifying Paper — a sole-authored research paper of at least 5,000 words, demonstrating original analysis and familiarity with existing research. The examining committee consists of three Category I faculty, at least two from the technical communication program. Based on exam results, the committee may recommend changes to the student's Program of Study. If the student fails the Qualifying Examination, the committee may recommend a re-examination. The second attempt at the exam is regarded as final.

The **Comprehensive Examination** assesses a student's expertise and ability to apply the literature in three research areas. The exam should be taken by the end of the student's third year in the Ph.D. program. The examining committee consists of three Category I faculty from the technical communication program and one from a Ph.D.-granting academic unit at IIT other than the Humanities Department. The student works with the committee to select research areas and develop a reading list for each one. Areas and reading lists must be approved by all committee members prior to the exam. A timed, written exam requires the student to respond to one or more questions in each area. The committee may recommend a re-examination over any area(s) that the student fails. The second attempt at the exam is regarded as final.

The **Dissertation Proposal** is a detailed written plan for original research that will culminate in the dissertation. The proposal is typically presented within one semester after the student has passed the Comprehensive Examination. The proposal is developed under the guidance of the student's major advisor and typically addresses (1) the research problem or issue to be investigated, (2) its significance to the field, (3) a thorough review of relevant research, (4) a detailed description of and rationale for the research method(s) to be used, (5) a plan of work, and (6) a statement of anticipated results or outcomes. The proposal review committee consists of four Category I faculty: three from technical communication and one from a Ph.D.-granting academic unit at IIT other than the Humanities Department. The committee must formally approve the proposal before the student begins further work on the dissertation. As part of the review process, the committee may request one or more meetings with, or presentations by, the student.

The **Final Thesis Examination** is an oral defense of the dissertation. The Dissertation Committee consists of four Category I faculty: three from technical communication and one from a Ph.D.-granting academic unit at IIT other than the Humanities Department. A student who fails the exam may be re-examined after 30 days. The second attempt at the exam is regarded as final.

The **Dissertation** should constitute an original contribution to scholarship in technical communication and may address areas of interaction between technical communication and other disciplines (e.g., 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 or Speech Analysis Lab), pedagogical, historical, or theoretical.

Certificate Programs

Admission Guidelines

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 a graduate certificate student. Certificate students who later apply to one of the department's M.S. programs or the Ph.D. program must meet the admission guidelines for that program. All coursework taken toward a certificate in technical communication or in instructional design and

passed with a grade of "B" or better may also be applied to the M.S. in Technical Communication and Information Design, the M.S. in Information Architecture, or the Ph.D. in Technical Communication (for students who are admitted to one of those programs), as long as those courses were not applied to another degree. However, no more than 9 hours of 400-level coursework may be counted toward a degree program.

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). The program consists of 12 credit hours of coursework (four courses).

AND one of the following:

COM 428 Verbal and Visual Communication
COM 435 Intercultural Communication
COM 523 Communicating Science
COM 530 Standards-Based Web Design

Required Courses

COM 424 Document Design

OR

COM 528 Document Design

COM 525 User Experience Research and Evaluation

COM 425 Editing

OR

COM 529 Technical Editing

Certificate in Instructional Design

This certificate is primarily for experienced technical communicators who wish to acquire focused competency in instructional design. 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. This certificate teaches the core concepts, instructional methods, and assessment instruments for designing materials using various forms of text, visual media, technology, and instructional techniques. The program consists of 15 credit hours (five required courses).

Required Courses

COM 424 Document Design

OR

COM 528 Document Design

COM 525 User Experience Research and Evaluation

COM 530 Standards-Based Web Design

COM 535 Instructional Design

COM 542 Knowledge Management

Course Descriptions

Communication

COM 501

Introduction to Linguistics

An introduction to the systematic study of language. Focus on the core areas of linguistics such as sound patterns of language (phonology), form (syntax, morphology), and meaning (semantics, pragmatics) as well as applied areas such as language variation, language, acquisition, psychology of language, and the origin of language.

(3-0-3)

COM 503

Analyzing & Communicating Quantitative Data

An introduction to statistics and data analysis tailored to the needs of communication and information professionals. Emphasis is placed on developing intuition as to which analyses are appropriate given one's questions of interest as well as how to interpret and communicate the results of analyses. Students will analyze real data sets using SPSS in the computer lab.

(3-0-3)

COM 506

World Englishes

Analysis of the variations of the English language throughout geographic and cultural regions of the world.

(3-0-3)

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.

(3-0-3)

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.

(3-0-3)

COM 510

The Human Voice: Description, Analysis, & Application

Analysis of human and synthetic speech intended for technology mediated environments and devices. Focus on talker characteristics that affect speech intelligibility and social factors that affect talker characteristics. Attention to design characteristics of technology mediated speech and how humans react to it.

(3-0-3)

COM 511

Linguistics for Technical Communication

This course examines linguistic theory as it relates to everyday problems. The course is divided into four sections, each of which expose students to an application of these topics to broader issues. Topics include sound patterns of speech, sentence structure, meaning and language and society.

(3-0-3)

COM 515

Discourse Analysis

Analysis of spoken and written texts on the intersentential and metalinguistic levels (e.g. semantic roles; given-new information; deixis and anaphora; presupposition and entailment; direct and indirect speech acts; schema theory). Applications to social and professional issues such as intercultural communication; sociopolitical discourse; discourse in educational, legal, and medical settings; narratives and literary texts.

(3-0-3)

COM 521

Key Concepts in Technical Communication

Broad coverage of concepts and issues in current and classic scholarship in the field of technical communication. Intensive work in bibliographic research methods for academic genres.

(3-0-3)

COM 523

Communicating Science

This course focuses on strategies for communicating scientific information in professional settings. Students develop a literature review, proposal, and feasibility study; learn how to adapt scientific information to various audiences; and complete exercises on style, grammar, and other elements of effective professional communication. Emphasis on usability, cohesion, and style in each assignment.

(3-0-3)

COM 525

User Experience Research & Evaluation

An introduction to principles of user-centered design and to methods for conducting user experience research. Students will learn how to plan and conduct projects that evaluate the design, interface, and experience of a product or service. Course work includes designing studies, collecting and interpreting data, and reporting findings and recommendations from the perspective of user-centered design.

(3-0-3)

COM 528

Document Design

Principles and strategies for effective document and information design focusing on print media and familiarizing students with current research and theory as well as with practices in document design. Students design, produce, and evaluate documents for a variety of applications, such as instructional materials, brochures, newsletters, graphics, and tables.

(3-0-3)

COM 529

Technical Editing

Principles and practical applications of editing at all levels, working with both hard and soft copy and including copymarking, copyediting, proofreading, grammar and style, and comprehensive editing. Attention primarily to documents from science, technology, and business.

(3-0-3)

COM 530

Standards-Based Web Design

Theory and practice of structuring and designing information for web-enabled devices. This course emphasizes web standards, accessibility, and agile design methods.

(3-0-3)

COM 531

Web Application Development

A production-intensive course in applied theory and practice of developing web-based applications emphasizing interface and experience design using emerging Web standards and backend development using Ruby-based web application frameworks.

Prerequisite(s): [(COM 530)]

(3-0-3)

COM 532

Rhetoric of Technology

A course that explores the theoretical and applied intersections of the rhetorical tradition and digital communication technologies.

(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 & Grant Writing

Course covers all aspects of federal and foundation proposal cycle, from proposal development through review and decision-making process. Emphasis on research proposals incorporating quantitative and qualitative methods, but activity-based proposals addressed as well.

(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 communications staff, with attention to presentation technologies.

(3-0-3)

COM 541

Information Structure & Retrieval

An examination of conceptual foundations and applied uses of structured languages and databases for structuring information with an emphasis on approaches to single-sourcing materials for presentation in digital and print formats.

(3-0-3)

COM 542

Knowledge Management

Analysis of the nature and uses of knowledge in organizations and groups with attention to technical communicators' roles and tasks in collecting, codifying, storing, retrieving, and transferring information within organizations. Emphasis on web-based strategies, techniques, and tools.

(3-0-3)

COM 543

Publication Management

Intensive work developing and using systems to create and deliver content digitally and in print. Special emphasis on project management and large-team collaboration. Formerly known as COM 537.

Prerequisite(s): [(COM 530*) OR (COM 541*) OR (COM 542*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

COM 545

Writing for Academic Publication

Practice in developing written and spoken academic genres (e.g., reviews, articles, conference papers, CVs, job talks). Special attention to analyzing and evaluating academic journals; submitting items to journals and conferences; managing time during the research, writing, and publication process; revising work and providing feedback to others; and mastering the conventions of academic writing.

(3-0-3)

COM 552

Gender & Technological Change

Have you ever wondered why more men choose to portray themselves as women online than the reverse? Or why there are more boys than girls in China? Or why vibrator technology was seen as a medical necessity in the 19th century? Have you ever thought about how the interplay between technology and gender constructs everything from our modern military to how we choose to spend our free time? To where we work? This course explores the history of technology by using gender as a category of analysis. It also looks at how technological objects and tools participate in molding elements of our culture that we may take for granted as logical or timeless. By looking at change over time, we will analyze the different ways technology affects how we live and see ourselves and how gender defines technological priorities.

(3-0-3)

COM 553

Globalization & Localization

The examination and application of research on cultural dimensions in communication such as individualist versus collectivist. Also, an examination of topics from a theoretical linguistic perspective such as contrastive rhetoric. These topics are then related to best practices in web and document design.

(3-0-3)

COM 554

Science & Technology Studies

This course focuses on the latest work in science and technology studies and the history of technology from ethics in genetic engineering to the social dimensions of computing. Other topics include the intersection of gender and sexuality with new technologies, the role of communications media in "rewiring" our brains and our social connections, and the role of the world wide web in constructing national and global technocracy. In the course, students will read and discuss works by academics as well as journalists in order to offer grounding in the historical, social, and economic background of key technical topics and the presentation of technical topics for wider audiences. The course will also focus on the ways in which authors leverage different information technologies to communicate to wider audiences and how those methods are evolving.

(3-0-3)

COM 561

Teaching Technical Communication

Principles, strategies, and resources for teaching technical communication and for developing and assessing technical communication curricula, especially at the postsecondary level.

(3-0-3)

COM 571

Persuasion

The study of covert and overt persuasion and their influences on society and individuals.

(3-0-3)

COM 574**Communications in Politics**

This course introduces students to the general theories and practices of political campaign communication today. It investigates how those rules and types apply in the current presidential campaign. More generally, the course teaches students to produce written and oral discourse appropriate to the humanities.

(3-0-3)

COM 577**Communication Law & Ethics**

This course explores ethical and legal issues concerning communication in diverse contexts, such as: the mass media - e.g. print, broadcast, and electronic; government and politics; organizational hierarchies - e.g. public and private sector workplaces; academic life - e.g. the classroom, student, and faculty affairs; and interpersonal relations - e.g. love, friendship, marriage. Students will research and write an article length paper, and may also do additional research and/or classroom work.

(3-0-3)

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.

(3-0-3)

COM 583**Social Networks**

This course will discuss a variety of measures and properties of networks, identify various types of social networks, describe how position within and the structure of networks matter, use software tools to analyze social network data, and apply social network analysis to areas such as information retrieval, social media, and organizational behavior.

(3-0-3)

COM 584**Humanizing Technology**

This course will investigate and experiment with both conceptual and applied efforts to humanize technology, especially computer technology. We will question the goals of humanization and its relationships to concepts such as design ethics and user-centered and emotional design. While the focus of the class will be on computer technology and programming languages, we will also look at humanization with regard to industrial design, engineering, architecture, and nanotechnologies.

(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.

(Credit: Variable)

COM 591**Research & Thesis for Master's Degree**

Permission of instructor required.

(Credit: Variable)

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 and analysis of or commentary on the choices made in the production of the document. (Credit: Variable. Most M.S. students take 6 credits of project studies)

(Credit: Variable)

COM 597**Special Problems**

Permission of instructor required.

(Credit: Variable)

COM 601**Research Methods & Resources**

This course addresses the logic of research design. The first part of the course focuses on formulating clear research questions and hypotheses. The second part addresses various designs (surveys, correlations, experiments, mixed designs, etc.) and their potential to test hypotheses.

(3-0-3)

COM 602**Qualitative Research Methods**

This course is intended for graduate students in technical communication and related fields who are planning to conduct qualitative research in a variety of settings.

Prerequisite(s): [(COM 601)]

(3-0-3)

COM 603**Quantitative Research Methods**

This course is for doctoral students of technical communication who have a command of general research methods but who require a deeper understanding of methods for the collection and analysis of quantitative data.

Prerequisite(s): [(COM 601)]

(3-0-3)

COM 691**Research & Thesis Ph.D.**

This is a variable credit course which Ph. D. candidates sign up for as they work on their dissertations. Permission of instructor required.

(Credit: Variable)

History

HIST 597**Special Problems: History**

Advanced topics in the study of history, in which there is special student and faculty interest. Variable Credit: 1-6

(Credit: Variable)

Humanities

HUM 601**Teaching Assistant Seminar**

Required of all teaching assistants at IIT, this course introduces students to classroom and course management issues, strategies, and ethics. In addition, students give classroom-lecture style presentations using basic instructional visual aids.

(0-0-0)

Philosophy

PHIL 551

Science & Values

This course will consider questions such as: What role should values play in scientific inquiry? Should scientists consider only epistemic or cognitive values, or should they take into account social and cultural values? Could science be objective and make progress if it is shaped by social and cultural values?

(3-0-3)

PHIL 560

Ethics

A study of the fundamental issues of moral philosophy.

(3-0-3)

PHIL 570

Engineering Ethics

A study of moral and social responsibility for the engineering profession including such topics as safety, confidentiality, and government regulation.

(3-0-3)

PHIL 571

Ethics in Architecture

A study of the moral problems architects must resolve in the practice of their profession, including problems of confidentiality, candor, esthetics, and economy, arising from the special responsibilities of architects to the public, client, employer, and colleagues.

(3-0-3)

PHIL 573

Business Ethics

Ethical issues relating to individual and corporate responsibility, self and governmental regulation, investment, advertising, urban problems, the environment, and preferential hiring.

(3-0-3)

PHIL 574

Ethics in Computer Science

Moral problems that confront professionals in computer-related fields, including questions raised by the concept of intellectual property and its relationship to computer software, professional codes of ethics for computer use, and responsibility for harm resulting from the misuse of computers.

(3-0-3)

PHIL 580

Topics in Philosophy

An investigation into a topic of current or enduring interest in philosophy, which will be announced by the instructor when the course is scheduled. Graduate standing required.

(3-0-3)

PHIL 597

Special Problems in Philosophy

Advanced topics in the study of philosophy, in which there is special student and faculty interest. Variable Credit: 1-6 Prerequisite: Instructor permission required.

(Credit: Variable)

Study of Ethics in the Professions

SEP 501

Foundation of Ethics in Profession, Business & Government

This course covers the sources and substance of business and government standards and professional codes. It focuses on issues that concern all these institutions, for example, confidentiality, loyalty, conflict of interest, and obligations to the public.

(3-0-3)

SEP 503

Business Engineering: Ethics & Cultral in Workforce

This course covers issues raised by real and apparent differences in standards in different countries. Bribery, compensation standards, and workplace safety are among the problems to be considered. The course also covers 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.

(3-0-3)

Undergraduate Courses Available to Graduate Students

Note: Students may take up to an approved number of the following courses.

AAH 491

Independent Reading and Research

COM 401

Advanced Composition and Prose Analysis

COM 421

Technical Communication

COM 423

Communication in the Workplace

COM 424

Communication in the Workplace

COM 425

Communication in the Workplace

COM 428

Verbal and Visual Communication

COM 430

Introduction to Web Design and Management

COM 431

Introduction to Web Design and Management

COM 432

Introduction to Web Design and Management

COM 435

Intercultural Communication

COM 437

Video Documentation

COM 438

Video Documentation

COM 440

Introduction to Journalism

HIST 491

Independent Reading and Research

PHIL 491

Independent Study

Industrial Technology and Management

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3424 S. State Street
Chicago, IL 60616
312.567.3650
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Director:
Mazin Safar

The Master of Industrial Technology and Operations (M.I.T.O.) is a professional degree designed for individuals who plan to make a career in industry. The purpose of this degree is to enhance the ability of 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 M.I.T.O. curriculum prepares students to move into management, supervisory and staff positions in industry. The M.I.T.O. is considered to be a “hybrid” degree, blending practical application of current technologies with the management skills needed to oversee a wide range of industrial operations. Students build a program of study suited to their career interests and experience. The M.I.T.O. is not a 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 GPA of 3.3 or better in the first three 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 writing and a combined score of 900 for the verbal and quantitative portions of the exam taken prior to July 2011, or a combined score of 292 for exams taken August 2011 and after. Applicants from countries where English is not the primary language also must complete the TOEFL with a minimum score of 70 on the Internet-based test (equivalent to 523 PBT) with no individual section scored below 15. IELTS scores are also accepted, with a minimum score of 5.5. Students with a TOEFL score between 70 and 89 or an IELTS score between 5.5 and 6.0 will be required to complete an English assessment test upon arrival at IIT to identify need and placement in a remedial English course during the first term of study.

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. International students must also submit financial support documentation verifying sufficient funds to cover degree studies and living expenses.

Prospective students who have previously obtained a M.S. or even a Ph.D. in highly technical subjects may be well served to pursue the M.I.T.O. degree. These individuals are often technical experts who, once employed in industry, have found that they lack an understanding of industrial operations, applied technologies, and management skills. As a hybrid program covering both technology and management, the M.I.T.O. curriculum enables such specialists to move from technology into operations.

Faculty

Maurer, William, Industry Professor and Coordinator of Outreach Activities. B.S., University of Illinois; M.S., Keller Graduate School of Management. Operations, lean manufacturing, corporate strategy.

Safar, Mazin, Industry Professor and Program Director. B.S., Al-Hikma University (Iraq); M.S., Illinois Institute of Technology; M.B.A., University of Chicago. Operations management, supply chain, inventory control, economics.

Adjunct Faculty

Arditi, David, Professor of Civil and Architectural Engineering. B.S., M.S., Middle East Technical University (Turkey); Ph.D., Loughborough University (United Kingdom). Construction engineering and management.

Ayman, Roya, Professor of Psychology and Director of Industrial/Organizational Training. B.A., M.A., Ph.D., University of Utah. Leadership, diversity, organizational climate, and work-family interface.

Bobco, William, Adjunct Professor. B.S., M.B.A., University of Chicago. Production management, supply chain management, materials handling.

Coates, James, Adjunct Professor. B.S. National Louis University. Facilities Maintenance, HVAC, stationary engineering, electrical systems.

Davis, Blake, Adjunct Professor. B.A., M.A., Illinois Institute of Technology. City and regional planning, sustainability, environmental issues.

Footlik, Robert B., PE, Adjunct Professor. B.S., Illinois Institute of Technology. Industrial engineering, warehousing operations, logistics and distribution technologies.

Goldberg, Joel, Adjunct Professor. B.Ed., Northeastern Illinois University. Training, manufacturing processes, industrial and operations management, entrepreneurship.

Gopal, Gurram, Adjunct Professor. B.Tech., Indian Institute of Technology (India); M.S., Ph.D., Northwestern University. Chemical Engineering, industrial engineering, operations research, economics, finance.

Hoffman, Robert, Adjunct Professor. Oxford and London School of Economics. Transportation, logistics, and economics.

Jain, Jagjit, Adjunct Professor. B. Tech. in Mechanical Engineering; M.S. in Operations Research; M.B.A. in Finance/Economics/Accounting.

Jabbari, Kamyar, Adjunct Professor. B.S., Towson State; M.B.A., University of Chicago; J.D., IIT Chicago-Kent College of Law. Corporate finance, international finance, economics, and banking law.

Kleiman, Lori, SPHR, Adjunct Professor. B.A., University of Illinois; M.A.S., California National University. Human resource management, employment law.

Kumiega, Andrew, Adjunct Professor. B.S., University of Illinois (Chicago); M.S., Illinois Institute of Technology; M.S., Ph.D., University of Illinois (Chicago). Engineering management, industrial engineering, finance.

Lemming, Raymond, Adjunct Professor. B.S. in Civil Engineering, B.S. in Psychology, M.B.A. in Organizations and Management, Juris Doctor.

Lewis, Philip, Adjunct Professor. B.S., Milwaukee School of Engineering. Industrial management, manufacturing processes.

Prendergast, John, Adjunct Professor. B.A. in Occupational Education; M.A. in Education.

Rozansky, Irene, Adjunct Professor. B.A., Purdue University; M.B.A., University of Massachusetts. Industrial risk assessment and management.

Shankar, Rama, Adjunct Professor. B.S., Mechanical Engineering; M.S., Materials Management; M.S., Engineering Management. Quality control, industrial management and operations, six sigma.

Shields, Herb, Adjunct Professor. B.S., Clarkson University. Electrical engineering, logistics, purchasing and acquisitions.

Tijunelis, Donatas, PE, Adjunct Professor. B.S., M.S. in Chemical Engineering, D.B.A.. Operations management, strategic project management, energy and sustainability.

Tomal, Daniel, Adjunct Professor. B.S., M.S., Ph.D., Bowling Green State University. Electrical technology, industrial technology, administration and supervision.

Twombly, John R., Clinical Professor of Accounting and Finance and Director of Undergraduate Programs in Stuart School of Business. B.S., University of Pennsylvania; M.B.A., Ph.D., University of Chicago; Certified Public Accountant. Financial and managerial accounting.

Master of Industrial Technology and Operations

Each student's program of study is customized to best serve individual career objectives. Of the 30 credit hours required for the M.I.T.O. degree, the student must complete at least 18 credit hours of INTM graduate courses. Up to 12 credit hours of senior (400-level) courses may be completed as part of the degree. A maximum of 6 credit hours may be applied from special project courses (INTM 597 or an Interprofessional Project (IPRO 497)). A total of 9 credit hours taken at a different university (passed with the grade of "B" or better) may be transferred to IIT and applied towards the M.I.T.O. degree if those credits have not been applied toward any earned degree (subject to administrative approval). No thesis or comprehensive examination is required as part of this degree.

The flexibility of course options within the M.I.T.O. program allows students to complete an industrial specialization, or simply take the 10 courses of greatest

interest. A specialization requires the completion of 12 credit hours (4 courses) in any one of four concentrations within the INTM curriculum: Industrial Facilities (IF), Industrial Sustainability (ST), Manufacturing Technology (MT), or Supply Chain Management (SCM). Alternatively, students may complete up to 4 courses in another IIT department with appropriate qualifications and approvals. For example, students have taken courses from Stuart School of Business, Armour College of Engineering, and the Food Safety and Technology Program.

INTM courses are presented live and via interactive video at IIT's Main Campus in Chicago and Rice Campus in Wheaton IL. In addition, the M.I.T.O. program can be completed entirely online. Using a delayed Internet format (lecture videos are posted within 24 hours after the live session), students can log on and view lectures at the time and location of their choice. A demonstration of IIT web-based courses is available at http://iit.edu/iit_online/.

Master of Industrial Technology and Operations

30 credit hours

Required Credit Hours

Elective courses 18-30 hours

Special project 0-6 hours

Optional specialization courses 12 hours

Elective Courses

INTM 404 Sales, Marketing, & Product Introduction
 INTM 406 Quality Control in Manufacturing
 INTM 410 Operations Management
 INTM 413 Facilities & Construction Administration
 INTM 417 Construction Estimating
 INTM 425 Human Resource Management
 INTM 427 E-Commerce
 INTM 432 Vendor/Customer Relations
 INTM 477 Entrepreneurship in Industry
 INTM 502 Fundamentals of Industrial Engineering
 INTM 507 Construction Technology
 INTM 508 Cost Management
 INTM 509 Inventory Control
 INTM 511 Industrial Leadership
 INTM 515 Advanced Project Management
 INTM 518 Industrial Risk Management
 INTM 520 Applied Strategies for the Competitive Enterprise

INTM 522 Computers in Industry
 INTM 530 Transportation
 INTM 531 Manufacturing Processes for Metals and Mechanical Systems
 INTM 532 Manufacturing Processes for Electronics and Electrical Systems
 INTM 533 Manufacturing Processes in Chemical Industries
 INTM 540 Supply Chain Management
 INTM 542 Warehousing and Distribution
 INTM 543 Purchasing
 INTM 544 Export/Import
 INTM 545 Strategic International Business
 INTM 546 Manufacturing and Logistics Information Systems
 INTM 559 Issues in Industrial Sustainability
 INTM 560 Sustainability of Critical Materials
 INTM 561 Energy Options for Industry
 INTM 597 Special Projects

Up to 12 elective credits of 400-level INTM courses may be completed

Up to 12 elective credits of 400- or 500-level courses from a different academic discipline may be completed, with advisor and instructor approval.

Specialization Courses

An industrial specialization requires completion of four (4) courses within an identified subject area.

Industrial Facilities

- INTM 413 Facilities and Construction Administration
- INTM 417 Construction Estimating
- INTM 507 Construction Technology
- INTM 515 Advanced Project Management

Supply Chain Management

- INTM 509 Inventory Control
- INTM 530 Transportation
- INTM 540 Supply Chain Management
- INTM 542 Warehousing and Distribution
- INTM 543 Purchasing
- INTM 544 Export/Import
- INTM 546 Manufacturing and Logistics Information Systems

Manufacturing Technology

- INTM 406 Quality Control in Manufacturing
- INTM 531 Manufacturing Processes for Metals and Mechanical Systems
- INTM 532 Manufacturing Processes for Electronics and Electrical Systems
- INTM 533 Manufacturing Processes in Chemical Industries
- INTM 546 Manufacturing and Logistics Information Systems

Industrial Sustainability

- INTM 559 Issues in Industrial Sustainability
- INTM 560 Sustainability of Critical Materials
- INTM 561 Energy Options for Industry
- INTM 562 Special Topics in Sustainability

Course Descriptions

Numbers in parentheses indicate class, lab and total credit hours, respectively.

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 508

Cost Management

Accounting basics are introduced with primary emphasis on the costing and estimating procedures as used in industry. The objective of this course is to provide a good understanding of financial activities and hands-on experience in working with a variety of costing and accounting systems.

(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) 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 514

Topics in Industry

This course provides overview of multiple industrial sectors and the influences that are forcing change. All aspects of industry are considered: history of industry, inventory, supply chain, e-commerce, management, manufacturing, industrial facilities, resource management, electronics and chemical industries, alternate energies, marketing, entrepreneurship, computers as tools, and other specialty areas.

(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 (Gantt, 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, 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 518

Industrial Risk Management

Each year industrial companies are affected by critical incidents which cause disruptions in operations and significant monetary losses due to repairs and/or lost revenue. Whether it is a small fire, an extended electrical outage or an incident of a more serious magnitude, all company stakeholders-from the board of directors to the employees to the customers -are impacted. The key to understanding the complexities of industrial resiliency lies in focusing on the issues of preparedness: prevention, mitigation and control. This course is designed to prepare the student for managing a critical incident, including understanding risk and business impact, emergency preparedness, contingency planning and damage control.

(3-0-3)

INTM 520

Applied Strategies for the Competitive Enterprise

Course covers the application of proven management principles and operational practices. Learn how high performance companies create a competitive advantage despite economic challenges and a transitional customer base. Factors covered include strategy deployment, financial analysis, new product development, quality, customer service, and attaining market leadership. Case studies illustrate variable impacts on business situations.

(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 530

Transportation

This course covers transportation practices and strategies for the 21st century. The role and importance of transportation in the economy and its relationship to the supply chain will be covered in detail. Transportation modes – trucks, rail, air, and water – will be examined for both domestic and global transportation. Costing and pricing strategies and issues will be discussed as well as security issues in domestic and international transportation.

(3-0-3)

INTM 531

Manufacturing Processes for Metals & Mechanical Systems

A broad range of manufacturing processes are studied including casting, forging, rolling, sheet metal processing, machining, joining, and non-traditional methods such as powder, EDM, and additive processes. Particular attention on interrelationships between manufacturing processes and properties developed in the work piece, both intended and unintended. Economic considerations and tradeoffs, as well as computer-integrated manufacturing topics, are also explored. (3-0-3)

INTM 532

Manufacturing Processes for Electronics & 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

Chemical Manufacturing Processes in Industry

This course provides an overview of current and emerging chemical processes employed in the energy, food, drug, and plastics sectors. Current and future impacts of various manufacturing processes on society, environment, and sustainability are covered as are issues related to OSHA, EPA, FDA, USDA, and other regulatory systems. The various implications of recovery and reuse are explored as well as new non-polluting, zero-emissions processes and technologies. Students will gain an appreciable understanding of “how it’s made” and the range of chemical processes and related technical challenges involved in manufacturing. A background in chemistry is not required. (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 & Distribution

This course covers warehouse layout and usage based on product requirement 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

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

Organizational involvement in international business activities – whether sourcing material and designs, expanding product sales and reach, or creating economies of scale and scope – requires an understanding of various factors in international finance, marketing, and strategy. This course brings together these disciplines to explore financial factors that may add or transform risks, the necessary adjustments in the creation of global marketing strategy, and the strategies for creating and preserving a competitive advantage in the international arena. (3-0-3)

INTM 546

Manufacturing & Logistics Information Systems

This course provides an overview of manufacturing and supply chain information systems, tools, and techniques utilized for effective decision making. Current state-of-the-art and commercially available industrial software packages, such as MRP, WMS, TMS, APS, etc., will be used and their impact on management decision making analyzed. (3-0-3)

INTM 547

Supply Chain Strategies

The range of supply chain strategies to be considered when assessing a firm’s internal and external supply chain network. Strategies involved in the end-to-end supply chain including product life cycle management (PLM), inventory optimization, network design optimization, management tools for optimizing supply chains, relationships with other parts of the organization, in-house versus third-party approaches, and suitable performance measurements.

Prerequisite(s): [(INTM 441 with min. grade of D) OR (INTM 540)] (3-0-3)

INTM 559**Issues in Industrial Sustainability**

Examines the concept of sustainability and its application in the industrial environment. Identifies underlying stresses on natural and human environments and the resultant problems for business and society including legal, ethical, and political issues related to sustainability. Global warming, peak oil, and commodity pricing are considered as indicators of the need for improvements in sustainability. Industrial ecology will be discussed as well as strategies for developing sustainable practices in manufacturing, power generation, construction, architecture, logistics, and environmental quality. Coverage includes case studies on businesses that have developed successful sustainability programs.

(3-0-3)

INTM 560**Sustainability of Critical Materials**

This course explores the limitations in supply and the need for sustainable use of carbon and non-carbon-based materials such as oil, minerals, food, water, and other natural resources used by industry. Limitations in the global availability of such resources pose challenges to industry which will require careful consideration and planning to ensure continued prosperity for current and future generations. Course will cover strategies and options to mitigate anticipated shortages and optimize the use of non-renewable natural resources, review of fuel and raw material pricing, and cost/benefit analysis of sustainable development proposals. Technical analyses will be presented during class discussions, but a technical background is not required.

(3-0-3)

INTM 561**Energy Options in Industry**

Carbon-based fuels are a limited resource and within decades will be in very short supply. Associated energy costs will increase and industry will be required to incorporate alternate fuels and/or power sources, such as uranium (for nuclear power), hydroelectric, geothermal, wind, wave, solar, etc. This course presents such energy options and explores the anticipated impact on industry.

(3-0-3)

INTM 562**Special Topics in Sustainability**

This course allows the student to research and report on an industrial sustainability issue of interest and relevance to their career objectives. Topics may touch on industrial ecology, ethics, regulations, environment, resource use, alternative manufacturing methods, facilities, logistics, etc. This is the fourth course in a specialization in industrial sustainability.

(0-0-3)

INTM 594**Special Projects**

Special project.

(Credit: Variable)

INTM 597**Special Projects**

Independent study and project. Permission of instructor required.

(Credit: Variable)

Department of Information Technology and Management

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Dean and Chair:

C. Robert Carlson
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The mission of the Department of Information Technology & Management is to educate and inform students to prepare them to assume technical and managerial leadership in the information technology and cyber security fields. The Information Technology and Management degrees apply a hands-on, reality-based approach to education that allows students to apply what they learn in class to solve real-life problems. Additional courses may be taken from the IIT Chicago-Kent College of Law curriculum to give cyber security and forensics practitioners a thorough grounding in legal issues and compliance. The program provides an innovative experience where students work on cutting-edge, industry-sponsored projects. This teaching philosophy prepares students to become innovators, entrepreneurs and leaders of the future. For some areas of study, it is possible to complete the entire Master of Information Technology & Management degree online.

Degrees Offered

Master of Information Technology & Management

Master of Cyber Forensics and Security

Certificate Programs

Advanced Software Development
Cyber Security Management
Cyber Security Technologies
Data Center Operations and Management
Data Management and Analytics
Digital Voice and Data Communication Technologies

Information Technology Innovation, Leadership, and Entrepreneurship
System Administration
Systems Analysis
Web Design and Application Development

Faculty

Carlson, C. Robert, Professor, Dean of the School of Applied Technology, Director of the Rice Campus, and Chair of Information Technology and Management. B.A. Augustana College, Ph.D. University of Iowa. Database design, object-oriented modeling and design, software engineering, and IT entrepreneurship.

Davids, Carol, Industry Professor and Director of the School of Applied Technology Real-Time Communications Laboratory. B.S. Engineering Mathematics Columbia University, M.I.T.M. Illinois Institute of Technology. Voice over IP, voice and data networks, and digital and voice communications.

Hajek, Jeremy, Industry Associate Professor. B.I.T.M., M.I.T.M., Illinois Institute of Technology. Cloud computing, systems architecture, enterprise computing, embedded systems, operating systems.

Hendry, Robert, Industry Professor. B.S.C.S Aurora University, M.S.I.T. University of Maryland. Data management, databases, data analytics, data warehousing, application development, and informatics.

Lidinsky, William, Industry Professor, Interim Director, Center for Cybersecurity and Forensics Education, and Director of the School of Applied Technology Security and Forensics Laboratory. B.S.E.E., M.S.E.E. Illinois Institute of Technology, M.B.A. University of Chicago. Computer networking, computer and network security, computer and network forensics, vulnerability testing, and steganography.

Papademas, James, Industry Professor. B.S., B.S.B.A., M.B.A., M.S.M.C. Roosevelt University. M.I.S.M. Keller Graduate School of Management. Object-Oriented Programming, Application Development, Database Design, Mobile Applications.

Trygstad, Raymond E., Industry Professor, Associate Chair of the Department, Interim Associate Director, Center for Cybersecurity and Forensics Education, and Director of Information Technology for the School of Applied Technology. B.S. United States Naval Academy, M.S.S.M. University of Denver. System administration, operating system virtualization, information security management, information technology policy, cloud computing, open source operating systems and applications, and multimedia.

Laboratories and Research Centers

The IIT School of Applied Technology operates and administers over 400 computers and servers at the Main and Rice Campuses to support teaching, learning and research. Ten laboratories include a networking/network security and computer forensics facility, and a dedicated Real-Time Communications (RTC) facility which includes an entire CISCO VoIP LAN as well as video and mesh wireless capabilities. The security/forensics and RTC laboratories as well as the general-use laboratories provide additional facilities for student projects

and applied research, some of which is undertaken in conjunction with industry partners. Some laboratories are 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

The Center for Cyber Security and Forensics Education

The Center for Cyber Security and Forensics Education (C²SAFE) is a multi-disciplinary center within the IIT School of Applied Technology. The objectives of the Center for Cyber Security and Forensics Education are to:

- Develop, promote and support education and research in cybersecurity technologies and management, information assurance, and digital forensics across all academic disciplines at Illinois Institute of Technology.
- Engage with business and industry, government, professional associations, and community colleges to enhance knowledge, awareness and education in cybersecurity and digital forensics and improve practices in information assurance.
- Coordinate the designation of Illinois Institute of Technology as a National Center of Academic Excellence in Information Assurance by the National Security Agency and the Department of Homeland Security.
- Maintain resources for education and research in cybersecurity and digital forensics, publish student and faculty research in the field, and sponsor, organize and conduct conferences and other events to promote and advance cyber security and forensics education.

- Support IIT academic departments in the delivery of the highest caliber of cyber security and digital forensics education.

The Center plans, organizes and conducts the annual ForenSecure conference in the Spring of each year, as well as additional activities and student competitions that advance the mission of the Center.

The Center actively cooperates and coordinates activities with agencies of the Federal government and with professional organizations and programs such as the Information Systems Security Association (ISSA), the Information Systems Audit and Control Association (ISACA), the Association of Information Technology Professionals (AITP), the Association for Computing Machinery (ACM), the Institute of Electrical and Electronic Engineers (IEEE), UNIFORUM, CompTIA, Infragard, and others. The Center makes every effort to engage in joint activities with these organizations and to encourage them to engage with the Center whenever possible.

Resources for education and research as well as published student and faculty research in the form of technical reports and white papers are available on the Center's website at <http://ccsafe.iit.edu/>.

Admission Requirements

Applicants for admission must have earned a four-year bachelors 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 300 combined quantitative and verbal, 151 quantitative, and 2.5 analytical writing 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 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. Proficiency may also be demonstrated by presentation of documentation of equivalent training or certification; in this case waivers of the prerequisites may only be granted by the graduate adviser or the ITM Associate Director.

Current prerequisites for the Master of Information Technology & Management include computer hardware and operating system literacy (ITM 301 or equivalent coursework, certification, or experience); basic knowledge of HTML, CSS, and JavaScript (ITMD 361 or ITMD 461); and the ability to create and administer databases using a modern database management system (ITMD 421). Students enrolled in undergraduate post-baccalaureate studies (see page 28) may take these courses as part of that program.

Current prerequisites for the Master of Cyber Forensics and Security include computer hardware and operating system literacy (ITM 301 or equivalent coursework, certification or experience); an ability to program at a competent level using a contemporary programming language (ITMD 411 or ITMD 510); basic knowledge of networking concepts, protocols, methods, and the Internet (ITMO 440 or ITMO 540); and the ability to create and administer databases using a modern database management system (ITMD 421). Students enrolled in undergraduate post-baccalaureate studies (see page 28) may take these courses as part of that program.

Placement Examinations

Students entering the Master of Information Technology and Management degree program may be required to take placement examinations based on an evaluation of their background and their undergraduate degree program.

Students may be required to demonstrate proficiency in the use of a contemporary objectoriented programming language through completion of a programming proficiency examination. Students will be requested to complete a representative set of basic programming tasks and will have a choice of contemporary programming languages in which to complete the tasks; Visual Basic is not an acceptable language for this purpose. References may be consulted, but the test is timed so ability to code

is necessary. Students who cannot satisfactorily complete the exam may be required to attend a refresher workshop or short course in their selected programming language, or may be required to complete an ITM programming course; appropriate action will be based on their score on the exam.

Students who are not required to complete the Test of English as a Foreign Language (TOEFL) but have low scores on the GRE Verbal may be required to complete an English evaluation. If students cannot pass the examination or evaluation they will be required to enroll in an appropriate PESL course and demonstrate proficiency at course completion.

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

At the conclusion of their studies, graduates of this degree should be able to:

- Deliver optimal technical and policy technology solutions for the problems of business, industry, government, non-profit organizations, and individuals in each student's particular area of focus.
- Work with, lead, and manage teams in an enterprise environment to collaboratively arrive at optimal technology solutions.
- Manage and deploy information resources applicable to each student's particular area of focus in an enterprise setting.

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 an ability to program at a competent level using a contemporary

programming language (ITMD 411); basic knowledge of net-working concepts, protocols and methods (ITMO 540); knowledge of the Internet, including the ability to build Web sites and deliver them on a server (ITMD 461); the ability to create and administer databases using a modern database management system (ITMD 421); and the ability to install, configure, use and administer an open-source operating system (ITMO 456). Students enrolled in under-graduate post-baccalaureate studies (see page 28) may take these courses as part of that program, but they will not then be applied to their graduate degree.

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 specialization may be available at the discretion of the student's advisor. Final determination of completion of a specialization will be made by a student's graduate adviser. 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

ITMD 411 Intermediate Software Development

AND 6 hours from the following:

ITMD 421 Data Modeling and Applications

ITMD 461 Internet Technologies and Web Design

ITMO 456 Introduction to Open Source Operating Systems

ITMO 540 Introduction to Data Networks and the Internet

Notes: Core courses may be waived upon presentation of evidence of equivalent coursework, certification or experience or successful completion of the placement examination. Approval of waivers will be made by the student's adviser or the ITM Associate Director. If one or two core courses are waived, students must still complete nine hours of core course content. Core courses that also apply to specializations will still fulfill the core course requirement.

Computer and Information Security (21 hours)

Recommended Courses (12 hours)

ITMO 456 Introduction to Open Source Operating Systems

ITMS 548 Cyber Security Technologies

ITMS 549 Cyber Security Technologies: Projects and Advanced Methods

ITMS 578 Cyber Security Management

AND 6 hours from the following:

Any 500-level ITMS elective (ITMS 579 may only be taken once as part of this requirement).

AND 3 or more hours from the following:

Any 500 level ITMS elective

ITMM 585 Legal & Ethical Issues in Information Technology

ITMM 586 Information Technology Auditing

ITMO 533 Enterprise Server Administration

OR

ITMO 541 Network Administration and Operations

OR

ITMO 553 Open Source System Administration

Data Center Operations and Management (21 hours)

Recommended Courses (12 hours)

ITMT 535 Data Center Architecture
ITMO 540 Introduction to Data Networks and the Internet
ITMO 554 Operating System Virtualization
ITMM 576 Data Center Management

ITMM 574 Information Technology Management Frameworks
ITMO 544 Cloud Computing Technologies
ITMO 546 Telecommunications Over Data Networks
ITMO 557 Storage Technologies
ITMS 548 Cyber Security Technologies
ITMS 578 Cyber Security Management
ITMS 588 Incident Response, Disaster Recovery, and Business Continuity

AND 9 hours from the following:

ITMD 526 Data Warehousing

Data Management (18 hours)

Recommended Courses (9 hours)

ITMD 421 Data Modeling and Applications
ITMD 422 Advanced Database Management
ITMD 528 Database Security

ITMD 527 Data Analytics
ITMD 529 Advanced Data Analytics
ITMM 574 Information Technology Management Frameworks
ITMO 557 Storage Technologies
ITMS 578 Cyber Security Management
ITMT 531 Object Oriented System Analysis, Modeling, and Design

AND 9 hours from the following:

ITMD 521 Client/Server Technologies & Applications
ITMD 526 Data Warehousing

Digital Systems Technology (18 hours)

Recommended Courses (9 hours)

ITMD 555 Intelligent Device Applications
ITMT 533 Operating System Design Implementation
ITMT 593 Embedded Systems

INTM 522 Computers in Industry
ITMO 540 Introduction to Data Networks and the Internet
ITMO 541 Network Administration and Operations
ITMO 542 Wireless Technologies and Applications
ITMO 544 Cloud Computing Technologies
ITMO 545 Telecommunications Technology
ITMO 546 Telecommunications Over Data Networks
ITMD 565 Rich Internet Applications

AND 9 hours from the following:

ITMD 511 Application Development Methodologies
ITMD 555 Intelligent Device Applications
ITMD 556 Intelligent Device Projects

IT Management and Entrepreneurship (18 hours)

Recommended Courses (9 hours)

ITMM 571 Project Management for Information Technology Management
ITMM 574 Information Technology Management Frameworks
ITMM 581 Information Technology Entrepreneurship

ITMD 532 UML-Based Software Development
ITMS 578 Information Systems Security Management
ITMT 531 Object Oriented System Analysis, Modeling, and Design
TECH 581 Consulting for Technical Professionals
INTM 511 Industrial Leadership
INTM 515 Advanced Project Management
INTM 522 Computers in Industry
INTM 543 Purchasing

AND 9 hours from the following:

Any 500-level ITMM elective

Management Information Systems (21 hours)

Recommended Courses (9 hours)

ITMD 421 Data Modeling and Applications
 ITMD 422 Advanced Database Management
 ITMM 571 Project Management for Information Technology

AND 9 hours from the following:

ITMD 526 Data Warehousing
 ITMD 527 Data Analytics
 ITMD 529 Advanced Data Analytics
 ITMD 532 UML-Based Software Development

ITMM 572 Process Engineering for Information Technology Managers
 ITMM 574 Information Technology Management Frameworks
 ITMM 586 Information Technology Auditing
 ITMO 544 Cloud Computing Technologies
 ITMO 554 Operating System Virtualization
 ITMO 557 Storage Technologies
 ITMT 531 Object Oriented System Analysis, Modeling and Design
 TECH 581 Consulting for Technical Professionals
 INTM 522 Computers in Industry

Software Development (18 hours)

Recommended Courses (9 hours)

ITMD 515 Advanced Software Programming
 ITMD 532 UML Based Software Development
 ITMM 571 Project Management for Information Technology Management

AND 9 hours from the following:

ITMD 412 Advanced Structured and Systems Programming
 ITMD 511 Application Development Methodologies

ITMD 513 Open Source Programming
 ITMD 519 Topics in Software Development
 ITMD 521 Client/Server Technologies and Applications
 ITMD 534 Human and Computer Interaction
 ITMD 536 Software Testing and Maintenance
 ITMM 572 Process Engineering for Information Technology Managers
 ITMO 556 Introduction to Open Source Software
 ITMS 518 Coding Security
 ITMT 531 Object Oriented System Analysis, Modeling, and Design

System Administration (18 hours)

Recommended Courses (9 hours)

ITMO 541 Network Administration and Operations
 ITMO 551 Distributed Workstation System Administration

OR

ITMO 552 Client-Server System Administration

AND 9 hours from the following:

ITMM 571 Project Management for Information Technology Management
 ITMM 574 Information Technology Management Frameworks

ITMM 575 Networking and Telecommunications Management
 ITMO 456 Introduction to Open Source Operating Systems
 ITMO 544 Cloud Computing Technologies
 ITMO 551 Distributed Workstation System Administration

OR

ITMO 552 Client-Server System Administration
 ITMO 554 Operating System Virtualization
 ITMO 557 Storage Technologies
 ITMS 558 Operating System Security

Systems Analysis (18 hours)

Recommended Courses (9 hours)

ITMM 571 Project Management for Information Technology
 ITMM 572 Process Engineering for Information Technology Managers
 ITMT 531 Object Oriented System Analysis, Modeling, and Design

AND 9 hours from the following:

ITMD 511 Application Development Methodologies

ITMD 532 UML Based Software Development
 ITMD 534 Human and Computer Interaction
 ITMD 536 Software Testing and Maintenance
 ITMM 574 Information Technology Management Frameworks
 ITMM 575 Networking and Telecommunications Management
 ITMM 586 Information Technology Auditing
 ITMS 578 Cyber Security Management
 TECH 581 Consulting for Technical Professionals
 INTM 522 Computers in Industry

Voice and Data Communication Technology (21 hours)

Recommended Courses (12 hours)

ITMO 456 Introduction to Open Source Operating Systems
ITMO 540 Introduction to Data Networks and the Internet
ITMO 545 Telecommunications Technology
ITMO 546 Voice Communications Over Data Networks

ITMM 575 Networking and Telecommunications Management
ITMO 541 Network Administration and Operations
ITMO 542 Wireless Technologies and Applications
ITMO 544 Cloud Computing Technologies
ITMO 547 Telecommunications Over Data Networks: Projects & Advanced Methods
ITMS 543 Vulnerability Analysis and Control
ITMS 548 Cyber Security Technologies
ITMS 549 Cyber Security Technologies: Projects & Advanced Methods

AND 9 hours from the following:

ITMD 565 Rich Internet Applications
ITMM 571 Project Management for Information Technology Management

Web Design and Application Development (18 hours)

Recommended Courses (9 hours)

ITMD 461 Internet Technologies & Web Design
ITMD 534 Human and Computer Interaction
ITMD 562 Web Site Application Development

ITMD 555 Intelligent Device Applications
ITMD 563 Intermediate Web Application Development
ITMD 564 Advanced Web Application Development
ITMD 565 Rich Internet Applications
ITMD 566 Service-Oriented Architectures
ITMD 569 Topics in Application Development
ITMM 571 Project Management for Information Technology Management
ITMO 541 Network Administration and Operations
COM 525 User Experience Research and Evaluation

AND 9 hours from the following:

ITMD 513 Open-Source Programming
ITMD 515 Advanced Software Programming
ITMD 519 Topics in Software Development

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 or more alternative courses listed for each area; more alternatives may be possible at the discretion of the student's advisor.

Web Design and Application Development

*ITMD 461 Internet Technologies & Web Design
ITMD 562 Web Site Application Development
ITMD 565 Rich Internet Applications

Data Management

*ITMD 421 Data Modeling and Applications
ITMD 521 Client/Server Technologies and Applications

Information Technology Management

*ITMM 571 Project Management for Information Technology
ITMM 574 Information Technology Management Frameworks
ITMM 586 Information Technology Auditing

Networking and Communications

*ITMO 540 Introduction to Data Networks and the Internet
ITMO 541 Network Administration and Operations

Systems Administration

*ITMO 550 Enterprise End-User System Administration
AND

ITMO 533 Enterprise Server Administration

OR

*ITMO 456 Introduction to Open Source Operating System

AND

*ITMO 553 Open Source System Administration

Software Development

*ITMD 411 Intermediate Object Oriented Programming
ITMD 532 UML Based Software Development

Computer & Information Security

ITMS 528 Database Security
*ITMS 548 Cyber Security Technologies
*ITMS 578 Cyber Security Management

Master of Cyber Forensics and Security

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. Law courses count as 500-level courses toward this total).

GPA: 3.0/4.0

At the conclusion of their studies, graduates of the Master of Cyber Forensics and Security degree should be able to:

- Design and implement a comprehensive enterprise security program using both policy and technology to implement technical, operational and managerial controls
- Comprehensively investigate information security incidents and violation of law using computer resources in a manner such that all evidence is admissible in a court of law.
- Technically secure enterprise information assets and resources to deter, detect, and prevent the success of attacks and intrusions.

Core Courses (15 hours)

Required Courses

ITMS 538 Cyber Forensics
ITMS 543 Vulnerability Analysis and Control
ITMS 548 Cyber Security Technologies
ITMS 578 Cyber Security Management
LAW 273 Evidence

Note: Core course requirements may be waived upon presentation of evidence of equivalent coursework, certification or experience. Approval of waivers will be made by the student's adviser or the ITM Associate Chair.

Elective Courses (15 hours)

Select at least twelve hours from the following:

Any 500-level ITMS course not listed in required courses above. ITMS 579, Topics in Cyber Security, may be taken more than once.

ITMM 585 Legal and Ethical Issues in Information Technology

ITMM 586 Information Technology Auditing

ITMO 456 Introduction to Open Source Operating Systems

ITMT 594 Special Projects in Information Technology

ITMT 597 Special Problems in Information Technology

AND select at least three hours from the following:

LAW 240 National Security Law

LAW 478 Computer and Network Privacy and Security: Ethical, Legal, and Technical Considerations

LAW 495 Electronic Discovery

Note: LAW electives not listed above may be substituted as approved by the student's adviser or the ITM Associate Chair.

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. All courses may be later applied toward the Master of Information Technology and Management degree or the Master of Cyber Forensics and Security degree for those who apply and are accepted to the 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. Prerequisites may be required for some courses in certificates; these prerequisites will not be applied to the certificate.

Advanced Software Development Certificate

This program is designed for students seeking knowledge that will enhance their skills as a software developer.

Required Courses

ITMD 515 Advanced Software Programming
ITMM 571 Project Management for Information Technology Management

AND two of the following:

ITMD 511 Application Development Methodologies
ITMD 513 Open Source Programming
ITMD 519 Topics in Software Development
ITMD 532 UML Based Software Development
ITMD 534 Human and Computer Interaction
ITMD 536 Software Testing and Maintenance
ITMO 556 Introduction to Open Source Software
ITMS 518 Coding Security

Students who have already completed coursework, training, or certification equivalent to ITMM 571 may substitute a fourth course from the above list.

Cyber Security Management Certificate

This program is designed for students seeking knowledge that will prepare them for careers in the management of information security.

Required Courses

ITMS 548 Cyber Security Technologies
ITMS 578 Cyber Security Management

AND two of the following:

ITMM 586 Information Technology Auditing
ITMS 543 Vulnerability Analysis and Control
ITMS 579 Topics in Information Security (may be taken twice)
ITMS 588 Incident Response, Disaster Recovery, and Business Continuity

Cyber Security Technologies Certificate

This program is designed for students seeking knowledge that will prepare them for careers in computer and network security technologies and to deal with the challenging computer and network security problems facing society.

Required Courses

ITMS 543 Vulnerability Analysis and Control
ITMS 548 Cyber Security Technologies

AND two of the following:

ITMS 518 Coding Security
ITMS 528 Database Security
ITMS 538 Computer Forensics
ITMS 539 Steganography
ITMS 549 Cyber Security Technologies: Projects & Advanced Methods
ITMS 555 Mobile Device Forensics
ITMS 558 Operating System Security

Data Center Operations and Management Certificate

This program is designed for students seeking knowledge that will prepare them for a career in data center operations.

Required Courses:

ITMM 576 Data Center Management
ITMO 540 Introduction to Data Networks and the Internet
ITMO 554 Operating System Virtualization
ITMT 535 Data Center Architecture

Students who have already completed coursework, training, or certification equivalent to ITMO 540 may substitute a fourth course from the list below.

ITMO 544 Cloud Computing Technologies
ITMO 557 Storage Technologies
ITMS 548 Cyber Security Technologies
ITMS 588 Incident Response, Disaster Recovery, and Business Continuity

Data Management and Analytics Certificate

This program is designed for students seeking knowledge that will prepare them for careers in data management and analytics.

Required Courses

ITMD 421 Data Modeling and Applications
ITMD 422 Advanced Database Management
ITMD 527 Data Analytics

AND one of the following:

ITMD 526 Data Warehousing
ITMS 528 Database Security
ITMD 529 Advanced Data Analytics
ITMT 531 Object Oriented System Analysis, Modeling, and Design

Students who have already completed coursework, training, or certification equivalent to ITMD 421 may substitute a fourth course from the above list.

Digital Voice and Data Communication Technologies Certificate

This program is designed for students seeking knowledge that will prepare them for careers in digital voice and data communications.

Required Courses

ITMO 540 Introduction to Data Networks and the Internet
ITMO 545 Telecommunications Technology
ITMO 546 Telecommunications Over Data Networks

AND one of the following:

ITMM 575 Networking & Telecommunications Management
ITMO 541 Network Administration and Operations
ITMO 547 Telecommunications Over Data Networks: Projects & Advanced Methods

Students who have already completed coursework, training, or certification equivalent to ITMO 540 may substitute a fourth course from the above list.

Information Technology Innovation, Leadership, and Entrepreneurship Certificate

This program is designed for students seeking knowledge that will prepare them to be leaders, innovators and entrepreneurs in the field of information technology.

Required Courses

ITMM 571 Project Management for Information Technology Management
ITMM 581 Information Technology Entrepreneurship
ITMM 582 Business Innovation

AND one of the following:

Any ITMM Elective
INTM 511 Industrial Leadership
INTM 515 Advanced Project Management
INTM 522 Computers in Industry
INTM 543 Purchasing
TECH 581 Consulting for Technical Professionals

Students who have already completed coursework, training, or certification equivalent to ITMM 571 may substitute a fourth course from the above list. Only one INTM course may be applied to the certificate.

System Administration Certificate

This program is designed for students seeking knowledge that will prepare them for a career as a systems administrator.

One of the following two six-credit-hour course sequences:

ITMO 550 Enterprise End-User System Administration

AND

ITMO 533 Enterprise Server Administration

OR

ITMO 456 Introduction to Open Source Operating Systems

AND

ITMO 553 Open Source System Administration

AND two of the following:

ITMM 571 Project Management for Information Technology Management

ITMO 544 Cloud Computing Technologies

ITMO 554 Operating System Virtualization

ITMS 558 Operating System Security

Systems Analysis Certificate

This program is designed for students seeking knowledge that will prepare them for a career as a systems analyst.

Required Courses

ITMM 571 Project Management for Information Technology

ITMM 572 Process Engineering for Information Technology Managers

ITMT 531 Object Oriented System Analysis, Modeling, and Design

AND one of the following:

INTM 522 Computers in Industry

ITMD 511 Application Development Methodologies

ITMD 532 UML Based Software Development

ITMD 534 Human and Computer Interaction

ITMD 536 Software Testing and Maintenance

TECH 581 Consulting for Technical Professionals

Students who have already completed coursework, training, or certification equivalent to ITMM 571 may substitute a fourth course from the above list.

Web Design and Application Development Certificate

This program is designed for students seeking knowledge that will prepare them for careers in Web design and application development.

Required Courses

ITMD 461 Internet Technologies & Web Design

ITMD 562 Web Site Application Development

AND two of the following:

ITMD 534 Human and Computer Interaction

ITMD 555 Intelligent Device Applications

ITMD 563 Intermediate Web Application Development

ITMD 564 Advanced Web Application Development

ITMD 565 Rich Internet Applications

ITMD 566 Service-Oriented Architectures

ITMD 569 Topics in Application Development

Students who have already completed coursework, training, or certification equivalent to ITMD 461 may substitute a fourth 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 within the front of this bulletin.)

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.

Course Descriptions

Numbers in parentheses indicate class, lab and credit hours, respectively.

Information Technology & Management: Development

ITMD 411

Intermediate Software Development

This course covers a broad spectrum of object-oriented programming concepts and application programming interfaces. The student considers the details of object-oriented development in topics of multi-threading, data structure collections, stream I/O and client interfaces. Software engineering topics of packaging and deployment are covered as well. Hands-on exercises reinforce concepts taught throughout the course.

Prerequisite(s): [(ITM 311)]
(2-2-3)

ITMD 412

Advanced Structured & Systems Programming

Structured programming continues with advanced concepts including strings, arrays, pointers, data structures, file manipulation, and dynamic memory management. Students create more complex applications that work with user input, manipulate user supplied text or text obtained from a file, apply standard library routines for working with literal text, use pointers to store complex structures within arrays, and read and write data from files, the console, and the terminal. The object-oriented programming (OOP) paradigm is covered in depth including the philosophy of OOP, classes and objects, inheritance, template classes, and making use of class libraries.

Prerequisite(s): [(ITM 312)]
(2-2-3)

ITMD 421

Data Modeling & Applications

Basic data modeling concepts are introduced. Hands-on database design, implementation, and administration of single-user and shared multi-user database applications using a contemporary relational database management system.

(2-2-3)

ITMD 422

Advanced Database Management

Advanced topics in database management and programming including client server application development are introduced. Expands knowledge of data modeling concepts and introduces object-oriented data modeling techniques. Students will learn the use of Structured Query Language in a variety of application and operating system environments.

Prerequisite(s): [(ITMD 421)]
(3-0-3)

ITMD 460

Fundamentals of Multimedia

Students are introduced to computer-based multimedia theory, concepts, and applications. Topics include desktop publishing, hypermedia, presentation graphics, graphic images, animation, sound, video, multimedia on the World Wide Web and integrated multimedia authoring techniques.

(2-2-3)

ITMD 461

Internet Technologies & Web Design

This course will cover the creation of Web pages and sites using HTML, CSS, Javascript and graphical applications. Networked multimedia distribution technologies are also explored. The design of effective Web site including page layout, user interface design, graphic design, content flow and site structure as well as management of Web site resources including intranet management and design considerations are addressed. Students design and create a major Web site with multiple pages and cross-linked structures.

(2-2-3)

ITMD 510

Object-Oriented Application Development

This course covers a broad spectrum of object-oriented programming concepts and application programming interfaces. The student considers the details of object-oriented development in topics of multi-threading, data structure collections, stream I/O and client interfaces. Software engineering topics of packaging and deployment are covered as well. Strong emphasis is placed on the creation of applications providing solutions for defined business problems. Hands-on exercises reinforce concepts taught throughout the course.

(2-2-3)

ITMD 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(s): [(ITMD 411) OR (ITMD 412)]
(2-2-3)

ITMD 512

Structured & Systems Programming

Structured programming with advanced concepts including strings, arrays, pointers, data structures, file manipulation, and dynamic memory management. Students create complex applications that work with user input, manipulate user supplied text or text obtained from a file, apply standard library routines for working with literal text, use pointers to store complex structures within arrays, and read and write data from files, the console, and the terminal. The object-oriented programming (OOP) paradigm is covered in depth including the philosophy of OOP, classes and objects, inheritance, template classes, and making use of class libraries. Strong emphasis is placed on the creation of applications providing solutions for defined business problems or specific operating system issues.

Prerequisite(s): [(ITM 312)]
(2-2-3)

ITMD 513

Open Source Programming

Contemporary open-source programming languages and frameworks are presented. The student considers design and development topics in system, graphical user interface, network and web programming. Dynamic scripting languages are covered using object-oriented, concurrent and functional programming paradigms. Concepts gained throughout the course are reinforced with numerous exercises which will culminate in an open-source programming project.

Prerequisite(s): [(ITMD 411)]
(2-2-3)

ITMD 515

Advanced Software Programming

This course considers Web container application development for enterprise systems. The primary focus is on database connectivity (JDBC) integration with Web application programming using an enterprise-level application framework. A Web application term project considers the design and implementation of a database instance that serves as the information tier in a contemporary 3-tier enterprise solution.

Prerequisite(s): [(ITMD 411)]
(2-2-3)

ITMD 519

Topics in Software Development

This course will cover a particular topic in software development varying from semester to semester in which there is particular student or staff interest. The course may be taken more than once but only 9 hours of ITMD 419/519 credit may be applied to a degree.

(Credit: Variable)

ITMD 521

Client/Server Technologies & 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(s): [(ITMD 421)]
(2-2-3)

ITMD 523

Advanced Topics in Data Management

Advanced topics in database management and programming including client server application development are introduced. Students will learn the use of Structured Query Language in a variety of application and operating system environments. Expands knowledge of data modeling concepts and introduces object-oriented data modeling techniques with specific attention to the use of database management systems in response to defined business problems.

(3-0-3)

ITMD 526

Data Warehousing

This class will introduce the student to concepts needed for successfully designing, building and implementing a data warehouse. The class will provide the technological and managerial knowledge base for data modeling approaches such as the star schema and database de-normalization issues. Topics such as loading the warehouse, performance considerations, and other concepts unique to the data warehouse environment will be discussed demonstrated in detail.

Prerequisite(s): [(ITM 421) OR (ITMD 421)]
(3-0-3)

ITMD 527

Data Analytics

This is a hands-on course that focuses on the creation, maintenance, and analysis of large informatics databases. Concepts such as data modeling, probability, linear regression, and statistical data analysis are covered in depth. In addition, this course will use large simulated equities, healthcare, insurance, and banking database systems. The student is expected to have a working understanding of relational database concepts as well as SQL.

Prerequisite(s): [(ITMD 421)]
(3-0-3)

ITMD 529

Advanced Data Analytics

Informatics is the application of information technology to solve problems in other fields. Informaticists use technology and information to build intelligent systems used to bridge the gaps between information, technology, and the people who use it. The study of informatics is about blending applied mathematics with technology while understanding the broader consequences of computing on society and the problem being solved. It is important for any student to develop a broad perspective of technology and the people it serves. This course builds upon the student's knowledge of mathematical concepts of predictive modeling of samples and populations with an emphasis on applying technology to solve real world problems.

Prerequisite(s): [(ITMD 527)]
(3-0-3)

ITMD 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(s): [(ITMD 412)]
(3-0-3)

ITMD 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)

ITMD 536

Software Testing & 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

Prerequisite(s): [(ITMM 471) OR (ITMM 571)]
(3-0-3)

ITMD 545

Web Real-Time Communications

This course covers a set of protocols, architectures, and APIs designed to enable browser-to-browser real-time communication of voice, video, and data. Students will learn to apply basic technologies including WebSockets, HTTP, HTML5, Web Sockets, NAT, STUN, TURN, and ICE to ensure two-way real-time communication is established using the WebRTC API's and architectures. Students will use JavaScript and development environments to create basic data and media applications based on the WebRTC technologies and will record the impact of their applications on the performance and behavior of the networks that carry them.

Prerequisite(s): [(ITMD 411) OR (ITMD 510)] AND [(ITMD 461*)] AND [(ITMO 440) OR (ITMO 540)] AND [(ITMO 456) OR (ITMO 556)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

ITMD 555

Intelligent Device Applications

Intelligent device application development is covered with various technologies on mobile and robotic platforms. Utilizing contemporary toolkits, the student considers design and development on emulated and real "smart" devices including smart phones, personal digital assistants, sensors, actuators, and robots. Numerous exercises reinforce concepts gained throughout the course. A term project will integrate course topics into a comprehensive intelligent device application. This course may be taken more than once but only 9 hours of ITM 455/555 or ITMD 455/555 credit may be applied to a degree.

(Credit: Variable)

ITMD 556

Intelligent Device Projects

Students create projects that exercise and expand their understanding of intelligent device application development. Instructional materials and lectures are provided as needed to support projects. Scope and deliverables will be determined through joint decision of the instructor and students. Students will describe requirements, create test plans as needed, demonstrate the application when applicable, create a written description of the work, and may deliver a formal presentation to an audience appropriate to the scope and scale of the work completed. This course may be taken more than once but only 6 hours of ITMD 556 credit may be applied to a degree.

Prerequisite(s): [(ITMD 555)]

(2-2-3)

ITMD 562

Web Site Application Development

Programming the Common Gateway Interface (CGI) for Web pages is introduced with emphasis on creation of interfaces to handle HTML 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 Web site including basic CGI programs with Web interfaces and process data flows from online forms with basic database structures.

Prerequisite(s): [(ITM 461) OR (ITMD 461)]

(2-2-3)

ITMD 563

Intermediate Web 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.

Prerequisite(s): [(ITM 411) OR (ITMD 411)] AND [(ITM 461) OR (ITMD 461)]

(2-2-3)

ITMD 564

Advanced Web Application Development

Strategies for management of electronic commerce allow students to learn to re-engineering 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(s): [(ITM 563) OR (ITMD 563)]

(2-2-3)

ITMD 565

Rich Internet Applications

Students learn to create interactive rich Internet applications using Web development frameworks, applications, and techniques that primarily operate on the client-side. These applications often exhibit the same characteristics as desktop applications and are typically delivered through a standards-based Web browser, via a browser plug-in, or independently via sandboxes or virtual machines. Current software frameworks used to download, update, verify and execute these applications are addressed as well as writing applications for deployment in these frameworks.

Prerequisite(s): [(ITM 461) OR (ITMD 461)]

(2-2-3)

ITMD 566

Service-Oriented Architectures

This course covers IT enterprise systems employing web services technologies in SOA and ESB architectural patterns. The student considers SOA which defines and provisions IT infrastructure and allows for a loosely-coupled data exchange over disparate applications participating in business processes. The simplification of integration and flexible reuse of business components within SOA is greatly furthered by ESB. Lab exercises using contemporary toolkits are utilized to reinforce platform-agnostic course topics.

Prerequisite(s): [(ITM 411 and ITM 461) OR (ITMD 411 and ITMD 461)]

(2-2-3)

ITMD 567

Web Systems Integration

In this project-based course, student teams will build an enterprise-grade website and web infrastructure integrating server-side applications, databases, and client-side rich internet applications as a solution to a defined business problem.

Prerequisite(s): [(ITMD 462) OR (ITMD 562)] AND [(ITMD 465) OR (ITMD 565)]

(3-0-3)

ITMD 569

Topics in Application Development

This course will cover a particular topic in application development, varying from semester to semester, in which there is a particular student or staff interest. This course may be taken more than once but only 9 hours of ITM 469/569 or ITMD 469/569 credit may be applied to a degree.

(Credit: Variable)

Information Technology & Management: Management

ITMM 570

Fundamentals of Management for Technology Professionals

This course explores fundamentals of management for professionals in high-technology fields. It addresses the challenges of the following: managing technical professionals and technology assets; human resource management; budgeting and managerial accounting; management of services, infrastructure, outsourcing, and vendor relationships; technology governance and strategy; and resource planning.

(3-0-3)

ITMM 571

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)

ITMM 572

Process Engineering for Information Technology Managers

This course will provide students with the knowledge and skills to define, model, measure and improve business processes. The course will focus on re-engineering 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(s): [(ITMM 470) OR (ITMM 570)]

(3-0-3)

ITMM 573

Building & 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(s): [(ITM 471 with min. grade of D) OR (ITM 571) OR (ITMM 471 with min. grade of D) OR (ITMM 571)]

(3-0-3)

ITMM 574

Information Technology Management Frameworks

This course will examine the application of industry standard frameworks to the management of information technology infrastructure, development and operations. Frameworks including the Information Technology Infrastructure Library (ITIL), Control Objectives for Information and related Technology (COBIT), and others will be covered. Students will learn to use these frameworks to tailor a set of concepts and policies to necessary manage IT in a specific enterprise.

(3-0-3)

ITMM 575

Networking & Telecommunications Management

This course address the design, implementation, and management of computer networks and enterprise telecommunications 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.

(3-0-3)

ITMM 576

Data Center Management

This course is an in-depth examination of best practices in the management of enterprise data centers. Topics include data center consolidation; data center maintenance; server and network management methods and tools; budget and finance; service-level agreements; managing data center personnel and staff; and disaster recovery

(3-0-3)

ITMM 577

Case Studies in Management of Information Technology

This course examines approaches and models for the management of information technology at an enterprise level through the use of case studies in the field.

(3-0-3)

ITMM 581

Information Technology Entrepreneurship

This course prepares students to become leaders in information technology and to build ITM companies. Students design and develop a prototype ITM product and prepare a business plan and venture proposal presentation.

(3-0-3)

ITMM 582

Business Innovation

This course is designed to teach innovative thinking through theory, methods, and practice of innovation. The course incorporates Einstein's thinking, and Edison's method to establish the innovation process that can be applied in current business environment. Current economic conditions and global sourcing requires that innovation becomes a leading tool for developing a competitive edge. Innovation has been considered a competency of educated, design engineering, and a selected few employees that has become insufficient today. Corporations and organizations need innovation to develop customer-specific solutions in almost real time.

(3-0-3)

ITMM 584
Information Technology at C-Level

The issues, competencies, challenges and rewards of managing information technology in major enterprises at the Chief Information Officer/Chief Technology Officer level are examined in depth. The course will equip students with a fundamental awareness of what the enterprise and the profession expects from the highest levels of IT management. Readings, case studies and guided discussions will be supplemented by a series of guest lectures from-and discussions with-Chicago-area IT professional currently employed in these roles.

(3-0-3)

ITMM 585
Legal & 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)

ITMM 586
Information Technology Auditing

Industry standard practices and standards in the auditing of information technology in an organization are addressed, with a particular emphasis on examination of IT governance, assets, controls, and control techniques. Specific areas covered will include the audit process, IT governance, systems and infrastructure life cycle management, IT service delivery and support, protection of information assets, and business continuity and disaster recovery. Students will examine case studies and complete hands-on exercises.

(3-0-3)

Information Technology & Management: Operations

ITMO 456
Introduction to Open Source Operating Systems

Students learn to set up and configure an industry-standard open source operating system including system installation and basic system administration; system architecture; package management; command?line commands; devices, filesystems, and the filesystem hierarchy standard. Also addressed are applications, shells, scripting and data management; user interfaces and desktops; administrative tasks; essential system services; networking fundamentals; and security, as well as support issues for open source software. Multiple distributions are covered with emphasis on the two leading major distribution forks.

(2-2-3)

ITMO 517
Shell Scripting for System Administration

Focuses on preparation of shell scripts to enhance and streamline system administration tasks in all contemporary server operating systems. Scripting will be taught in both native and portable environments. The course will address shell programming, regular expressions, common and system-specific shell utilities and built-in commands, user defined and shell variables, flow control structures, shell functions, and the creation and execution of shell scripts. Homework and hands-on exercises will provide practical experience in contemporary server environments. Same as ITMO 417.

(3-0-3)

ITMO 533
Enterprise Server Administration

Students learn to set up, maintain, and administer X86-based servers and associated networks using a contemporary industry-standard proprietary operating system. Topics include hardware requirements; software compatibility; system installation, configuration, and options and post-installation topics; administrative and technical practices required for system security; process management; performance monitoring and tuning; storage management; back-up and restoration of data; and disaster recovery and prevention. Also addressed is configuration and administration of common network and server services such as DNS, DHCP, remote access, email, basic virtualization, web and web services, and more.

Prerequisite(s): [(ITMO 540)]

(2-2-3)

ITMO 540
Introduction to Data Networks & 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, organization, 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)

ITMO 541

Network Administration & 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 workgroups and domains: file and printer sharing, remote access, and Windows networking are addressed. A research paper in the above topic areas is required.

Prerequisite(s): [(ITM 440) OR (ITM 540) OR (ITMO 440) OR (ITMO 540)]
(2-2-3)

ITMO 542

Wireless Technologies & Applications

This course will provide students with the knowledge of wireless communication technologies. The course will focus on the 3G and 4G wireless networks such as UMTS, LTE, and WiMAX. Students will have the opportunity to study the different wireless networks architectures and major network elements including devices, base stations, base station controller, and core networks. Major topics of the course include air interfaces, protocols, session management, QoS, security, mobility, and handoff.

(3-0-3)

ITMO 544

Cloud Computing Technologies

Computing applications hosted on dynamically-scaled, virtual resources available as services are considered. Collaborative and non-collaborative “cloud-resident” applications are analyzed with respect to cost, device/location independence, scalability, reliability, security, and sustainability. Commercial and local cloud architectures are examined. A group-based integration of course topics will result in a project employing various cloud computing technologies.

(2-2-3)

ITMO 545

Telecommunications Technology

This course introduces technologies underlying telecommunications and real-time communications systems and services. Topics will include: wire-line and fiber systems including those associated with the public switched telephone networks and cable service providers; wireless systems including cellular, Wi-Fi and WiMAX. Methods and architectures for delivery of signaling, voice and video are introduced; analog telephone systems, digital telephone systems on circuit switched networks both wire-line and cellular; digital telecommunications on packet switched networks. Codecs and transformation of voice and video into digital formats are introduced. Physical and data-link layer protocols are studied with emphasis on how they carry voice and video. Channelization and multiple-access methods are introduced. Switching methods studied include circuit switching, virtual circuit switching and packet switching.

(3-0-3)

ITMO 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 to PSATN 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.

(2-2-3)

ITMO 547

Telecommunications Over Data Networks: Projects & Advanced Methods

Mentored projects focused on real-time media applications, systems and services. HTTP-based and SIP-based systems are studied; reference is made to RTCWeb, W3C and IETF specifications and initiatives. Topics may include web-based real-time media applications; web-conferencing and distributed class-room applications; communications systems using SIP and Web technologies; standards-based systems supporting emergency calls over IP backbone networks; metrics for performance characteristics of real-time systems; security of streaming media; interoperability/conformance testing of real-time applications and services. Students present/demonstrate projects in a public meeting. Students should have previous or concurrent experience with one or more of the following: SIP, HTTP, HTML, and scripting or coding languages.

Prerequisite(s): [(ITM 546) OR (ITMO 546)]
(2-2-3)

ITMO 550

Enterprise End-User System Administration

Students learn to set up, configure, and maintain end-user desktop and portable computers and devices in an enterprise environment using a contemporary proprietary operating system, including the actual installation of the operating system in a networked client-server environment. User account management, security, printing, disk configuration, and backup procedures are addressed with particular attention to coverage of networked applications. System installation, configuration, and administration issues as well as network file systems, network access, and compatibility with other operating systems are also addressed. Administration of central server resources associated with management and provisioning of end-user systems in workgroups, domains, or forests is also addressed.

(2-2-3)

ITMO 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 work-station, 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.

(4-4-6)

ITMO 553

Open Source System Administration

Students learn to set up, configure, and administer an industry-standard open source server operating system including integration with client systems using a variety of operating systems in a mixed environment. Topics include hardware requirements; software compatibility; administrative and technical practices required for system security; process management; performance monitoring and tuning; storage management; back-up and restoration of data; and disaster recovery and prevention. Also addressed are configuration and administration of common network and server services such as DNS, DHCP, firewall, proxy, remote access, file and printer sharing, email, web, and web services as well as support issues for open source software.

Prerequisite(s): [(ITMO 540 and ITMO 556)]
(2-2-3)

ITMO 554

Operating Systems Virtualization

This course will cover technologies allowing multiple instances of operating systems to be run on a single physical system. Concepts addressed will include hypervisors, virtual machines, paravirtualization and virtual appliances. Both server and desktop virtualization will be examined in detail, with brief coverage of storage virtualization and application virtualization. Business benefits, business cases and security implications of virtualization will be discussed. Extensive hands-on assignments and a group project will allow students to gain first-hand experience of this technology.

(2-2-3)

ITMO 556

Introduction to Open Source Software

This course will cover the fundamental concepts and philosophy behind free and open source software (FOSS). The course will discuss open source and free software licensing; open source business strategies and impact; FOSS utilization in the enterprise; and development methodologies. Students will learn to set up and configure an industry-standard open source operating system, including system installation, and basic system administration; system architecture; package management; command-line commands; devices, filesystems, and the filesystem hierarchy standard. Also addressed are applications, shells, scripting and data management; user interfaces and desktops; administrative tasks; essential system services; networking fundamentals; and security, as well as support issues for open source software. Multiple distributions are covered with emphasis on the two leading major distribution forks.

(2-2-3)

ITMO 557

Storage Technologies

Modern enterprise data storage technologies and architectures are examined in depth. Topics include storage devices, file systems, storage networks, virtual storage, RAID, NAS, SAN, and other current enterprise-level storage models. Storage management, replication, deduplication, storage tiers, backups as well as fundamentals of business continuity, application workload, system integration, and storage/system administration are addressed. Specific knowledge and skills required to configure networked storage to include archive, backup, and restoration technologies are covered.

(3-0-3)

Information Technology & Management: Security

ITMS 518

Coding Security

This course examines security architecture elements within modern object-oriented programming languages that create the framework for secure programming. Analysis of components and services with their inherent strength and weaknesses give rise to common coding security challenges. An exploration of identity management, encryption services and common hacking techniques will enable the student's ability to develop secure code. Homework assignments and projects will reinforce theories taught.

Prerequisite(s): [(ITM 411) OR (ITMD 411)]

(3-0-3)

ITMS 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(s): [(ITM 421) OR (ITMD 421)]

(3-0-3)

ITMS 538

Cyber 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 of evidence using various forensic tools that reconstruct criminally liable actions at the physical and logical levels are also addressed. Technical topics covered include detailed analysis of hard disks, files systems (including FAT, NTFS and EXT), and removable storage media; mechanisms for hiding and detecting hidden information; and the hands-on use of powerful forensic analysis tools.

(2-2-3)

ITMS 539

Steganography

Digital steganography is the science of hiding covert information in otherwise innocent carrier files so that the observer is unaware that hidden information exists. This course studies both digital steganography and digital steganalysis (the science of discovering the existence of and extracting the covert information). In addition to understanding the science and the pathologies of specific carriers and hiding algorithms, students will have hands-on experience with tools to both hide and extract information. Carrier files such as image, audio, and video files will be investigated.

Prerequisite(s): [(ITM 538) OR (ITMS 538)]

(2-2-3)

ITMS 543

Vulnerability Analysis & Control

This course addresses hands-on ethical hacking, penetration testing, and detection of malicious probes and their prevention. It provides students with in-depth theoretical and practical knowledge of the vulnerabilities of networks of computers including the networks themselves, operating systems and important applications. Integrated with the lectures are laboratories focusing on the use of open source and freeware tools; students will learn in a closed environment to probe, penetrate and hack other networks

(2-2-3)

ITMS 548

Cyber Security Technologies

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-course,

Prerequisite(s): [(ITM 440) OR (ITM 540) OR (ITMO 440) OR (ITMO 540)]

(2-2-3)

ITMS 549

Cyber Security Technologies: Projects & Advanced Methods

Prepares students for a role as a network security analyst and developer and gives 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 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(s): [(ITM 448) OR (ITM 548) OR (ITMS 448) OR (ITMS 548)]
(2-2-3)

ITMS 555

Mobile Device Forensics

This course will address methods for recovering digital data or evidence and conducting forensic analysis of mobile devices such as smart phones and tablets. Various devices will be compared including iPhone, Android, and Blackberry. A brief review of Linux and related forensic tools. ANAND technology and mobile file systems will be discussed. Students will learn how to unlock and root mobile devices and recover data from actual mobile devices.

Prerequisite(s): [(ITM 538) OR (ITMS 538)]
(2-2-3)

ITMS 557

Introduction to Cyber Warfare

Cyber warfare is defined as “warfare waged in cyberspace,” which can include defending information and computer networks and deterring information attacks as well as denying an adversary’s ability to do the same. It can include offensive information operations mounted against an adversary or even dominating information on the battlefield. Students participating in this discussion-based course will explore the current state of cyber security from national and international perspectives and consider cyber-based operations through the lens of a government pursuing strategic goals. How might their actions impact the industry’s ability to conduct business operations? What does the current threat environment look like? The course will include extensive discussions and student presentations.

(3-0-3)

ITMS 558

Operating Systems 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.

(2-2-3)

ITMS 578

Cyber Security Management

In-depth examination of topics in the management of information technology security including access control systems & methodology, business continuity & disaster recovery planning, legal issues in information system security, ethics, computer operations security, physical security and security architecture & models using current standards and models.

(3-0-3)

ITMS 579

Topics in Information Security

This course will cover a particular topic in Information Security, varying from semester to semester, in which there is particular student or staff interest. This course may be taken more than once but only 9 hours of ITM 479/579 or ITMS 479/ITMS 579 credit may be applied to a degree.

(Credit: Variable)

ITMS 584

Governance, Risk, & Compliance

This course is an in-depth examination of topics in information technology/information security governance, risk, and compliance including information assurance policies, standards, and compliance as well as the examination of security risk analysis and the performance of systems certification and accreditation.

Prerequisite(s): [(ITMS 478 with min. grade of D) OR (ITMS 578)]
(3-0-3)

ITMS 588

Incident Response, Disaster Recovery, & Business Continuity

Students learn to design and manage key business information security functions including incident response plans and incident response teams disaster recovery plans; and business continuity plans. Reporting, response planning and budgeting are all addressed. Students working in teams will prepare an incident response, disaster recovery, or business continuity plan for a real-world organizations such as a business or a government body or agency.

(3-0-3)

Information Technology & Management: Theory and Technology

ITMT 492

Embedded Systems & Reconfigurable Logic Design

This course covers reconfigurable intelligent devices programmed with modern high level languages focusing on design and integration to modern environments. The course will also cover the topic and deployment of wireless sensor networks and the use of rapid prototyping for commercial application. Students will discover hardware, software and firmware design trade-offs as well as best practices in current embedded systems development. A final project will integrate course topics into a system using an embeddable single-board microcontroller.

Prerequisite(s): [(ITM 311) OR (ITM 312)]
(3-0-3)

ITMT 495

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.

(Credit: Variable)

ITMT 514**Enterprise Application Architecture**

This course examines current enterprise application architectures from the perspective of senior technology planners and managers. Topics such as models and patterns of enterprise application architecture, application virtualization, cloud application architectures, integration of custom application infrastructure with major vendor products, and full systems integration issues will be addressed.

Prerequisite(s): [(ITM 411) OR (ITMD 411)]

(3-0-3)

ITMT 531**Object-Oriented System Analysis, Modeling, & 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)

ITMT 533**Operating System Design Implementation**

This course introduces students to the fundamental principles of operating systems design, and gives them hands-on experience with real operating systems installation, design and implementation. The students apply what they learned about operation systems design to practical implementation, by modifying and extending the MINIX Operating System, MS Windows, and LINUX are briefly discussed as case studies.

(3-0-3)

ITMT 535**Data Center Architecture**

The course deals with building integrated data center information infrastructures, including facility, hardware, software, and network components as solutions to particular enterprise information management needs and requirements. Students will learn critical elements of modern data center design including physical plant construction; network infrastructure; data storage technologies; power provisioning and conditioning; environmental controls and HVAC; system and physical security; modular component use; and planning for growth.

(3-0-3)

ITMT 537**Instructional Technologies**

In this course students will create, assess, and deploy current technologies used for K-College instruction and corporate training environments. Topics covered include developing training materials, courses, individualized instruction, websites, multimedia projects, and on-line instruction in educational settings. focus will be given to modern programming environments and models for developing instructional materials.

(3-0-3)

ITMT 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)

ITMT 594**Special Projects in Information Technology**

Special projects.

(Credit: Variable)

ITMT 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.

(Credit: Variable)

ITMT 596**Graduate Honors Studies in Information Technology**

Graduate honors project, thesis or whitepaper. Prerequisites: Graduate honors status and consent of the instructor.

(Credit: Variable)

ITMT 597**Special Problems in Information Technology**

Independent study and project.

(Credit: Variable)

Technology

TECH 580**Topics in the Management of Technology**

This course will cover a particular topic, varying from semester to semester, in which there is particular student or staff interest. This course may be taken more than once but only 9 hours of TECH 580 credit may be applied to a degree.

(Credit: Variable)

TECH 581**Consulting for Technical Professionals**

This course explores the application of technology and technical management skills to working with business, industry, or various professions in solving specific problems for an organization as an internal or external consultant. Students learn how to involve clients in all phases of problem identification and solution with the goal that, at the end of a consulting assignment, the clients are able to sustain the necessary changes in their organization. Particular attention is paid to managing expectations among change agents, managers, executives, technical professionals, and other members of the organization. The course will cover the most critical, high-level, functional frameworks used by top consulting firms today as well as the tools commonly used by consulting professionals.

(3-0-3)

TECH 597**Special Problems in Technology**

Independent study and projects in applied technology that are multi/cross-disciplinary not tied to a specific department.

(Credit: Variable)

Undergraduate Courses Available to Graduate Students as Prerequisites Only

Note: Students may take up to an approved number of the following courses.

ITM 301
Introduction to Contemporary Operating Systems and Hardware I

ITM 302
Introduction to Contemporary Operating Systems and Hardware II

ITM 311
Introduction to Software Development

ITM 312
Introduction to Systems Software Programming

Intellectual Property Management and Markets

Program Director:

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Knowledge and other intellectual assets are increasingly recognized as a driving force of innovation and economic growth. Intellectual property rights are becoming central to the modern economy. IIT's Master of Intellectual Property Management and Markets program (IPMM) was developed to respond to the need for highly qualified professionals for this important and fast-growing area.

The IPPM program provides a foundational understanding of intellectual property that integrates the perspectives and skills of five key disciplines: business, law, engineering, design, and computer science. Courses track the lifecycle of intellectual property from its inception to full exploitation. Graduates of this program will be equipped to take a strategic or leadership role leveraging and managing IP, whether through marketing, research and development, portfolio management, legal protection, or business transactions.

Degree Offered

Master of Intellectual Property Management
and Markets

Degree Requirements

30 credit hours

No thesis is required, but there is a capstone/project course requirement (2 credits). This course is an experiential learning opportunity that integrates the students' newly acquired knowledge, experiences and expertise. Students will create a global intellectual property strategy and plan for a company.

Course Descriptions

IPMM 500

Context/Introduction & Protecting IP

This introduction will address the relatively unique nature of intangible property and the key ways it differs from “brick and mortar” assets. Some historical background on property structures will be covered. The rapid growth of patent, trademark and copyright protection and their importance to the global economy will be explored. Case studies that will be used throughout the program will be introduced. Integrated into the introduction is a survey course that will compare and contrast the four intellectual property regimes – patent, trade secret, trademark and copyright – in the context of their application to business. Topics to be explored include the point at which protection arises, the scope of protection available and the basis for enforcement actions. National and international considerations will be covered. The class will work in teams to identify and define protectable IP. Open only to Intellectual Property Management and Markets majors.

(4-0-4)

IPMM 501

Managing the Creative Process

This course teaches two approaches for innovation: top down and bottom up. The first part of the class will focus on top down innovation, specifically looking at innovation with a corporate, strategic lens. This section will include topics such as patterns of innovation, dominant design, various innovation strategies, as well as organizing for innovation. The second part of the class will focus on bottom up innovation, focused primarily on an approach for developing innovative, user-centered products and services. Students will learn methods for identifying unmet needs and generating new ideas. The intention is to teach students the why (from a corporate point of view, why is innovation critical?) and the how (from a project point of view, how do we create innovations?) of innovation. Open only to Intellectual Property Management and Markets majors.

(3-0-3)

IPMM 502

IAM Methodologies & IP Assessment

This course provides students with the fundamental structures for good intellectual asset management and with examples of the variety of ways in which those structures are implemented in businesses. Core to this study are the variety of techniques for conducting assessments of IP in the marketplace, in the competition, and within the business to determine strengths and vulnerabilities. Students also learn how to determine what IP the organization might need to meet its business strategies, what supporting products and services exist to assist in the management and assessment of IP. The course focuses on the legal, business and technical pros and cons of internal development of IP in the context of the marketplace and the business landscape. Open only to Intellectual Property Management and Markets majors.

(3-0-3)

IPMM 503

Acquiring IP

An in-depth examination of the ways IP may be acquired other than through creation. Topics include: asset purchase; business transactions such as joint ventures and joint development; strategic alliances; licenses; mergers and acquisitions; and patent pooling. Emerging issues such as open sourcing and open innovation will be explored. Antitrust implications of these various business transactions will be covered from a business perspective.

(3-0-3)

IPMM 504

IP & Business Strategy

Business Strategy is about creatively deploying organizational resources, including intellectual property, in order to create a sustainable competitive advantage for the company. In turn, sustainable competitive advantage is the key to long-term profitability of the company. In this course, students will learn about the various tools, concepts and theories of strategy development and execution. In particular, the focus is on the deployment of IP in innovative business strategies that ultimately drive competitive advantage and profitability. From a theoretical standpoint, the discussion will largely revolve around corporate and business unit strategy, aided by interesting case studies that show the use of intellectual property by companies generating competitive advantage. This discussion is supplemented by a computer simulation game called the Blue Ocean Strategy Simulation (BOSS) which helps student understand the process of developing innovative business strategies and implementing them in practice. The total combination of lectures, case studies and the simulation will result in a rich and exciting learning experience for students.

(3-0-3)

IPMM 505

Global IP Management

This is a broad course covering the critical areas of IP portfolio management in a variety of business settings. The course focuses on the role of innovation and intellectual property within the global operation of companies and addresses strategies for global IP coverage, including decisions on when, where and how to seek IP protection on a cost-effective basis. This course will also teach principles of IP portfolio management that affect the operations, planning, knowledge management, and new product/process development of businesses trading internationally. Various scenarios and cases will be discussed, such as technological discontinuities, mergers, divestitures, regulations, nationalization of corporate assets, and reorganizations.

(3-0-3)

IPMM 506

Maximizing IP Value

This is an examination of the methods used to value IP in various settings: IP owned by a business; IP which is the target of acquisition; and IP which has been asserted against a business by a third party IP owner. All of the methods examined will be anchored in a review of applicable regulations and accounting principles. Other topics covered are: securitization and/or monetization of IP with particular focus on IP holding companies and their benefits, liabilities, and challenges; issues of taxation with particular focus on tax efficient means of optimizing IP value; and deployment of and defense against the adversarial assertion of IP by non-practicing entities (also known as “patent trolls”).

(3-0-3)

IPMM 507

Capstone

This course will provide an experiential learning opportunity which brings together and applies the new knowledge, experiences, and expertise derived from the doctrinal classes. Working in teams, students will create an intellectual property strategy and plan for a business or institution which is currently underutilizing its IP assets or facing IP challenges from third parties or competitors. Each team will prepare a written and oral presentation to a panel of experts representing senior management of the business studied.

(2-0-2)

IPMM 508

Facts, Statistics, & Evaluating Data

Modeling of business, financial, and technical information is essential to intelligent risk taking necessary for understanding intellectual property and its economic value. This course provides fundamental understanding of the statistics, modeling tool, and data assessment necessary to construct useful, analytical models for use in the assessment of intellectual property.

(3-0-3)

Chicago-Kent College of Law

565 W. Adams St.
Chicago, IL 60661
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admissions@kentlaw.iit.edu
www.kentlaw.iit.edu

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. The

law school is housed in a 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 U.S. 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 law school 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.)

Doctor of the Science of Law (J.S.D.)

Joint-Degree Programs

J.D./LL.M. in Family Law
J.D./LL.M. in Financial Services Law
J.D./LL.M. in Taxation

With Stuart School of Business:

J.D./M.B.A.
J.D./M.P.A.
J.D./M.S. in Environmental Management and Sustainability
J.D./M.S. in Finance

With University of Illinois at 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.

Business Law
Criminal Litigation
Environmental and Energy Law
Intellectual Property Law

International and Comparative Law
Labor and Employment Law
Litigation and Alternative Dispute Resolution
Praxis Experiential Learning Curriculum
Public Interest Law

Research Centers

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.

Center for Empirical Studies of Intellectual Property

The Center for Empirical Studies of Intellectual Property, the first academic center of its kind in the nation, promotes the application of quantitative and qualitative

social science methods to studying important questions about innovation and creativity.

Center for Information, Society, and Policy

The Center for Information, Society, and Policy is a collaboration among Chicago-Kent public policy experts and IIT technology experts. The Center promotes interdisciplinary research into privacy and information security issues raised by information technologies and social networks. Experts include computer scientists, psychologists, lawyers, business experts, and theorists in systems

design and human/system interfaces. Forming the Center's interdisciplinary task forces, they focus on critical unsolved policy problems to find the appropriate balance of risks and benefits. Emphasis is placed on forging a shared understanding of the problems at hand and a common language with which to discuss and analyze proposed solutions.

Institute for Compliance

The Institute for Compliance promotes careers in financial compliance, trains and prepares students for such careers, increases knowledge of the importance of compli-

ance, and provides various events for the Chicago-based compliance and legal community. It is the first institute of its kind located in a law school.

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 in-

tegrate 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.

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 pro-

fessional community to train students and professionals, monitor policies and trends, and reflect upon major issues in a neutral setting.

Institute for Science, Law and 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 diffi-

cult 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 on the Supreme Court of the United States

The Institute on the Supreme Court of the United States (ISCOTUS) educates internal and external audiences about the Court and its role in our constitutional system of government. ISCOTUS's Academic Center is designed to provide new opportunities that showcase the significant intellectual contributions of Chicago-Kent's faculty and to give students the opportunity to learn

from appellate advocates with experience in the Court and from prominent jurists. The other two main components of ISCOTUS are Oyez[®], a widely used multimedia database devoted to the Court and its work, and the Civic Education Project, which merges ISCOTUS's academic and technological dimensions to promote public education about the Court.

Justice John Paul Stevens Jury Center

Chicago-Kent's Jury Center serves as a clearinghouse for information about the jury to academics, students, judges, lawyers, and members of the press and public. The Center's website provides a centralized resource for jury studies and includes an annotated bibliography with summaries of recent and forthcoming academic articles

on capital juries, comparative jury systems, history of juries, jury behavior, jury selection, and public policy; a collected list of law review symposia on the jury; and links to other jury resources. The Jury Center also undertakes special projects, such as an evaluation of state court websites for prospective jurors.

Research and Training Facilities

Chicago-Kent College of Law Library

The law library contains approximately 500,000 volumes and countless electronic subscriptions to a wide variety of online material. It supports Chicago-Kent College of Law and other IIT graduate programs taught at the Downtown Campus. Areas of collection strength include law, business, and international relations, and the library is a depository for materials from the European Union, the United Nations, and the United States federal government. The library provides both wired and wireless

access to the Internet, seats more than 400 people, and contains 10 group study rooms that may be reserved by IIT students. Seating throughout the library provides access to all of the online research systems, both remote (e.g., LexisNexis, Westlaw, and numerous other subscription databases) 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. 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. Students with laptops can also use network ports available almost everywhere in the building. Every seat in the library and almost every classroom seat has a hardwired computer

node with adjacent power connections. 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 student resources, including online registration and grading systems, are available 24/7 from anywhere with an Internet connection. Faculty members routinely prepare interactive tutorials that can be accessed by students ahead of class.

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 advanced computer and audiovisual technology in a traditional setting.

The Bruce M. Kohen Courtroom

The Bruce M. Kohen Courtroom is a 738-square-foot, state-of-the-art facility that includes two 90-inch television monitors, a Crestron automated lighting control system, and an audiovisual system with three built-in document cameras and four display monitors. Named for Bruce M. Kohen '79, a retired partner of Anesi, Ozmon,

Rodin, Novak, & Kohen Ltd. in Chicago, the Kohen Courtroom provides a realistic courtroom atmosphere for classroom instruction and for competition practice by students on the law school's trial advocacy and moot court teams.

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.

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 more than a dozen full-time attorneys and serves more than 1,000 clients each year. Students who intern in the law offices have the opportunity to work on cases in a wide variety of clinical practice areas—civil practice, criminal law, entrepreneurial law, environmental law, family law, health and disability law, immigration law, intellectual property law, mediation, open government/government watchdog law (Center for Open Government), and tax law—under the supervision of a clinical professor. Other skills training opportunities are

available through the Judicial and Legal Externship programs. Students in the Judicial Externship Program are placed with participating judges in the federal district, appellate, and bankruptcy courts, and in Illinois state courts at all levels. 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 Legal Externship Program work with teaching attorneys in a wide range of government and private practice settings.

Faculty

Visit the Chicago-Kent website for detailed faculty biographies (www.kentlaw.iit.edu/faculty).

Adams, Susan J., 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.

Andrews, Lori B., Distinguished Professor of Law and Director of the Institute for Science, Law and Technology. B.A., Yale College; J.D., Yale Law School.

Atuahene, Bernadette, Professor of Law. B.A., University of California-Los Angeles; M.P.A., Harvard University; J.D., Yale Law School.

Bailey, Kimberly D., Associate Professor of Law. B.A., Indiana University-Bloomington; J.D., University of Michigan Law School.

Baker, Katharine K., Professor of Law. B.A., Harvard-Radcliffe College; J.D., University of Chicago Law School.

Batlan, Felice, Professor of Law, Director of the Institute for Compliance, and Co-Director of the Institute for Law and the Humanities. B.A., Smith College; J.D., Harvard Law School; Ph.D., New York University.

Birdthistle, William A., Professor of Law. B.A., Duke University; J.D., Harvard Law School.

Boni-Saenz, Alexander A., Assistant Professor of Law. A.B., Harvard College; M.Sc., London School of Economics; J.D., Harvard Law School.

Brill, Ralph L., Professor of Law. A.B., J.D., University of Illinois, Urbana-Champaign.

Brody, Evelyn, Professor of Law. B.A., Yale University; J.D., Georgetown University Law Center.

Brown, Bartram S., Professor of Law and Co-Director of the Program in International and Comparative Law. B.A., Harvard University; J.D., Columbia Law School; Ph.D., Graduate Institute of International Studies (Switzerland).

Brown, Gerald, Clinical Professor of Law and Director of the Graduate Program in Taxation. B.S.C., DePaul University; J.D., University of Chicago.

Buccafusco, Christopher J., Associate Professor of Law and Co-Director of the Center for Empirical Studies of Intellectual Property. B.S., Georgia Institute of Technology; J.D., University of Georgia School of Law.

Chapman, Howard S., Professor of Law and Director of the Program in Business Law. B.S., J.D., University of Illinois, Urbana-Champaign.

Cho, Sungjoon, Professor of Law. LL.B., M.P.A., Seoul National University (Korea); LL.M., University of Michigan Law School; S.J.D., Harvard Law School.

Collens, Lewis M., President Emeritus of Illinois Institute of Technology and Professor of Law Emeritus. B.A., M.A., University of Illinois, Urbana-Champaign; J.D., University of Chicago.

Conviser, Richard J., Professor of Law. B.A., J.D., University of California-Berkeley; Dr. Jur., University of Cologne (Germany).

Coyne, Daniel T., Clinical Professor of Law. B.A., University of Illinois-Chicago; J.D., The John Marshall Law School.

De Armond, Elizabeth, Professor of Legal Research and Writing, Director of the Legal Research and Writing Program, and Director of Writing Services. B.S., Georgia Institute of Technology; J.D., University of Notre Dame Law School; LL.M., Harvard Law School.

de Freitas, Rhonda E., Clinical Assistant Professor of Law. B.A., Florida International University; J.D., Loyola University of Chicago School of Law.

Decatorsmith, Jonathan P., Clinical Assistant Professor of Law. B.A., University of Illinois, Urbana-Champaign; J.D., University of Colorado Law School.

Eglit, Howard C., Professor of Law. B.A., University of Michigan; J.D., University of Chicago Law School.

Ehrenberg, Suzanne, Professor of Legal Research and Writing. B.A., Williams College; J.D., University of Chicago Law School.

Erickson, Hon. David A., Senior Instructor of Law, Director of the Trial Advocacy Program, and Director of the Program in Criminal Litigation. B.A., Northern Illinois University; J.D., The John Marshall Law School.

Gerber, David J., 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 Law School.

Godfrey, Douglas W., Professor of Legal Research and Writing. B.A., M.A., University of Illinois, Urbana-Champaign; J.D., University of Michigan Law School.

Goldman, Jerry, Research Professor of Law and Director of the Oyez Project. A.B., M.A., Brooklyn College; Ph.D., Johns Hopkins University.

Gonzalez, Richard J., Clinical Professor of Law. B.A., Northwestern University; J.D., Ohio State University College of Law.

Greenberg, Sanford N., Professor of Legal Research and Writing. A.B., Princeton University; J.D., George Washington University Law School; M.A., Ph.D., University of California-Berkeley.

Gross, Vivien C., Clinical Professor of Law. B.A., Northwestern University; M.A., University of Illinois, Urbana-Champaign; J.D., Indiana University School of Law-Bloomington.

Hablutzel, Philip N., Professor of Law and Director of the Institute of Illinois Business Law. B.A., Louisiana State University; M.A., J.D., University of Chicago.

Harding, Sarah K., Associate Professor of Law and Associate Dean for Faculty. B.A., McGill University (Canada); LL.B., Dalhousie Law School (Canada); B.C.L., Oxford University (England); LL.M., Yale Law School.

Harpalani, Vinay, Visiting Assistant Professor of Law. B.A., University of Delaware; M.S., Master of Bioethics, Ph.D., University of Pennsylvania; J.D., New York University School of Law.

Harper, Heather F., Clinical Assistant Professor of Law. B.A., Northwestern University; J.D., Boston College Law School.

Harris, Edward C., Associate Professor of Legal Writing and Assistant Dean for Intellectual LL.M. Programs. B.A., Loyola University-Chicago; J.D., IIT Chicago-Kent College of Law.

Harris, Steven L., Professor of Law. B.A., J.D., University of Chicago.

Haugh, Todd, Visiting Assistant Professor of Law. B.A., Brown University; J.D., University of Illinois College of Law.

Heyman, Steven J., Professor of Law. A.B., Harvard College; J.D., Harvard Law School.

Johnson, Kari L. Aamot, Professor of Legal Research and Writing. B.A., St. Olaf College; J.D., University of Minnesota Law School.

Keller, Cherish M., Assistant Professor of Legal Research and Writing for LL.M. Programs. B.S., University of Illinois, Urbana-Champaign; J.D., IIT Chicago-Kent College of Law.

Kentra, Pamela A., Clinical Professor of Law. B.A., University of Illinois, Urbana-Champaign; J.D., IIT Chicago-Kent College of Law.

Kling, Richard S., Clinical Professor of Law. B.A., University of Illinois-Chicago; J.D., Northwestern University School of Law.

Koch, Valerie Gutmann, Visiting Assistant Professor of Law. A.B., Princeton University; J.D., Harvard Law School.

Kraus, Edward, Clinical Professor of Law. B.A., University of Michigan; J.D., Georgetown University Law Center.

Krent, Harold J., Professor of Law and Dean, IIT Chicago-Kent College of Law. A.B., Princeton University; J.D., New York University School of Law.

Laser, Gary S., Associate Professor of Law, Director of Clinical Education, and Co-Director of the Program in Criminal Litigation. B.B.A., J.D., University of Miami.

Leader, Laurie E., Clinical Professor of Law. A.B., Washington University; J.D., Cleveland-Marshall College of Law.

Lee, Edward, Professor of Law and Director of the Program in Intellectual Property Law. B.A., Williams College; J.D., Harvard Law School.

Malin, Martin H., Professor of Law and Director of the Institute for Law and the Workplace. B.A., Michigan State University; J.D., George Washington University Law School.

Marder, Nancy S., Professor of Law, Director of the Justice John Paul Stevens Jury Center, and Co-Director of the Institute for Law and the Humanities. B.A., Yale University; M.Phil., University of Cambridge; J.D., Yale Law School.

Mencini, Ana Mendez, Clinical Assistant Professor of Law. B.A., Lake Forest College; M.A., DePaul University; J.D., IIT Chicago-Kent College of Law.

Munsterman, Herbert F., Lecturer of Law, Director of the Intellectual Property Management and Markets Program, and Director, Intellectual Property. B.S., Iowa State University; M.S., Northwestern University; J.D., Drake University Law School.

Nahmod, Sheldon H., Distinguished Professor of Law. A.B., A.M.R.S., University of Chicago; LL.B., LL.M., Harvard Law School.

Perritt, Henry H., Jr., Professor of Law and Director of the Graduate Program in Financial Services Law. S.B., S.M., Massachusetts Institute of Technology; J.D., Georgetown University Law Center.

Piatt, Mickie A., Associate Professor of Law and Deputy Director of the Program in Intellectual Property Law. B.A., M.L.S., J.D., University of Texas-Austin.

Rosado Marzán, César F., Assistant Professor of Law. B.A., Haverford College; M.A., Ph.D., Princeton University; J.D., University of Pennsylvania Law School.

Rosen, Mark D., Professor of Law. B.A., Yale College; J.D., Harvard Law School.

Ross-Jackson, Marsha L., Lecturer of Law, Assistant Dean for Student Professional Development, and Executive Director of the Institute for Law and the Workplace. B.A., Hampton University; M.P.A., Roosevelt University J.D., DePaul University College of Law.

Rudstein, David S., Professor of Law and Co-Director of the Program in Criminal Litigation. B.S., LL.M., University of Illinois, Urbana-Champaign; J.D., Northwestern University School of Law.

Schmidt, Christopher W., Associate Professor of Law and Director of the Institute on the Supreme Court of the United States (ISCOTUS). B.A., Dartmouth College; M.A., Ph.D., Harvard University; J.D., Harvard Law School.

Schwartz, David L., Professor of Law and Co-Director of the Center for Empirical Studies of Intellectual Property. B.S., University of Illinois, Urbana-Champaign; J.D., University of Michigan Law School.

Shapiro, Carolyn, Associate Professor of Law (on leave). B.A., University of Chicago; M.A., University of Chicago Harris Graduate School of Public Policy; J.D., University of Chicago Law School.

Sherman, Jeffrey G., Professor of Law Emeritus. A.B., J.D., Harvard University.

Sowle, Stephen D., Senior Lecturer of Law and Assistant Dean for Academic Administration and Student Affairs. B.A., Williams College; J.D., Yale Law School.

Spak, Michael I., Professor of Law. B.S., J.D., DePaul University; LL.M., Northwestern University School of Law.

Staudt, Ronald W., Professor of Law and Director of the Center for Access to Justice and Technology. B.S., B.A., St. Joseph's College; J.D., University of Chicago Law School.

Steinman, Joan E., Distinguished Professor of Law. A.B., University of Rochester; J.D., Harvard Law School.

Stern, Stephanie M., Professor of Law. B.A., Brown University; J.D., Yale Law School.

Stewart, Margaret G., Professor of Law Emeritus. B.A., Kalamazoo College; J.D., Northwestern University School of Law.

Stiverson, Keith Ann, Senior Lecturer of Law and Director, IIT Chicago-Kent College of Law Library. B.S., Rio Grande College; M.S.L.S., Catholic University of America; J.D., Georgetown University Law Center.

Streseman, Kent D., Clinical 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.

Strubbe, Mary Rose, Professor of Legal Research and Writing and Assistant Director of the Institute for Law and the Workplace. B.A., Mundelein College; J.D., IIT Chicago-Kent College of Law.

Sudendorf, Patricia M., Instructor of Law and Director of the LL.M. Program in Trial Advocacy for Internationals. B.A., Loyola University; J.D., Loyola University School of Law.

Tarlock, A. Dan, Distinguished Professor of Law and Director of the Program in Environmental and Energy Law. A.B., LL.B., Stanford University.

Walters, Adrian J., Ralph L. Brill Professor of Law. B.A., University of Cambridge (England); Graduate Diploma in Law, Nottingham Polytechnic (England).

Warner, Richard, 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.

Wright, Richard W., Distinguished Professor of Law. B.S., California Institute of Technology; J.D., Loyola University of Los Angeles; LL.M., Harvard Law School.

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 LSAC Credential 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 website at www.kentlaw.iit.edu/admissions.

Juris Doctor (J.D.)

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, but incoming first-year evening students may take one course during the summer semester before their first year. 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, but full-time students participating in the 1L Your Way program may defer Legislation until the second year in favor of taking an approved elective or special clinical rotation during the spring term. 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.

Master of Laws (LL.M.)

Chicago-Kent offers Master of Laws (LL.M.) degree programs in family law; financial services law; international intellectual property law; taxation; trial advocacy; and U.S., international, and transnational 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.

degree programs in financial services law; international intellectual property law; trial advocacy; and U.S., international, and transnational law are offered to foreign attorneys. Chicago-Kent also offers combined J.D./LL.M. degree programs in taxation, family law, and financial services law, which enable students to earn both degrees after seven semesters of full-time residence, instead of eight.

Doctor of the Science of Law (J.S.D.)

The J.S.D. degree is Chicago-Kent's most advanced degree, designed primarily for those who are interested in sustained independent legal research and writing with the ultimate goal of pursuing a career in legal academics. The basic aim of the program is to provide opportunity and encouragement for distinguished scholarship through ad-

vanced coursework, seminars, colloquia, and independent research, under the advice and guidance of members of the Chicago-Kent faculty. To earn the degree, candidates are required to submit a dissertation and to pass an oral defense of the dissertation within five years of enrollment in the program.

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./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 offers both full- and part-time stu-

dents 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./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./M.B.A.

A joint-degree J.D./M.B.A. program in conjunction with IIT 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 worlds.

J.D./M.S. in Environmental Management and Sustainability

The law school offers a joint J.D./M.S. in Environmental Management and Sustainability degree program in conjunction with IIT Stuart School of Business. The Environmental Management Program is a unique multidisciplinary program integrating engineering, law, and busi-

ness management to answer the increasing demand for management-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./M.S. in Finance

The law school, in conjunction with IIT Stuart School of Business, offers a joint-degree J.D./M.S. in Finance. 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./M.P.A.

The law school offers a joint-degree J.D./M.P.A. in conjunction with IIT Stuart School of Business. This pro-

gram explores practices and policies in the public sector.

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 contemporary issues at the intersection of public health, law, and medicine. Students in the joint-degree program acquire legal tools to

help solve pressing public health problems, learn how to impact public policymakers, explore and understand the empirical assumptions about public health that drive legal decision-making, and discover how emerging medical technologies and new healthcare delivery mechanisms 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.

Business Law

The Business Law Certificate Program allows students to explore a broad range of business-related topics to build legal careers representing small and large businesses and corporations. Graduates have a solid understanding of the basic principles of business and commercial law and are familiar with the increasingly complex regulatory environment that business lawyers commonly encounter in practice. The curriculum includes traditional subjects such as business organizations, securities regulation, and taxation. It also allows students to focus on individ-

ual interests by including an extensive array of elective courses such as E-Commerce, International Capital Markets, Employment Relationships, and Futures Regulation. The program requires a total of 24 credit hours emphasizing both theory and practice. Students must take three required courses, two courses from a list of core courses, additional courses from a list of elective courses, and a specialized legal writing course, and must complete an experiential requirement.

Criminal Litigation

Chicago-Kent's Program in Criminal Litigation is designed to give students a comprehensive and balanced professional education to prepare them for the practice of criminal law. To earn the certificate, students must complete 24 credit hours of coursework from an approved

curriculum. With emphases on both theory and practical skills development, the certificate program represents an opportunity to synthesize the goals of Chicago-Kent's academic program in criminal law with those of the Trial Advocacy Program and the Chicago-Kent Law Offices.

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 theoretical underpinnings of environmentalism. The program attracts students from a wide range of professions. A highly regarded faculty teaches a carefully considered

curriculum 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 intersects with technology, science, and the arts to protect their clients' creative products. The field of intellectual property 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 writ-

ing courses and develop litigation skills by participating in moot court competitions. The program encourages scholarship and discourse among academics, practitioners, and students with events like the Chicago Intellectual Property Colloquium. Students complete 20 credit hours of approved coursework, including courses in patent law, copyright law, and trademark and unfair competition 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 coursework 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 2-credit 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 an additional labor/employment elective. 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 evidence, pretrial litigation, trial advocacy, a judicial externship, and litigation and ADR clinical offerings. 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, immigration, and tax law.

Praxis Program

The Praxis Program is designed for students who want to fully embrace a practice- or experience-based course of study. The curriculum capitalizes on the law school's already robust hands-on learning offerings to guide participants through an individualized course of study designed to provide exposure to the core competencies required of successful lawyers. Participating students must complete

the course Practice and Professionalism, take 24 credits of experiential or skills-based coursework, create a professional online portfolio, and satisfy a list of required core experiences drawn from a list of practice-based competencies. Students enrolled in the Praxis Program may concurrently enroll in an additional, subject-matter certificate program offered by Chicago-Kent.

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 as a career 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 that satisfy individual career and interest objectives.

Each student also meets 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 Chicago-Kent 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 remains 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 website for detailed information about faculty (www.kentlaw.iit.edu/faculty) and courses

(www.kentlaw.iit.edu/course-descriptions).

Department of Mathematics and Science Education

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Chair:
TBD

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 6-12). The department offers Professional

Master's, Master of Science, and Ph.D. degrees in mathematics 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 designs, 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
Doctor of Philosophy in Collegiate Mathematics Education

Research Areas

Research areas include informal science/math education, curriculum development, integration of science/math disciplines and across disciplines, and instructional meth-

ods; students and teachers' conceptions of scientific/mathematic inquiry and nature of science/math, instructional models, evaluation, and research design.

Faculty

Lederman, Judith S., Associate Professor of Mathematics and Science Education and Director of Teacher Education. B.A., Rhode Island College; M.S., Worcester Polytechnic Institute; Ph.D., Curtin University of Technology (Australia). Informal science education, curriculum development, integration of science disciplines and across disciplines, and instructional methods.

Lederman, Norman G., Distinguished Professor of Mathematics and Science Education. B.S., M.S. Bradley University; M.S., New York University; Ph.D., Syracuse University. Students' and teachers' conceptions of scientific inquiry and nature of science, instructional models, evaluation, and research design.

Popovic, Gorjana, Senior Instructor of Mathematics and Science Education. B.S., University of Belgrade (Serbia); M.S., Ph.D., Illinois Institute of Technology.

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. applicants:

900 (quantitative + verbal) 2.5 (analytical writing)

GRE score minimum for Ph.D. applicants:

1000 (quantitative + verbal) 3.0 (analytical writing)

TOEFL minimum 600/250/80* 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/internet-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 program 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

MSED 501 Advanced Strategies: Mathematics

MSED 540 Informal Education Practicum

MSED 550 Clinical Supervision in
Science/Mathematics

MSED 552 Assessment and Evaluation

OR

MSED 560 Research and Evaluation

MSED 555 Middle and Secondary Level Mathematics
Curriculum

MSED 580 Adolescent Psychology

Master of Science Thesis Option (6 credit hours)

MSED 591 Research and Thesis

Professional Master's Non-Thesis Option (3 credit hours)

MSED 538 Inquiry and Problem Solving

And a minimum of three credit hours from the following:

MSED 531 Teacher Education/Professional
Development in Mathematics

MSED 562 Action Research I

MSED 571 Problem Solving and Nature of Mathematics

AND nine credits of select coursework from discipline-specific mathematics courses

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

MSED 502 Advanced Strategies: Science

MSED 540 Informal Education Practicum

MSED 550 Clinical Supervision in
Science/Mathematics

MSED 552 Assessment and Evaluation

OR

MSED 560 Research and Evaluation

MSED 554 Middle and Secondary Level Science
Curriculum

MSED 580 Adolescent Psychology

Master of Science Thesis Option (6 credit hours)

MSED 591 Research and Thesis

Professional Master's Non-Thesis Option: (3 credit hours)

MSED 538 Inquiry and Problem Solving

And a minimum of three credit hours from the following:

MSED 530 Teacher Education/Professional
Development in Science

MSED 562 Action Research I

MSED 570 Inquiry and Nature of Science

AND nine credits of select coursework from discipline-specific science courses.

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 bachelor's degree (preferably in an area of science or mathematics) and wish to pursue both a teaching certification and a master's degree. This accelerated course of study allows the student to achieve certification and a master's degree in just 45 credit hours, instead of the 54 credit hours that would be required if certification and master's degree were pursued separately.

Required Courses

MSED 300 Instructional Methods/Strategies I

MSED 400 Instructional Methods/Strategies II

MSED 450 Professional Internship (6 credit hours)

MSED 500 Analysis of Classrooms II (Practicum and
Seminar)

MSED 501/502 Advanced Strategies: Mathematics/Science

MSED 538 Inquiry and Problem Solving

MSED 540 Informal Education Practicum

MSED 550 Clinical Supervision
in Science/Mathematics

MSED 552 Assessment and Evaluation

MSED 554/555 Middle and Secondary Level Science/
Mathematics Curriculum

MSED 580 Adolescent Psychology

AND nine credits from graduate level science/mathematics courses.

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 five position statements (ranked by faculty)

Top three ranked must be defended orally and in writing.

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.

Required Courses (30 credit hours)

MSED 545 Statistics for Educators I

MSED 546 Statistics for Educators II

MSED 550 Clinical Supervision in Science/Mathematics

MSED 552 Assessment and Evaluation

MSED 555 Middle and Secondary Level Mathematics Curriculum

MSED 580 Adolescent Psychology

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

Electives (minimum of nine credit hours)

MSED 501 Advanced Strategies: Mathematics

MSED 531 Teacher Education/Professional Development in Mathematics

MSED 538 Inquiry and Problem Solving

MSED 540 Informal Education Practicum

MSED 560 Research and Evaluation

MSED 562 Action Research I

MSED 571 Problem Solving and Nature of Mathematics

MSED 594 Special Projects (Independent Studies within MSED)

MSED 597 Special Problems

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 credit hours)

Total minimum credits: 84 credit hours

42 maximum transfer of graduate credits from master's (24 credits from coursework/eight credits from research)

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 five position statements (ranked by faculty)

Top three ranked must be defended orally and in writing.

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 (30 credit hours)

- MSED 545 Statistics for Educators I
- MSED 546 Statistics for Educators II
- MSED 550 Clinical Supervision in Science/Mathematics
- MSED 552 Assessment and Evaluation
- MSED 554 Middle and Secondary Level Science Curriculum
- MSED 580 Adolescent Psychology
- 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

Electives (minimum of nine credit hours)

- MSED 502 Advanced Strategies: Science
- MSED 530 Teacher Education/Professional Development in Science
- MSED 538 Inquiry and Problem Solving
- MSED 540 Informal Education Practicum
- MSED 562 Action Research I
- MSED 570 Inquiry and Nature of Science
- MSED 594 Special Projects (Independent Studies within MSED)
- MSED 597 Special Problems

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 credit hours)

Total minimum credits: 84 credit hours

42 maximum transfer of graduate credits from master's (24 credits from coursework/eight credits from research)

Doctor of Philosophy in Collegiate Mathematics Education

85 credit hours beyond the bachelor's degree*

Qualifying exam

Comprehensive exam

Dissertation and Defense

This joint Ph.D. program is offered through the collaboration of the departments of Applied Mathematics (AM) and Mathematics and Science Education (MSED). The objective of the program is to provide advanced education in the teaching and learning of collegiate mathematics through coursework and original research. These advanced studies will enable graduates to teach a wide range of college level mathematics courses, conduct theoretical and practical research on collegiate mathematics teaching and learning, or develop and evaluate college mathematics curriculum.

AM Core Requirements (18 credit hours)

MATH 476 Statistics

MATH 500 Applied Analysis I

MATH 515 Ordinary Differential Equations and Dynamical Systems

MATH 532 Linear Algebra

MATH 553 Discrete Applied Mathematics I

MATH 577 Computational Mathematics I

MSED Core Requirements (18 credit hours)

MSED 598 Methods of College Teaching in Mathematics and Science

MSED 599 College Teaching Practicum

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

AM Electives (minimum of 12 credit hours)

MATH 402 Complex Analysis

MATH 420 Geometry

MATH 475 Probability

MATH 5xy (any 500-level AM courses)

MSED Electives (minimum of 9 credit hours)

MSED 501 Advanced Strategies: Mathematics

MSED 550 Clinical Supervision in Science/Mathematics

MSED 552 Assessment and Evaluation

MSED 555 Middle and Secondary Level Mathematics Curriculum

MSED 571 Problem Solving and Nature of Mathematics

The qualifying exam is fulfilled by achieving better than a 3.5/4.0 GPA on the MATH 476, MATH 500, MATH 553, and MATH 577 AM core courses and a 3.5/4.0

GPA on the MSED 601, MSED 602, MSED 603, and MSED 604 MSED core courses and passing an oral examination within the first five semesters of Ph.D. study. The oral exam consists of two one-hour parts covering AM and MSED core courses respectively. For the AM part, the candidate selects any two out of the four above-mentioned AM core courses plus another AM core course to be tested on during the oral exam. For the MSED part, the candidate proposes five position statements ranked by the faculty. The MSED oral exam is composed of the two position statements with the highest rankings. Position Statement 1: Written defense to support position with empirical research. Position Statement 2: Oral defense.

The comprehensive exam 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.

A minimum of 25 hours should be devoted to thesis research (CMED 691). The dissertation is expected to contain a distinct and substantial, original and publishable contribution to the field of study. An oral examination in defense of the thesis constitutes completion of the degree.

(*) 32 credits maximum transfer from master's coursework; 42 maximum transfer of graduate coursework credits; the number of subjects allowed for transfer credit depends on what subject have been recently taken and is decided on a case-by-case basis

Admission Criteria: Admission to the joint Ph.D. program in collegiate mathematics education requires:

- A master's or bachelor's Degree in mathematics or applied mathematics. Candidates whose degree is in another related field (such as, computer science, physics, or engineering) and whose background in mathematics is strong are also eligible for admission and are encouraged to apply.
- GRE score 1100 (quantitative and verbal), 3.0 (analytical)
- TOEFL (minimum score of 600 for paper-based, 250 for computer-based, and 100 for internet-based test) if from non-English speaking country
- A minimum GPA of 3.0/4.0 is required
- Professional statement of goals/objectives (2 pages)
- Vita
- Three letters of recommendation
- An interview may be required

Course Descriptions

Numbers in parentheses indicate class, lab and total credit hours, respectively.

MSED 500

Analysis of Classrooms II (Practicum & Seminar)

This course includes a two-hour seminar on campus each week along with approximately five hours per week in an area school. This is an introductory course that provides students background learning theory, classroom management, aspects of effective teaching, critical classroom variables, and the school as a system.

(3-0-3)

MSED 501

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 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 509

Instructional Strategies for Middle School Mathematics

This course addresses concerns of teaching grades 5 through 8 math by considering the social and psychological characteristics of students in transition from elementary to high school mathematics. The course uses a focus on rational number and reasoning (topics that span middle school curriculum) to study students' development of powerful representational systems and conceptual flexibility. Participants will learn about building mathematical community in which students construct mathematical evidence for claims of perceived regularities and patterns on logical reasoning and mathematical thinking. Participants will select, adapt, and design math tasks to serve instructional purposes and will learn what it means to build an ongoing assessment system that integrates self, peer, teacher, and formative/summative assessment into best practice.

(3-0-3)

MSED 510

Problem Based Algebra

Algebra is taught via a problem solving approach with connections to other topic areas such as geometry, statistics and probability. Explorations with and conjecturing about number relationships and functions provide experiences from which students develop algebraic habits of mind: Doing and undoing (algebraic thinking that involves reflective or reverse algebraic reasoning, doing problems and organizing data to representation situations in which input is related to output by well-defined functional rules); and abstracting from computation (developing the capacity to think about computations independently of particular numbers used). Instructor permission required.

(3-0-3)

MSED 511

Problem Based Number Theory

Number theory is taught via a problem solving approach with connections to geometry, logic, and probability. Explorations with and conjecturing about number patterns provide experiences from which students study various topics including the following: factors, primes, and prime factorization; counting techniques; greatest common factor (GCF) and least common multiple (LCM); divisibility; number patterns (e.g., Pascal's triangle, polygonal numbers, Pythagorean triples, Fibonacci numbers); Diophantine equations; remainder classes and modular arithmetic; iteration, recursion, and mathematical induction. Basic algebra and instructor permission required.

(3-0-3)

MSED 512

Philosophy of Science: Key Topics & Applications to K-12 Science Education

This course presents fundamental topics and key issues from philosophy of science (e.g., explanation, representation/models, evidence, laws and causation, confirmation/inductive logic, etc.). The goal of the course is to enrich teachers' understanding of philosophy of science so that they will be better prepared to design instructions both about science content and about NOS and NOSI. To achieve this, each course is explicitly linked to particular subject matter and concepts and/or NOS or NOSI ideas. Teachers will be facilitated to see why and how philosophy of science can inform science instruction.

(3-0-3)

MSED 513

Problem Based Statistics & Probability

This course emphasizes statistics and probability as practical subjects devoted to obtaining and processing data with a view toward making statements that often extend beyond the data. These statements (i.e., inferences) take the form of estimates, confidence intervals, significance tests, etc. The content of this course is concerned with the production of good data, and involves consideration of experimental designs and sample surveys. The activities have their origin in real data and are concerned with processing the data in the widest contexts and with a wide variety of applications such as social, administrative, medical, the physical sciences and the biological sciences. Basic Algebra and Instructor permission required.

(3-0-3)

MSED 514

Problem-Based Geometry

Geometry is taught via problem solving with connections to other topic areas such as algebra and number theory. Explorations of and conjecturing about fundamental concepts of Euclidean geometry in two and three dimensions and their application provide experiences from which students study various topics including the following: properties and relationships of geometric objects; geometric proof; area and volume; transformations, symmetry, and tessellations; trigonometric ratios; and visual modeling of algebraic operations as well as algebraic abstract concepts.

(3-0-3)

MSED 515

Physical Science Research Practicum I

The purpose of this course is to provide a comprehensive, immerse experience in scientific research for current and prospective K-12 science teachers. It is intended as the first in a two course sequence. In this course, students will begin by having a module covering key concepts in the sociology of science. The bulk of student work will be to participate in a laboratory placement. **Prerequisite:** Admission into Physical Science Initiative Cohort program, or approval of the instructor. (0-0-3)

MSED 516

Phys Sci Research Practicum II

The purpose of this course is to provide a comprehensive, immerse experience in scientific research for current and prospective K-12 science teachers. It is intended as the second in a two-course sequence. In this course, students will focus on making connections between the content of their research setting and the K-12 curriculum. The bulk of student work will be to participate in a laboratory placement. (0-0-3)

MSED 517

Problem-Based Calculus

This course is focused on the development of foundational ideas, concepts, and methods of introductory calculus and its basic applications with emphasis on various problem-solving strategies, visualization, mathematical modeling, and connections to algebra, geometry, number theory, and logic relevant to the middle school mathematics curriculum. Explorations with the SimCalc software and conjecturing about linking graphs, tables, and concrete to represent dynamic situations provide experiences from which students study various topics including the following: linear, quadratic, cubic, exponential, logarithmic, and trigonometric functions and their graphs; limits and continuity; rate of change, slope, tangent, and derivative; area under a curve and integration; and elements of infinite series.

Prerequisite(s): [(MSED 320) OR (MSED 514) OR (MSED 520)] AND [(MSED 510)] (3-0-3)

MSED 518

History of Science: Key Episodes, Topics, & Applications to K-12 Science Education

This course presents fundamental topics and key issues from history of science (the organization of science, science and religion, science and technology, scientific revolutions, etc.). The goal of the course is to enrich teachers' understanding of history of science so that they will be better prepared to design instructions both about science content and about NOS and NOSI. To achieve this, each course is explicitly linked to particular subject matter and concepts and/or NOS or NOSI ideas. Teachers will be facilitated to see why and how history of science can inform science instruction. (3-0-3)

MSED 520

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. Instructor permission required. (3-0-3)

MSED 521

Perspectives in Analysis

This course is focused on selected topics related to fundamental concepts and methods of classic analysis and their applications with emphasis on various problem-solving strategies, visualization, mathematical modeling, and interrelation of different areas of mathematics. Instructor permission required. (3-0-3)

MSED 523

Expedition Green – Environmental Science

The course is designed to prepare teachers to teach environmental processes and systems, an understanding of environmental issues, personal and civic responsibility, and critical thinking skills. Teachers will increase their knowledge of ecology, ecosystems, resource management, and sustainability. Each class explores how these environmental science topics can be brought back into the classroom using a variety of pedagogical skills and engaging activities. The Expedition Green course models the use of inquiry based, hands-on teaching methods as well as the multiple ways that an informal institution, such as the Museum of Science and Industry, can be used to enhance school curricula. This course meets during the academic year, six sessions, 8:00 a.m. to 3:00 p.m. (3-3-3)

MSED 524

Get Energized – Physical Science

Get Energized is designed to help teachers become more proficient in key physical science concepts related to energy. Teachers can increase their comfort level in teaching energy related topics such as light, mechanical, heat, sound, and electrical. Each full-day workshop focuses on a particular energy topic and explores how that topic can be brought back to the classroom in an engaging way. This program also explores how to further the interaction of inquiry-based teaching methods into the classroom as well as the multiple ways that an informal institution can be used to further the curriculum objectives established. Major topics include energy transformation, potential and kinetic energy, mechanical energy, electrical energy, sound, and thermal. The course meets during the academic year, six sessions, 8:00 a.m. to 3:00 p.m. (3-3-3)

MSED 525

All About You – Life Science

All About You focuses on life science, particularly the science of the human body. The teacher professional development series is designed to help teachers learn to utilize inquiry-based and hands-on/minds-on science curriculum both within and outside of the classroom setting. Through this intensive and engaging year-long program, the workshops focus on expanding science teachers' capacity by building their content knowledge and enhancing their instructional practice. Aside from this program being broad based and interdisciplinary, this program explores how to further the interaction of inquiry-based teaching methods into the classroom as well as the multiple ways that an informal institution, such as the Museum of Science and Industry, can be used to further the curriculum objectives established. Major topics include cells, tissues and organs, genetics and evolution, body systems, health and wellness. The course meets during the academic year, six sessions, 8:00 a.m. to 3:00 p.m. (3-3-3)

MSED 526

Great Lakes Rock – Earth Science

In Great Lakes Rock, late elementary and middle school teachers will increase their knowledge of earth systems science concepts and principles, especially those related to climate change and phenomena in the Great Lakes region. Teachers will discuss science content and practice inquiry-based classroom activities that address the following key topics: earth systems; great lakes ecosystems; and life and the environment.

(3-3-3)

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 533

Expedition Green – Environmental Science

The course is designed to prepare teachers to teach environmental processes and systems, an understanding of environmental issues, personal and civic responsibility, and critical thinking skills. Teachers will increase their knowledge of ecology, ecosystems, resource management, and sustainability. Each class explores how these environmental science topics can be brought back into the classroom using a variety of pedagogical skills and engaging activities. The Expedition Green course models the use of inquiry based, hands-on teaching methods as well as the multiple ways that an informal institution, such as the Museum of Science and Industry, can be used to enhance school curricula. This course is a continuation of MSED 523.

(3-0-3)

MSED 534

Get Energized – Physical Science

Get Energized is designed to help teachers become more proficient in key physical science concepts related to energy. Teachers can increase their comfort level in teaching energy related topics such as light, mechanical, heat, sound, and electrical. Each full-day workshop focuses on a particular energy topic and explores how that topic can be brought back to the classroom in an engaging way. This program also explores how to further the interaction of inquiry-based teaching methods into the classroom as well as the multiple ways that an informal institution can be used to further the curriculum objectives established. Major topics include energy transformation, potential and kinetic energy, mechanical energy, electrical energy, sound, and thermal. This course is a continuation of MSED 524.

(3-0-3)

MSED 535

All About You – Life Science

All About You focuses on life science, particularly the science of the human body. The teacher professional development series is designed to help teachers learn to utilize inquiry-based and hands-on/minds-on science curriculum both within and outside of the classroom setting. Through this intensive and engaging year-long program, the workshops focus on expanding science teachers' capacity by building their content knowledge and enhancing their instructional practice. Aside from this program being broad based and interdisciplinary, this program explores how to further the interaction of inquiry-based teaching methods into the classroom as well as the multiple ways that an informal institution, such as the Museum of Science and Industry, can be used to further the curriculum objectives established. Major topics include cells, tissues and organs, genetics and evolution, body systems, health and wellness. This course is a continuation of MSED 525.

(3-0-3)

MSED 536

Great Lakes Rock – Earth Science

In Great Lakes Rock, late elementary and middle school teachers will increase their knowledge of earth systems science concepts and principles, especially those related to climate change and phenomena in the Great Lakes region. Teachers will discuss science content and practice inquiry-based classroom activities that address the following key topics: earth systems; great lakes ecosystems; and life and the environment. This course is a continuation of MSED 526.

(3-0-3)

MSED 538

Inquiry & Problem Solving

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 542

Energy & Forces

This course is the first in a three-course sequence designed to cover physical science content for middle grade teachers. The underlying theme for the course is the concept of energy. The course will follow a strategy of introducing fundamental principles, and then covering further material as applications of those principles. The course will address energy, forces and interactions, momentum, materials and phases of matter. Students will explore a variety of scenarios involving these principles to develop their abilities to apply physics concepts to novel situations. Prerequisite: Admission to the Physical Science Initiative Cohort program, or approval of the instructor.

(3-0-3)

MSED 543**The Atomic World**

This course is the second in a three course sequence designed to cover physical science content for middle grades teachers. The underlying theme for the course is phenomena at the atomic scale. The course will follow a strategy of introducing broad, basic principles, and then covering further material as applications of those principles. The course will address issues of scale, historical model of matter, Heisenberg Uncertainty Principle, Young Double Slit Experiment, models of light, and reaction energies. Students will explore a variety of scenarios involving these principles to develop their abilities to apply physics concepts to novel situations.

(3-0-3)

MSED 544**Physical Science Applications**

This course is the third in a three-course sequence designed to cover physical science content for middle grade teachers. The underlying themes for the course are motion, astronomy, and earth science. The course will follow a strategy of applying the broad, basic principles covered in the previous two courses to new situations. The course will address the investigation of physical science content related to the nature of motion, astronomy, and earth science. Students will explore a variety of scenarios involving these principles to develop their abilities to apply physics concepts to novel situations.

(3-0-3)

MSED 545**Statistics for Educators I**

Part one of a two-part course. The course provides concepts and methods of gathering, describing and drawing conclusions from data. Statistical reasoning, probability, sampling, regression, correlation, forecasting, nonparametric statistics, conceptions and misconceptions about statistics, problem solving techniques and current research are included throughout the course.

(3-0-3)

MSED 546**Statistics for Educators II**

Part two of a two-part course. Statistical reasoning, probability, sampling, regression, correlation, forecasting, nonparametric statistics, conceptions and misconceptions about statistics, problem solving techniques and current research are included throughout the course.

(3-0-3)

MSED 547**Physical Science Instrumentation Methods**

This course is designed to explore investigation and experimentation methods in the physical sciences for middle grade teachers. The course will follow a strategy of introducing devices or tools used in experimentation and then designing and running fundamental experiments using these tools.

(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 & 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**Middle & Secondary Level Science Curriculum**

This course will develop a functional understanding of various factors that influence the development and direction of middle and secondary science curricula. Students will become familiar with strategies to integrate language arts, reading, and writing in the content area of science. Students will apply knowledge of subject matter, curriculum development, and curriculum theory to construct a hypothetical curriculum. Current trends, history of these trends, and rationales for science curriculum reform will be examined.

(3-0-3)

MSED 555**Middle & Secondary Level Mathematics Curriculum**

This course will develop a functional understanding of various factors that influence the development and direction of middle and secondary mathematics curricula. Students will become familiar with strategies to integrate language arts, reading, and writing in the content area of mathematics. Students will apply knowledge of subject matter, curriculum development, and curriculum theory to construct a hypothetical curriculum. Current trends, history of these trends, and rationales for mathematics curriculum reform will be examined.

(3-0-3)

MSED 560**Research & Evaluation**

Analysis of qualitative and quantitative empirical research in science and mathematics education.

(3-0-3)

MSED 562**Action Research I**

Reviewing, designing, and conducting research studies within the context of the students' own teaching.

(Credit: Variable)

MSED 563**Action Research II**

Reviewing, designing, and conducting research studies within the context of the students' own teaching. This course is a continuation of MSED 562.

(0-0-3)

MSED 564**Action Research III**

Reviewing, designing, and conducting research studies within the context of the students' own teaching. This course is a continuation of MSED 562 and MSED 563.

(0-0-3)

MSED 570**Inquiry & Nature of Science**

Developing a functional understanding of nature of science in the context of scientific inquiry.

(3-0-3)

MSED 571**Problem Solving & Nature of Mathematics**

Developing a functional understanding of nature of mathematics in the context of problem solving.

(3-0-3)

MSED 573

Expedition Green – Environmental Science

The course is designed to prepare teachers to teach environmental processes and systems, an understanding of environmental issues, personal and civic responsibility, and critical thinking skills. Teachers will increase their knowledge of ecology, ecosystems, resource management, and sustainability. Each class explores how these environmental science topics can be brought back into the classroom using a variety of pedagogical skills and engaging activities. The Expedition Green course models the use of inquiry based, hands-on teaching methods as well as the multiple ways that an informal institution, such as the Museum of Science and Industry, can be used to enhance school curricula. This course is condensed and offered in the summer semester only. (1.5-1.5-3)

MSED 574

Physical Science – Get Energized

Get Energized is designed to help teachers become more proficient in key physical science concepts related to energy. Teachers can increase their comfort level in teaching energy related topics such as light, mechanical, heat, sound, and electrical. Each full-day workshop focuses on a particular energy topic and explores how that topic can be brought back to the classroom in an engaging way. This program also explores how to further the interaction of inquiry-based teaching methods into the classroom as well as the multiple ways that an informal institution can be used to further the curriculum objectives established. Major topics include energy transformation, potential and kinetic energy, mechanical energy, electrical energy, sound, and thermal. This course is condensed, offered summer semester only. (1.5-1.5-3)

MSED 575

All About You – Life Science

All About You focuses on life science, particularly the science of the human body. The teacher professional development series is designed to help teachers learn to utilize inquiry-based and hands-on/minds-on science curriculum both within and outside of the classroom setting. Through this intensive and engaging year-long program, the workshops focus on expanding science teachers' capacity by building their content knowledge and enhancing their instructional practice. Aside from this program being broad based and interdisciplinary, this program explores how to further the interaction of inquiry-based teaching methods into the classroom as well as the multiple ways that an informal institution, such as the Museum of Science and Industry, can be used to further the curriculum objectives established. Major topics include cells, tissues and organs, genetics and evolution, body systems, health and wellness. This course is condensed, offered summer semester only. (1.5-1.5-3)

MSED 576

Earth Science – Great Lakes Rock

In Great Lakes Rock, late elementary and middle school teachers will increase their knowledge of earth systems science concepts and principles, especially those related to climate change and phenomena in the Great Lakes region. Teachers will discuss science content and practice inquiry-based classroom activities that address the following key topics: earth systems; great lakes ecosystems; and life and the environment. (3-0-3)

MSED 580

Adolescent Psychology

This course is designed to develop the participants' understanding of adolescent psychology. The main foci throughout the course are the unique aspects of adolescents and how those aspects influence behavior, learning, and social interactions, especially with regard to middle schools. Studies will include educational psychology theories and models, motivation and learning, developmental changes during adolescence, cognitive abilities, human ecology, diversity, and cultures. Additionally, participants will examine historical and philosophical perspectives of adolescent psychology and synthesize how these perspectives have influenced teaching, learning, and cultures in middle schools. The course will involve weekly readings and reflections, classroom experiences, short assignments, tests/quizzes, research projects, and formal class presentations. Requires admission into the secondary mathematics teacher certification program or instructor permission. (3-0-3)

MSED 583

Inquiry, Content & Nature of Science

This course is appropriate for continuing education of secondary education science teachers, who will be engaged in authentic scientific inquiry with practicing research scientists, learning about nature of science, scientific inquiry, and subject matter, and developing pedagogical knowledge and skills related to these concepts. The goal of the Project ICAN is to empower teachers to help their students to work toward scientific inquiry. (Variable:1-3)
(Credit: Variable)

MSED 584

Inquiry, Context, Nature & Science

Understanding nature of science as it relates to subject matter, and developing pedagogical knowledge and skills related to these concepts. (3-0-3)

MSED 591

Research & Thesis M.S.

A course that provides the guidance and opportunity for authentic research projects in Science or Mathematics Education to fulfill thesis requirements for MS Candidates. (Credit: Variable)

MSED 594

Special Projects

Advanced projects involving independent study, and especially fieldwork and modeling projects. (Variable: 1-6)
(Credit: Variable)

MSED 597

Special Problems

Current problems in science/mathematics education. May be repeated for credit with different topics. (Credit: Variable)

MSED 598

Methods of College Teaching in Mathematics & Science

The course is designed to allow each student to develop the theoretical background, practical knowledge, and skills for successful college level mathematics or science teaching. Specific emphasis will be placed upon instructional methods/models, curriculum development, and instructional planning. (3-0-3)

MSED 599

College Teaching Practicum

The purpose of the course is to enhance college level teacher preparation with an advanced learning experience joining together theory and practice. This course provides the student the opportunity to practice and improve knowledge and skills at teaching. The student may actively participate or act as an observer at a different college. In addition, students are required to prepare a Portfolio. The Portfolio provides the student an opportunity to demonstrate a readiness for teaching that describes their efforts and progress in preparing to teach science or mathematics at the college level.

(3-0-3)

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 & 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 & 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

A course that provides the guidance and opportunity for authentic research projects in Science or Mathematics Education to fulfill thesis requirements for PhD Candidates. Instructor permission required.

(Credit: Variable)

Department of Mechanical, Materials, and Aerospace Engineering

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10 W. 32nd St.
Chicago, IL 60616
312.567.3175
dept@mmae.iit.edu
www.mmae.iit.edu

Chair:
Keith Bowman

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 manufacturing engineering.

Degrees Offered

Master of Science in Mechanical and Aerospace Engineering
Master of Science in Materials Science and Engineering
Master of Science in Manufacturing Engineering
Master of Engineering in Mechanical and Aerospace Engineering

Master of Engineering in Materials Science and Engineering
Master of Engineering in Manufacturing Engineering
Doctor of Philosophy in Mechanical and Aerospace Engineering
Doctor of Philosophy in Materials Science and Engineering

Interdisciplinary Programs

Master of Science in Mechanical and Aerospace Engineering with specialization in Energy/Environment/Economics (E³)
Master of Science in Materials Science and Engineering with specialization in Energy/Environment/Economics (E³)

Master of Engineering in Mechanical and Aerospace Engineering with specialization in Energy/Environment/Economics (E³)
Master of Engineering in Materials Science and Engineering with specialization in Energy/Environment/Economics (E³)

Certificate Programs

Computer Integrated Design and Manufacturing

Product Quality and Reliability Assurance

Research Centers

Fluid Dynamics Research Center
(<http://fdrc.iit.edu/>)

Thermal Processing Technology Center
(<http://tptc.iit.edu/>)

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 and manufacturing; 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, biomechanics and its instrumentation, combustion, and internal combustion engines.

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.

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 nonferrous alloys, powder materials, laser processing and machining, 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 pro-

thetic devices; computational 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 tools, tribology, frictional wear characteristics of ceramics, dynamic systems, and mechanical vibrations; thermal sciences, 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

Arastoopour, Hamid, Professor of Chemical Engineering and Mechanical Engineering, Henry R. Linden Professor of Engineering, and Director of the Wanger Institute for Sustainability and Energy Research (WISER). B.S., Abadan Institute of Technology (Iran); M.S., Ph.D., G.E., Illinois Institute of Technology. Computational fluid dynamics (CFD) and transport phenomena of multiphase flow, fluidization, flow in porous media, particle technology and material processing, and environmental engineering problems, hydrogen storage, tire recycling, particle technology in applications to coal gasification, production of gas from unconventional gas reserves and hydrates, and energy sustainability issues.

Bowman, Keith J., Duchossois Leadership Professor of Materials Engineering and Chair. B.S., M.S., Case Western Reserve University; Ph.D., University of Michigan. Mechanical behavior of materials, electromechanical behavior, preferred orientation and property anisotropy, processing of ceramic materials.

Cammino, Roberto, Senior Lecturer of Mechanical and Aerospace Engineering. B.S., M.S., Ph.D., Illinois Institute of Technology. Fracture mechanics, finite element method.

Cassel, Kevin W., Associate Professor of Mechanical and Aerospace Engineering and Associate Chair. 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, and computational hemodynamics.

Cesarone, John C., Senior Lecturer of Mechanical Engineering. B.S., M.S., University of Illinois; Ph.D., Northwestern University. Robotics, reliability engineering and manufacturing.

Clack, Herek L., Associate Professor of Mechanical and Aerospace Engineering. B.S., Massachusetts Institute of Technology; 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.

Cramb, Alan W., Charles and Lee Finkl Professor of Metallurgical and Materials Engineering, Provost, and Senior Vice President for Academic Affairs. B.Sc., University of Strathclyde (Scotland); Ph.D., University of Pennsylvania. Initial solidification behavior of steels, solidification behavior of liquid oxides, effect of inclusion chemistry on solidification behavior, clean steel production, initial solidification phenomenon in a continuous casting mold.

Datta-Barua, Seebany, Assistant Professor of Mechanical and Aerospace Engineering. B.S., M.S., Ph.D. Stanford University. Satellite-based atmospheric remote sensing, global navigation satellite systems, geospace environment imaging, estimation and monitoring.

Gosz, Michael R., Associate Professor Mechanical and Materials Engineering and Vice Provost for Admissions and Financial Aid. 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.

Hall, Carrie M., Assistant Professor of Mechanical, Materials and Aerospace Engineering. B.S., Bob Jones University; Ph.D., Purdue University. Modeling and control of advanced internal combustion engines; development of clean and efficient utilization of alternative fuels.

Joerger, Mathieu, Research Assistant Professor of Mechanical, Materials and Aerospace Engineering. M.S, Ph.D., Illinois Institute of Technology.

Kallend, John S., Professor of Materials Engineering and Physics and Associate Dean for Accreditation, Armour College of Engineering. B.A., M.A., Ph.D., Cambridge University (England). Computational methods of crystallographic texture analysis and properties of polycrystalline aggregates.

Khanafseh, Samer, Research Assistant Professor of Mechanical and Aerospace Engineering. B.S., Jordan University of Science and Technology (Jordan); M.S., Ph.D., Illinois Institute of Technology.

Meade, Kevin P., Professor of Mechanical Engineering. B.S., M.S., Illinois Institute of Technology; Ph.D., Northwestern University. Solid mechanics, biomechanics, elasticity, fracture mechanics and computational mechanics.

Monnier, Bruno, Lecturer of Mechanical Engineering. Diploma d' Ingenieur, ENSEE/HT (France); M.S., Chalmers University of Technology (Sweden); Ph.D., Illinois Institute of Technology.

Nagib, Hassan M., John T. Rettaliata Professor of Mechanical and Aerospace Engineering. B.S., M.S., Ph.D., Illinois Institute of Technology. Fluid dynamics, heat transfer, applied turbulence, wind engineering, and aeroacoustics.

Nair, Sudhakar E., Professor of Mechanical and Aerospace Engineering and Applied Mathematics. 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.

Nash, Philip G., Professor of Materials Engineering and Director of the Thermal Processing Technology Center. B.S., City of London Polytechnic (England); Ph.D., Queen Mary College of London University (England). Physical metallurgy, intermetallics, powder metallurgy, composites, phase equilibria and transformations.

Ostrogorsky, Aleksandar, Professor of Mechanical and Materials Engineering. Dipl.Ing., University of Belgrade (Serbia); M.S., Rensselaer Polytechnic Institute; Sc.D., Massachusetts Institute of Technology. Heat and mass transfer phenomena occurring in materials processing; Directional solidification/single crystal growth focusing on semiconductor alloys; Wide band gap materials for gamma ray detectors (semiconductors and scintillators); Diffusion, growth of carbon nanotubes.

Pervan, Boris, Professor of Mechanical and Aerospace Engineering. B.S., University of Notre Dame; M.S., California Institute of Technology; Ph.D., Stanford University. Dynamics, control, guidance, and navigation.

Raman, Ganesh, Professor of Mechanical and Aerospace Engineering and Deputy Vice Provost for Research. 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.

Rempfer, Dietmar, Professor of Mechanical and Aerospace Engineering and Applied Mathematics and Associate Dean, Armour College of Engineering. M.S., Ph.D., Universitat Stuttgart (Germany). 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.

Ruiz, Francisco, Associate Professor of Mechanical and Aerospace Engineering. 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.

Shaw, Leon L., Rowe Family Professor of Materials Science and Engineering. B.S., M.Eng., Fuzhou University (China); M.S., Ph.D., University of Florida. Materials synthesis and processing, energy storage and conversion, solid freeform fabrication.

Spenko, Matthew, Associate Professor of Mechanical Engineering. B.S. Northwestern University; M.S., Ph.D., Massachusetts Institute of Technology. Robotics, design, dynamics, and control.

Srivastava, Ankit, Assistant Professor of Mechanical, Materials and Aerospace Engineering. B.Tech., Indian Institute of Technology (India); M.S., Ph.D., University of California, San Diego. Wave propagation, phononics, metamaterials, NDE-SHM through wave techniques, Micromechanics and homogenization.

Tin, Sammy, Professor of Materials Engineering. B.S., California Polytechnic State University-San Luis Obispo; M.S., Carnegie Mellon University; Ph.D., University of Michigan. Processing and deformation characteristics of high-temperature structural materials, modeling the microstructure of Ni-base superalloy turbine disks during thermomechanical processing, understanding the mechanisms of creep and fatigue deformation in advanced high-refractory content single crystal turbine blades.

Vural, Murat, Associate Professor of Mechanical and Aerospace Engineering. B.Sc., M.Sc., 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.

Wark, Candace E., Professor of Mechanical and Aerospace Engineering. B.S., M.S., Michigan State University; Ph.D., Illinois Institute of Technology. Fluid dynamics, turbulence, digital data acquisition and processing.

Williams, David R., Professor of Mechanical and Aerospace Engineering 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.

Wu, Benxin, Associate Professor of Mechanical Engineering. B.S., Tsinghua University; M.S., University of Missouri-Rolla; Ph.D., Purdue University. Laser-matter interactions, laser applications in manufacturing, materials processing, and other areas.

Admission Requirements

Cumulative minimum undergraduate GPA: 3.0/4.0

GRE score minimum:

1000 (quantitative + verbal) 3.0 (analytical writing)

Typical admitted quantitative score is 650 minimum.

TOEFL minimum: 550/213/80*

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 chair for graduate programs serves as a temporary advisor 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 advisor. 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://www.iit.edu/engineering/mmae>) 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. Maintaining the minimum GPA requirement does not guarantee admission to MMAE graduate degree programs. 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.

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

Master of Engineering in Mechanical and Aerospace Engineering

Master of Engineering in Materials Science and Engineering

Master of Engineering in Manufacturing Engineering

30 credit hours

These programs are aimed at broadening student potential beyond the B.S., enhancing technical versatility and, in some instances, providing the opportunity for changes in career path. The Master of Engineering programs are course-only degree programs and require a minimum of 30 credit hours. There is no thesis or comprehensive

examination requirement. 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 Engineering in Mechanical and Aerospace Engineering

Required Courses:

MMAE 501 Engineering Analysis I

AND one core course in major area of study

AND one of the following:

MMAE 451 Finite Element Methods in Engineering

MMAE 502 Engineering Analysis II

MMAE 517 Computational Fluid Dynamics

MMAE 532 Advanced Finite Element Methods

MMAE 544 Design Optimization

OR

MMAE 570 Computational Methods in Materials Processing

AND elective courses as needed.

Core courses as determined by major area of study

Fluid Dynamics

MMAE 510 Fundamentals of Fluid Mechanics

Thermal Sciences

MMAE 520 Advanced Thermodynamics

Solids and Structures

MMAE 530 Advanced Mechanics of Solids

Dynamics and Controls

MMAE 541 Advanced Dynamics

Computer Aided Design and Manufacturing:

MMAE 545 Advanced CAD/CAM

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.

Course Requirements for the Master of Engineering in Materials Science and Engineering

Required Courses (choose seven)

MMAE 468 Introduction to Ceramic Materials

MMAE 470 Introduction to Polymer Science

MMAE 472 Advanced Aerospace Materials

MMAE 478 Service Failure Analysis

MMAE 480 Forging & Forming

MMAE 501 Engineering Analysis I

MMAE 520 Advanced Thermodynamics

MMAE 533 Fatigue & Fracture Mechanics

MMAE 554 Electrical, Magnetic, & Optical Properties of Materials

MMAE 561 Solidification & Crystal Growth

MMAE 562 Design of Modern Alloys

MMAE 563 Advanced Mechanical Metallurgy

MMAE 564 Dislocations & Strengthening Mechanisms

MMAE 565 Materials Laboratory

MMAE 566 Problems in High-Temperature Materials

MMAE 567 Fracture Mechanisms

MMAE 568 Diffusion

MMAE 569 Advanced Physical Metallurgy

MMAE 570 Computational Methods in Materials Processing

MMAE 571 Microstructural Characterizations of Materials

MMAE 573 Transmission Electron Microscopy

MMAE 574 Ferrous Transformations

MMAE 576 Materials & Process Selection

MMAE 578 Fiber Composites

MMAE 579 Advanced Materials Processing

To complete the degree requirements, students may choose from a list of courses and may apply up to twelve credit hours of 400-level 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.

Course Requirements for Master of Engineering in Manufacturing Engineering

Mechanical and Aerospace Engineering Emphasis Required Courses

MMAE 545 Advanced CAD/CAM
MMAE 546 Advanced Manufacturing Engineering
MMAE 547 Computer-Integrated Manufacturing Technologies

OR

MMAE 557 Computer-Integrated Manufacturing Systems
MMAE 560 Statistical Quality and Process Control

AND one course in materials science and engineering

AND one course emphasizing numerical methods:

MMAE 451 Finite Element Methods in Engineering
MMAE 517 Computational Fluid Dynamics
MMAE 532 Advanced Finite Element Methods
MMAE 544 Design Optimization

OR

MMAE 570 Computational Methods in Materials Processing

AND elective courses as needed.

Materials Science and Engineering Emphasis Required Courses

MMAE 547 Computer-Integrated Manufacturing Technologies
MMAE 560 Statistical Quality and Process Control

AND one of the following:

MMAE 445 Computer-Aided Design
MMAE 545 Advanced CAD/CAM
MMAE 546 Advanced Manufacturing Engineering

OR

MMAE 576 Materials and Process Selection

AND one of the following:

MMAE 574 Ferrous Transformations
MMAE 585 Engineering Optics and Laser-Based Manufacturing

AND one course emphasizing numerical methods:

MMAE 451 Finite Element Methods in Engineering
MMAE 517 Computational Fluid Dynamics
MMAE 532 Advanced Finite Element Methods
MMAE 544 Design Optimization

OR

MMAE 570 Computational Methods in Materials Processing

AND elective courses as needed.

Master of Engineering in Manufacturing Engineering via Internet

30 credit hours

The Master of Engineering in Manufacturing Engineering 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.

Required Courses

MMAE 545 Advanced CAD/CAM
MMAE 546 Advanced Manufacturing Engineering
MMAE 560 Statistical Quality and Process Control

AND

MMAE 547 Computer-Integrated Manufacturing Technologies

OR

MMAE 557 Computer-Integrated Manufacturing Systems

AND one materials course

MMAE 563 Advanced Mechanical Metallurgy

AND one course with emphasis on numerical methods

MMAE 704 Introduction to Finite Element Analysis (2 credit hours)

AND at least 13 credit hours from:

MMAE 433 Design of Thermal Systems
MMAE 445 Computer-Aided Design
MMAE 540 Robotics
MMAE 557 Computer Integrated Manufacturing-Systems
MMAE 589 Applications in Reliability Engineering I
MMAE 590 Applications in Reliability Engineering II
MMAE 715 Project Management (2 credit hours)

Master of Science in Mechanical and Aerospace Engineering

Master of Science in Materials Science and Engineering

Master of Science in Manufacturing 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 advisor, 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 advisor. Graduate students pursuing the M.S. degree on a part-time basis should select a permanent advisor before registering for their twelfth credit hour. The student, in consultation with the advisor, prepares a program of study that reflects individual needs and interests. The advisor 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 advisor 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 I

MMAE 502 Engineering Analysis II

AND one core course in major area of study

AND 6 or more credit hours of non-core courses in major area

AND elective courses as needed.

Core courses as determined by major area of study

Fluid Dynamics

MMAE 510 Fundamentals of Fluid Mechanics

Thermal Sciences

MMAE 520 Advanced Thermodynamics

Solids and Structures

MMAE 530 Advanced Mechanics of Solids

Dynamics and Controls

MMAE 541 Advanced Dynamics

Computer Aided Design and Manufacturing

MMAE 545 Advanced CAD/CAM

No more than nine credit hours of 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.

Course Requirements for the Master of Science in Materials Science and Engineering

Required Courses (choose six)

MMAE 468 Introduction to Ceramic Materials

MMAE 470 Introduction to Polymer Science

MMAE 472 Advanced Aerospace Materials

MMAE 478 Service Failure Analysis

MMAE 480 Forging & Forming

MMAE 501 Engineering Analysis I

MMAE 520 Advanced Thermodynamics

MMAE 533 Fatigue & Fracture Mechanics

MMAE 554 Electrical, Magnetic, & Optical Properties of Materials

MMAE 561 Solidification & Crystal Growth

MMAE 562 Design of Modern Alloys

MMAE 563 Advanced Mechanical Metallurgy

MMAE 564 Dislocations & Strengthening Mechanisms

MMAE 565 Materials Laboratory

MMAE 566 Problems in High-Temperature Materials

MMAE 567 Fracture Mechanisms

MMAE 568 Diffusion

MMAE 569 Advanced Physical Metallurgy

MMAE 570 Computational Methods in Materials Processing

MMAE 571 Microstructural Characterizations of Materials

MMAE 573 Transmission Electron Microscopy

MMAE 574 Ferrous Transformations

MMAE 576 Materials & Process Selection

MMAE 578 Fiber Composites

MMAE 579 Advanced Materials Processing

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.

Course Requirements for Master of Science in Manufacturing Engineering

Mechanical and Aerospace Engineering Emphasis Required Courses

MMAE 545 Advanced CAD/CAM
MMAE 546 Advanced Manufacturing Engineering
MMAE 547 Computer-Integrated Manufacturing Technologies
MMAE 560 Statistical Quality and Process Control

AND one course in materials science and engineering

AND one course emphasizing numerical methods:

MMAE 451 Finite Element Methods in Engineering
MMAE 517 Computational Fluid Dynamics
MMAE 532 Advanced Finite Element Methods
MMAE 544 Design Optimization

OR

MMAE 570 Computational Methods in Materials Processing

AND elective courses as needed.

Materials Science and Engineering Emphasis Required Courses

MMAE 547 Computer Integrated Manufacturing Technologies
MMAE 560 Statistical Quality and Process Control

AND one of the following:

MMAE 445 Computer-Aided Design
MMAE 545 Advanced CAD/CAM
MMAE 546 Advanced Manufacturing Engineering
OR
MMAE 576 Materials and Process Selection

AND one of the following:

MMAE 574 Ferrous Transformations
MMAE 575 Ferrous Products: Metallurgy and Manufacture

OR

MMAE 585 Engineering Optics and Laser-Based Manufacturing

AND one course emphasizing numerical methods:

MMAE 451 Finite Element Methods in Engineering
MMAE 517 Computational Fluid Dynamics
MMAE 532 Advanced Finite Element Methods
MMAE 538 Computational Techniques in FEM
MMAE 544 Design Optimization

OR

MMAE 570 Computational Methods in Materials Processing

AND elective courses as needed.

Doctor of Philosophy in Materials Science and Engineering Doctor of Philosophy in Mechanical and Aerospace Engineering

84 credit hours beyond the Bachelor of Science
Qualifying examination
16 credit hours minimum 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.

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 background 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, or equivalent, 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 Materials Science and Engineering

Required Courses (choose six)

MMAE 468 Introduction to Ceramic Materials
MMAE 470 Introduction to Polymer Science
MMAE 472 Advanced Aerospace Materials
MMAE 478 Service Failure Analysis
MMAE 480 Forging & Forming
MMAE 501 Engineering Analysis I
MMAE 520 Advanced Thermodynamics
MMAE 533 Fatigue & Fracture Mechanics
MMAE 554 Electrical, Magnetic, & Optical Properties of Materials
MMAE 561 Solidification & Crystal Growth
MMAE 562 Design of Modern Alloys
MMAE 563 Advanced Mechanical Metallurgy
MMAE 564 Dislocations & Strengthening Mechanisms
MMAE 565 Materials Laboratory

MMAE 566 Problems in High-Temperature Materials
MMAE 567 Fracture Mechanisms
MMAE 568 Diffusion
MMAE 569 Advanced Physical Metallurgy
MMAE 570 Computational Methods in Materials Processing
MMAE 571 Microstructural Characterizations of Materials
MMAE 573 Transmission Electron Microscopy
MMAE 574 Ferrous Transformations
MMAE 576 Materials & Process Selection
MMAE 578 Fiber Composites
MMAE 579 Advanced Materials Processing

AND elective courses as needed.

Course Requirements for Mechanical and Aerospace Engineering

Required Courses:

MMAE 501 Engineering Analysis I

MMAE 502 Engineering Analysis II

AND two courses from group EA (fluid dynamics, thermals sciences and solids and structures students must take MMAE 507 Continuum Mechanics)

AND one core course in major area of study

AND one core course in second area

AND 9 or more credit hours of non-core courses in major area

AND elective courses as needed.

Core courses as determined by major area of study

Fluid Dynamics

MMAE 510 Fundamentals of Fluid Mechanics

Thermal Sciences

MMAE 520 Advanced Thermodynamics

Solids and Structures

MMAE 530 Advanced Mechanics of Solids

Dynamics and Controls

MMAE 541 Advanced Dynamics

Computer Aided Design and Manufacturing

MMAE 545 Advanced CAD/CAM

Group EA:

MMAE 503 Advanced Engineering Analysis

MMAE 508 Perturbation Methods

MMAE 509 Introduction to Continuum Mechanics

MATH 512 Partial Differential Equations

MATH 515 Ordinary Differential Equations and Dynamical Systems

MATH 522 Mathematical Modeling

MATH 535 Optimization I

MATH 544 Stochastic Dynamics

MATH 545 Stochastic Partial Differential Equations

MATH 553 Discrete Applied Mathematics I

ECE 511 Analysis of Random Signals

ECE 531 Linear System Theory

ECE 567 Statistical Signal Processing

Master of Science in Mechanical and Aerospace Engineering with (E³) Specialization

Master of Science in Materials Science and Engineering with (E³) Specialization

Master of Engineering in Mechanical and Aerospace Engineering with (E³) Specialization

Master of Engineering in Materials Science and Engineering with (E³) Specialization

The Energy/Environment/Economics (E³) 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.

E³specialization requires an interdisciplinary thesis in an E³area of research for M.S. and Ph.D. degrees, and an interdisciplinary graduate project for professional master's degrees. Graduate students in E³ should also be enrolled in fundamental courses related to the topics of energy, environment, and economics. E³ is designed primarily for students majoring in mechanical and aerospace, materials, chemical, environmental, 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.

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 E³specialization courses. Selected E³undergraduate courses may be substituted for graduate courses with the approval of the designated advisor, if the total undergraduate credit hours for the M.E. 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. 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, materials, 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.

Course Requirements for Master of Science in Mechanical and Aerospace Engineering with (E³) Specialization

Engineering Analysis Courses

MMAE 501 Engineering Analysis I
MMAE 502 Engineering Analysis II

Core Courses

CHE 543 Energy, Environment, & Economics

AND one of the following:

MMAE 520 Advanced Thermodynamics
CHE 503 Thermodynamics
CHE 553 Advanced Thermodynamics

AND one of the following:

MMAE 522 Nuclear, Fossil-Fuel, & Sustainable Energy Systems
MMAE 523 Fundamentals of Power Generation
MMAE 524 Fundamentals of Combustion
CHE 541 Renewable Energy Technologies

Non Core Courses

Two of the following:

MMAE 510 Fundamentals of Fluid Mechanics
MMAE 517 Computational Fluid Mechanics
MMAE 524 Fundamentals of Combustion
MMAE 525 Fundamentals of Heat Transfer
MMAE 526 Heat Transfer: Conduction

MMAE 527 Heat Transfer: Convection & Radiation

AND one of the following:

CHE 541 Renewable Energy Technologies
CHE 560/ Statistical Quality & Process Control
MMAE 560
EMS 500 Fundamentals of Environmental Science
EMS 503 Environmental Pollution Prevention & Control Strategies
EMS 504 Industrial Ecology & Systems
ENVE 501 Environmental Chemistry
ENVE 506 Chemodynamics
ENVE 542 Physiochemical Processes in Environmental Engineering
ENVE 551 Industrial Waste Treatment
ENVE 561 Design of Environmental Engineering Processes
ENVE 570 Air Pollution Meteorology
ENVE 577 Design of Air Pollution Control Devices
ENVE 578 Physical & Chemical Processes for Industrial Gas Cleaning
ENVE 580 Hazardous Waste Engineering

Thesis research

MMAE 591 Research and Thesis

AND elective courses as needed

Course Requirements for Master of Science in Materials Science and Engineering with (E³) Specialization

Core Courses

CHE 543 Energy, Environment & Economics
MMAE 468 Introduction to Ceramic Materials
MMAE 569 Advanced Physical Metallurgy

AND one of the following:

MMAE 520 Advanced Thermodynamics
CHE 503 Thermodynamics
CHE 553 Advanced Thermodynamics

AND one of the following:

MMAE 522 Nuclear, Fossil-Fuel, &
Sustainable Energy Systems
MMAE 523 Fundamentals of Power Generation
CHE 541 Renewable Energy Technologies
CHE 566 Electrochemical Engineering

AND elective courses as needed

Non Core Courses

Two of the following:

MMAE 525 Fundamentals of Heat Transfer
MMAE 561 Solidification & Crystal Growth
MMAE 563 Advanced Mechanical Metallurgy
MMAE 566 Problems in High-Temperature Materials
MMAE 571 Microstructural Characterization of
Materials
MMAE 573 Transmission Electron Microscopy
MMAE 579 Advanced Materials Processing
MMAE 470 Introduction to Polymer Science

AND one of the following:

CHE 567 Fuel Cell Fundamentals
EMS 500 Fundamentals of Environmental Science
EMS 503 Environmental Pollution Prevention
& Control Strategies
EMS 504 Industrial Ecology & Systems
ENVE 501 Environmental Chemistry
ENVE 506 Chemodynamics
ENVE 542 Physiochemical Processes in Environmental
Engineering
ENVE 551 Industrial Waste Treatment
ENVE 561 Design of Environmental Engineering
Processes
ENVE 570 Air Pollution Meteorology
ENVE 577 Design of Air Pollution Control Devices
ENVE 578 Physical and Chemical Processes for
Industrial Gas Cleaning
ENVE 580 Hazardous Waste Engineering

Thesis research

MMAE 591 Thesis

AND elective courses as needed

Course Requirements for Master of Engineering in Mechanical and Aerospace Engineering with (E³) Specialization

Engineering Analysis Courses

MMAE 501 Engineering Analysis I
MMAE 502 Engineering Analysis II

Core Courses

CHE 543 Energy, Environment & Economics

AND one of the following:

MMAE 520 Advanced Thermodynamics
CHE 503 Thermodynamics
CHE 553 Advanced Thermodynamics

AND one of the following:

MMAE 522 Nuclear, Fossil-Fuel, &
Sustainable Energy Systems
MMAE 523 Fundamentals of Power Generation
MMAE 524 Fundamentals of Combustion
CHE 541 Renewable Energy Technologies

Non Core Courses

Two of the following:

MMAE 510 Fundamentals of Fluid Mechanics
MMAE 517 Computational Fluid Mechanics
MMAE 524 Fundamentals of Combustion

MMAE 525 Fundamentals of Heat Transfer
MMAE 526 Heat Transfer: Conduction
MMAE 527 Heat Transfer: Convection & Radiation

AND one of the following:

CHE 541 Renewable Energy Technologies
CHE 560/ Statistical Quality & Process Control
MMAE 560
EMS 500 Fundamentals of Environmental Science
EMS 503 Environmental Pollution Prevention
& Control Strategies
EMS 504 Industrial Ecology & Systems
ENVE 501 Environmental Chemistry
ENVE 506 Chemodynamics
ENVE 542 Physiochemical Processes in Environmental
Engineering
ENVE 551 Industrial Waste Treatment
ENVE 561 Design of Environmental Engineering
Processes
ENVE 570 Air Pollution Meteorology
ENVE 577 Design of Air Pollution Control Devices
ENVE 578 Physical & Chemical Processes for
Industrial Gas Cleaning
ENVE 580 Hazardous Waste Engineering

AND elective courses as needed

Course Requirements for Master of Engineering in Materials Science and Engineering with (E³) Specialization

Core Courses

CHE 543 Energy, Environment & Economics
MMAE 468 Introduction to Ceramic Materials
MMAE 569 Advanced Physical Metallurgy

AND one of the following:

MMAE 520 Advanced Thermodynamics
CHE 503 Thermodynamics
CHE 553 Advanced Thermodynamics

AND one of the following:

MMAE 522 Nuclear, Fossil-Fuel, & Sustainable Energy Systems
MMAE 523 Fundamentals of Power Generation
CHE 541 Renewable Energy Technologies
CHE 566 Electrochemical Engineering

Non Core Courses

Two of the following:

MMAE 525 Fundamentals of Heat Transfer
MMAE 561 Solidification & Crystal Growth
MMAE 563 Advanced Mechanical Metallurgy
MMAE 566 Problems in High-Temperature Materials
MMAE 571 Microstructural Characterization of Materials
MMAE 573 Transmission Electron Microscopy
MMAE 579 Advanced Materials Processing
MMAE 470 Introduction to Polymer Science

AND one of the following:

CHE 567 Fuel Cell Fundamentals
EMS 500 Fundamentals of Environmental Science
EMS 503 Environmental Pollution Prevention & Control Strategies
EMS 504 Industrial Ecology & Systems
ENVE 501 Environmental Chemistry
ENVE 506 Chemodynamics
ENVE 542 Physiochemical Processes in Environmental Engineering
ENVE 551 Industrial Waste Treatment
ENVE 561 Design of Environmental Engineering Processes
ENVE 570 Air Pollution Meteorology
ENVE 577 Design of Air Pollution Control Devices
ENVE 578 Physical and Chemical Processes for Industrial Gas Cleaning
ENVE 580 Hazardous Waste Engineering

AND elective courses as needed

Certificate Programs

Computer Integrated Design and Manufacturing

Required Courses (choose four)

MMAE 445 Computer-Aided Design
MMAE 540 Robotics
MMAE 545 Advanced CAD/CAM
MMAE 547 Computer Integrated Manufacturing-Technologies
MMAE 557 Computer Integrated Manufacturing-Systems

Product Quality and Reliability Assurance

Required Courses

MMAE 560 Statistical Quality and Process Control
MMAE 589 Applications in Reliability Engineering I
MMAE 590 Applications in Reliability Engineering II
MMAE 720 Introduction to Design Assurance

Course Descriptions

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

MMAE 501

Engineering Analysis I

Vectors and matrices, systems of linear equations, linear transformations, eigenvalues and eigenvectors, systems of ordinary differential equations, decomposition of matrices, and functions of matrices. Eigenfunction expansions of differential equations, self-adjoint differential operators, Sturm-Liouville equations. Complex variables, analytic functions and Cauchy-Riemann equations, harmonic functions, conformal mapping, and boundary-value problems. Calculus of variations, Euler's equation, constrained functionals, Rayleigh-Ritz method, Hamilton's principle, optimization and control. Prerequisite: An undergraduate course in differential equations.

(3-0-3)

MMAE 502

Engineering Analysis II

Generalized functions and Green's functions. Complex integration: series expansions of complex functions, singularities, Cauchy's residue theorem, and evaluation of real definite integrals. Integral transforms: Fourier and Laplace transforms, applications to partial differential equations and integral equations.

Prerequisite(s): [(MMAE 501)]

(3-0-3)

MMAE 503

Advanced Engineering Analysis

Selected topics in advanced engineering analysis, such as ordinary differential equations in the complex domain, partial differential equations, integral equations, and/or nonlinear dynamics and bifurcation theory, chosen according to student and instructor interest.

Prerequisite(s): [(MMAE 502)]

(3-0-3)

MMAE 508

Perturbation Methods

Asymptotic series, regular and singular perturbations, matched asymptotic expansions, and WKB theory. Methods of strained coordinates and multiple scales. Application of asymptotic methods in science and engineering.

Prerequisite(s): [(MMAE 501)]

(3-0-3)

MMAE 509

Introduction to Continuum Mechanics

A unified treatment of topics common to solid and fluid mechanics. Cartesian tensors. Deformation, strain, rotation and compatibility equations. Motion, velocity gradient, vorticity. Momentum, moment of momentum, energy, and stress tensors. Equations of motion, frame indifference. Constitutive relations for elastic, viscoelastic, and fluids and plastic solids.

Prerequisite(s): [(MMAE 501)]

(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.

Prerequisite(s): [(MMAE 501*)] An asterisk (*) designates a course which may be taken concurrently.

(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(s): [(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(s): [(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(s): [(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 its consequences; moving frames, compressibility, stratification, hydromagnetics. Nonlinear theory and energy methods. Transition to turbulence.

Prerequisite(s): [(MMAE 502 and 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 acquisitions and processing.

Instructor's consent required.

(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 solution of the Navier-Stokes equations in the primitive-variables and vorticity-stream function formulations. Grids and grid generation. Numerical modeling of turbulent flows. Additional Prerequisite: An undergraduate course in numerical methods.

Prerequisite(s): [(MMAE 510)]

(3-0-3)

MMAE 518**Spectral Methods in Computational Fluid Dynamics**

Application of advanced numerical methods and techniques to the solution of important classes of problems in fluid mechanics. Emphasis is in methods derived from weighted-residuals approaches, like Galerkin and Galerkin-Tau methods, spectral and pseudospectral methods, and dynamical systems modeling via projections on arbitrary orthogonal function bases. Finite element and spectral element methods will be introduced briefly in the context of Galerkin methods. A subsection of the course will be devoted to numerical turbulence modeling, and to the problem of grid generation for complex geometries.

Prerequisite(s): [(MMAE 501 and MMAE 510)]

(3-0-3)

MMAE 519**Cardiovascular Fluid Mechanics**

Anatomy of the cardiovascular system. Scaling principles. Lumped parameter, one-dimensional linear and nonlinear wave propagation, and three-dimensional modeling techniques applied to simulate blood flow in the cardiovascular system. Steady and pulsatile flow in rigid and elastic tubes. Form and function of blood, blood vessels, and the heart from an engineering perspective. Sensing, feedback, and control of the circulation. Includes a student project.

(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: An undergraduate course in applied thermodynamics.

(3-0-3)

MMAE 522**Nuclear, Fossil-Fuel, & Sustainable Energy Systems**

Principles, technology, and hardware used for conversion of nuclear, fossil-fuel, and sustainable energy into electric power will be discussed. Thermodynamic analysis – Rankine cycle. Design and key components of fossil-fuel power plants. Nuclear fuel, reactions, materials. Pressurized water reactors (PWR). Boiling water reactors (BWR). Canadian heavy water (CANDU) power plants. Heat transfer from the nuclear fuel elements. Introduction to two phase flow: flow regimes; models. Critical heat flux. Environmental effects of coal and nuclear power. Design of solar collectors. Direct conversion of solar energy into electricity. Wind power. Geothermal energy. Energy conservation and sustainable buildings. Enrichment of nuclear fuel. Nuclear weapons and effects of the explosions.

(3-0-3)

MMAE 523**Fundamentals of Power Generation**

Thermodynamic, combustion, and heat transfer analyses relating to steam-turbine and gas-turbine power generation. Environmental impacts of combustion power cycles. Consideration of alternative and sustainable power generation processes such as wind and tidal, geothermal, hydroelectric, solar, fuel cells, nuclear power, and microbial. Prerequisite: An undergraduate course in applied thermodynamics.

(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: An undergraduate course in thermodynamics and heat transfer or instructor 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: An undergraduate course in heat transfer.

(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.

Prerequisite(s): [(MMAE 502 and MMAE 525)]
(3-0-3)

MMAE 527

Heat Transfer: Convection & 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(s): [(MMAE 525)]
(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 non-associated 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(s): [(MMAE 530)]
(3-0-3)

MMAE 530

Advanced Mechanics of Solids

Mathematical foundations: tensor algebra, notation and properties, eigenvalues and eigenvectors. Kinematics: deformation gradient, finite and small strain tensors. Force and equilibrium: concepts of traction/stress, Cauchy relation, equilibrium equations, properties of stress tensor, principal stresses. Constitutive laws: generalized Hooke's law, anisotropy and thermoelasticity. Boundary value problems in linear elasticity: plane stress, plane strain, axisymmetric problems, Airy stress function. Energy methods for elastic solids. Torsion. Elastic and inelastic stability of columns.

Prerequisite(s): [(MMAE 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

MMAE 531

Theory of Elasticity

Notion 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(s): [(MMAE 530)]
(3-0-3)

MMAE 532

Advanced Finite Element Methods

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 of 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(s): [(CAE 442) OR (MMAE 451)]
(3-0-3)

MMAE 533

Fatigue & 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: An undergraduate course in mechanics of solids.

(3-0-3)

MMAE 535

Wave Propagation

This is an introductory course on wave propagation. Although the ideas are presented in the context of elastic waves in solids, they easily carry over to sound waves in water and electromagnetic waves. The topics include one dimensional motion of elastic continuum, traveling waves, standing waves, energy flux, and the use of Fourier integrals. Problem statement in dynamic elasticity, uniqueness of solution, basic solution of elastodynamics, integral representations, steady state time harmonic response. Elastic waves in unbounded medium, plane harmonic waves in elastic half-spaces, reflection and transmission at interfaces, Rayleigh waves, Stoneley waves, slowness diagrams, dispersive waves in waveguides and phononic composites, thermal effects and effects of viscoelasticity, anisotropy, and nonlinearity on wave propagation.

(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: An undergraduate course in mechanics of solids.

(3-2-4)

MMAE 540

Robotics

Kinematics and inverse kinematics of manipulators. Newton-Euler dynamic formulation. Independent joint control. Trajectory and path planning using potential fields and probabilistic roadmaps. Adaptive control. Force control.

Prerequisite(s): [(MMAE 443 and MMAE 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

MMAE 541

Advanced Dynamics

Kinematics of rigid bodies. Rotating reference frames and coordinate transformations; Inertia dyadic. Newton-Euler equations of motion. Gyroscopic motion. Conservative forces and potential functions. Generalized coordinates and generalized forces. Lagrange's equations. Holonomic and nonholonomic constraints. Lagrange multipliers. Kane's equations. Elements of orbital and spacecraft dynamics. Additional Prerequisite: An undergraduate course in dynamics.

Prerequisite(s): [(MMAE 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

MMAE 542

Applied Dynamical Systems

This course will cover analytical and computational methods for studying nonlinear ordinary differential equations especially from a geometric perspective. Topics include stability analysis, perturbation theory, averaging methods, bifurcation theory, chaos, and Hamiltonian systems.

Prerequisite(s): [(MMAE 501)]
(3-0-3)

MMAE 543

Modern 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. Additional Prerequisite: An undergraduate course in classical control.

Prerequisite(s): [(MMAE 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

MMAE 544

Design Optimization

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: An undergraduate course in numerical methods.

(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(s): [(MMAE 445)]
(3-0-3)

MMAE 546

Advanced Manufacturing Engineering

Introduction to advanced manufacturing processes, such as powder metallurgy, joining and assembly, grinding, water jet cutting, laser-based manufacturing, etc. Effects of variables on the quality of manufactured products. Process and parameter selection. Important physical mechanisms in manufacturing process. Prerequisite: An undergraduate course in manufacturing processes or instructor consent.

(3-0-3)

MMAE 547

Computer-Integrated Manufacturing Technologies

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 551

Experimental Mechatronics

Team-based project. Microprocessor controlled electromechanical systems. Sensor and actuator integration. Basic analog and digital circuit design. Limited Enrollment.

Prerequisite(s): [(MMAE 443)]
(2-3-3)

MMAE 552

Introduction to the Space Environment

Overview of the space environment, particularly Earth's ionosphere, magnetosphere, and interplanetary space. Effects of solar activity on geospace variability. Basic plasma characteristics. Single particle motions. Waves in magnetized plasmas. Charged particle trapping in planetary magnetic fields and its importance in near-earth-space phenomena. Macroscopic equations for a conducting fluid. Ground and space-based remote sensing and in situ measurement techniques. Space weather effects on human-made systems. Students must have already taken undergraduate courses in electromagnetics and in fluid mechanics.

(3-0-3)

MMAE 554

Electrical, Magnetic & Optical Properties of Materials

Electronic structure of solids. Conductors, semiconductors, dielectrics, superconductors. Ferroelectric and piezoelectric materials. Magnetic properties, magnetocrystalline, anisotropy, magnetic materials and devices. Optical properties and their applications.

(3-0-3)

MMAE 555

Introduction to Navigation Systems

Fundamental concepts of positioning and dead reckoning. Principles of modern satellite-based navigation systems, including GPS, GLONASS, and Galileo. Differential GPS (DGPS) and augmentation systems. Carrier phase positioning and cycle ambiguity resolution algorithms. Autonomous integrity monitoring. Introduction to optimal estimation, Kalman filters, and covariance analysis. Inertial sensors and integrated navigation systems.

Prerequisite(s): [(MMAE 443 and MMAE 501*)] An asterisk (*) designates a course which may be taken concurrently.
(3-0-3)

MMAE 556

Nanoscale Imaging & Manipulation

Includes an overview of scanning probe microscopy and of AFM imaging; mathematical morphology; imaging simulation and surface recognition; and high-speed AFM imaging. Also covers nanoscale physics, including probing nanoscale forces, van der Waals force, electrostatic force, and capillary force. Nanomanipulation topics such as mechanical scratching and pushing electrophoresis, and augmented reality. Manipulation automation and manipulation planning. Applications of selected topics covered.

(3-0-3)

MMAE 557

Computer-Integrated Manufacturing Systems

Advanced topics in Computer-Integrated Manufacturing, including control systems, group technology, cellular manufacturing, flexible manufacturing systems, automated inspection, lean production, Just-In-Time production, and agile manufacturing systems.

(3-0-3)

MMAE 560

Statistical Quality & 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 & Crystal Growth

Properties of melts and solids. Thermodynamic and heat transfer concepts. Single and poly-phase alloys. Macro and micro segregation. Plane-front solidification. Solute boundary layers. Constitutional supercooling. Convection in freezing melts. Effective segregation coefficients. Zone freezing and purification. Single crystal growth technology. Czochralski, Kyropoulos, Bridgman, and Floating Zone methods. Control of melt convection and crystal composition. Equipment. Process control and modeling. Laboratory demonstration. Prerequisite: A background in crystal structure and thermodynamics.

(3-0-3)

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: A background in phase diagrams and thermodynamics.

(2-0-2)

MMAE 563

Advanced Mechanical Metallurgy

Analysis of the general state of stress and strain in solids. Analysis of elasticity 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: A background in mechanical properties.

(3-0-3)

MMAE 564

Dislocations & 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: Background in materials analysis.

(3-0-3)

MMAE 565

Materials Laboratory

Advanced synthesis projects studying microstructure and properties of a series of binary and ternary alloys. Gain hands-on knowledge of materials processing and advanced materials characterization through an integrated series of experiments to develop understanding of the processing-microstructure-properties relationship. Students arc melt a series of alloys, examine the cast microstructures as a function of composition using optical and electron microscopy, DTA, EDS, and XRD. The alloys are treated in different thermal and mechanical processes. The microstructural and mechanical properties modification and changes during these processes are characterized. Groups of students will be assigned different alloy systems, and each group will present their results orally to the class and the final presentation to the whole materials science and engineering group.

(1-6-3)

MMAE 566

Problems in High-Temperature Materials

Temperature-dependent mechanical properties. Creep mechanisms. Basic concepts in designing in high-temperature materials. Metallurgy of basic alloy systems. Surface stability. High-temperature oxidation. Hot corrosion. Coatings and protection. Elements of process metallurgy. Prerequisite: Background in mechanical properties, crystal defects, and thermodynamics.

Prerequisite(s): [(MMAE 564)]

(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. Prerequisite: Background in crystal structure, defects, and mechanical properties.

(3-0-3)

MMAE 568

Diffusion

Theory, techniques and interpretation of diffusion studies in metals. Prerequisite: Background in crystal structures, defects, and thermodynamics.

(2-0-2)

MMAE 569

Advanced Physical Metallurgy

Thermodynamics and kinetics of phase transformations, theory of nucleation and growth, metastability, phase diagrams. Prerequisite: Background in phase diagrams and thermodynamics.

(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 finite element method. It will consist of three parts: (1) Lectures on fundamental theories and models; (2) computational and numerical methods; (3) computer laboratories. Prerequisite: Background in finite element methods and materials processing.

(3-0-3)

MMAE 571**Microstructural Characterization of Materials**

Advanced optical microscopy. Scanning and transmission electron microscopes. X-ray microanalysis. Surface characterization. Quantitative microscopy. Elements of applied statistics.
(2-3-3)

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 micro characterization techniques for morphological, crystallographic, and elemental analysis at high spatial resolutions at 10 nanometers in metallurgical and ceramic studies will also be covered.
(2-3-3)

MMAE 574**Ferrous Transformations**

Allotropic modifications in iron and 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: Background in phase diagrams and thermodynamics.
(3-0-3)

MMAE 576**Materials & 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 578**Fiber Composites**

Basic concepts and definitions. Current and potential applications of composite materials. Fibers, Matrices, and overview of manufacturing processes for composites. Review of elasticity of anisotropic solids and transformation of stiffness/compliance matrices. Micromechanics: methods for determining mechanical properties of heterogeneous materials. Macromechanics: ply analysis, off-axis stiffness, description of laminates, laminated plate theories, special types of laminates. Applications of concepts to the design of simple composite structural components. Failure theories, hydrothermal effects. Prerequisite: Background in polymer synthesis and properties.
(3-0-3)

MMAE 579**Advanced Materials Processing**

Processing science and fundamentals in making advanced materials, particularly nanomaterials and composites. Applications of the processing science to various processing technologies including severe plastic deformation, melt infiltration, sintering, co-precipitation, sol-gel process, aerosol synthesis, plasma spraying, vapor-liquid-solid growth, chemical vapor deposition, physical vapor deposition, atomic layer deposition, and lithography.
Prerequisite(s): [(MMAE 467)]
(3-0-3)

MMAE 585**Engineering Optics & Laser-Based Manufacturing**

Fundamentals of geometrical and physical optics as related to problems in engineering design and research; fundamentals of laser-material interactions and laser-based manufacturing processes. This is a lecture-dominated class with around three experiments organized to improve students' understanding of the lectures. The topics covered include: geometrical optics (law of reflection and refraction, matrix method, etc.); physical optics (wave equations, interference, polarization, Fresnel equations, etc.); optical properties of materials and Drude theory; laser fundamentals; laser-matter interactions and laser-induced thermal and mechanical effects, laser applications in manufacturing (such as laser hardening, machining, sintering, shock peening, and welding). Knowledge of Heat & Mass Transfer required.
(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(s): [(MMAE 589)]
(3-0-3)

MMAE 591**Research & Thesis M.S.**

(Credit: Variable)

MMAE 593**MMAE Seminar**

Reports on current research. Full-time graduate students in the department are expected to register and attend.
(1-0-0)

MMAE 594**Project for Master of Engineering Students**

Design projects for the master of mechanical and aerospace engineering, master of materials engineering, and master of manufacturing engineering degrees.
(Credit: Variable)

MMAE 597**Special Topics**

Advanced topic in the fields of mechanics, mechanical and aerospace, metallurgical and materials, and manufacturing engineering in which there is special student and staff interest.
(Variable credit)
(Credit: Variable)

MMAE 600**Continuance of Residence**

(0-0-1)

MMAE 691**Research & Thesis Ph.D.**

(Credit: Variable)

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, isoperimetric finite elements, 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.
(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.
(2-0-2)

MMAE 707**High-Temperature Structural Materials**

Creep mechanisms and resistance. The use of deformation mechanisms maps in alloy design. Physical and mechanical metallurgy of high-temperature, structural materials currently in use. Surface stability: High-temperature oxidation, hot corrosion, protective coatings. Alternative materials of the 21st century. Elements of process metallurgy.
(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 & Nonlinear Finite Element Analysis**

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 student to solve practical engineering problems in solid mechanics and heat transfer using ABQUS 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.
Prerequisite(s): [(MMAE 704)]
(2-0-2)

MMAE 713**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 alternative, rate of return analysis, compound interest, inflation, depreciation, and estimating economic life of an asset.
(2-0-2)

MMAE 715**Project Management**

This course will cover the basic theory and practice of project management from a practical viewpoint. Topics will include project management concepts, recourses, duration vs. effort, project planning and initiation, progress tracking methods, CPM and PERT, reporting methods, replanning, team project concepts, and managing multiple projects. Microsoft Project software will be used extensively.
(2-0-2)

MMAE 724**Introduction to Acoustics**

This short course provides a brief introduction to the fundamentals of acoustics and the application to product noise prediction and reduction. The first part focuses on fundamentals of acoustics and noise generation. The second part of the course focuses on applied noise control.
(2-0-2)

Department of Physics

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

Chair:
Grant Bunker

The Department of Physics offers B.S., M.S., and Ph.D. degrees in physics. 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 a professional master's degree and related certificate program for part-time students, both on campus and through distance learning.

Degrees Offered

Master of Health Physics
Master of Science in Physics

Master of Science in Applied Physics
Doctor of Philosophy in Physics

Certificate Program

Radiological Physics

Research Centers

Center for Accelerator and Particle Physics
Center for the Molecular Study of Soft and Condensed Matter

Center for Synchrotron Radiation Research and Instrumentation

Research Facilities

The department has state-of-the-art computer and laboratory equipment and conducts research in the areas of elementary particle 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, Fourier transform infrared

spectrometers, and atomic force microscopes. 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), the Center for the Molecular Study of Soft and Condensed Matter, and the Center for Synchrotron Radiation Research and Instrumentation (CSRRI).

Faculty

Betts, R. Russell, Professor and Dean of the College of Science. B.A., M.A., Oxford University; M.S., Ph.D., University of Pennsylvania. Nuclear Physics.

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

Burnstein, Ray A., 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.

Chattopadhyay, Soma, Research Assistant Professor. B.S., M.S., University of Calcutta (India); Ph.D., Tata Institute of Fundamental Research (India).

Chen, Shih-Yew, Senior Lecturer and Director of the Health Physics Professional Master's Program.

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

Demortiere, Arnaud, Research Assistant Professor.

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

Gidalevitz, David, Associate Professor. B.S., M.S., Urals Technical University (Russia); Ph.D., Weizmann Institute of Technology (Israel). Membrane biophysics, biomaterials, drug delivery, biosensors and biomimetic thin films, and polymer films.

Glodowski, Alan, Senior Lecturer and Associate Chair. B.S., University of Wisconsin; M.S., Creighton University.

Hanlet, Pierrick, Research Assistant Professor. B.S., State University of New York-Stony Brook; Ph.D., University of Virginia.

Howard, Andrew J., Associate Professor of Biology and Physics and Laboratory Safety Officer. B.A., Pomona College; Ph.D., University of California-San Diego. Methods Development and Macromolecular crystallography. Biochemistry, Molecular Biochemistry and Biophysics.

Irving, Thomas C., Professor of Biology, Physics, and Biomedical Engineering and Executive Associate Chair - Biology, Biological and Chemical Sciences. B.Sc., M.Sc., Ph.D., University of Guelph (Canada). Structure and biophysics of macromolecular systems, muscle structure and physiology, synchrotron radiation instrumentation. Biochemistry, Molecular Biochemistry and Biophysics.

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

Kallend, John, Professor of Materials Engineering and Physics and Associate Dean for Accreditation. B.A., M.A., Ph.D., Cambridge University (England). Computational methods of crystallographic texture analysis and properties of polycrystalline aggregates.

Kaplan, Daniel, Professor. 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.

Mishra, Bhoopesh, Research Assistant Professor. B.Sc., Science College, Patna University (India); M.Sc., Indian Institute of Technology (India); Ph.D., University of Notre Dame.

Morrison, Timothy, Professor and Faculty Laboratory Safety Coordinator. B.A., Western Michigan University; Ph.D., University of Illinois, Urbana-Champaign. Solid-state physics, catalysts, x-ray absorption, x-ray optics.

Roberts, Thomas J., Research Professor.

Rubin, Howard A., Professor Emeritus. B.S., Massachusetts Institute of Technology; Ph.D., University of Maryland. Experimental elementary particle physics.

Schieber, Jay, Professor of Chemical Engineering and Physics and Director of the Center for the Molecular Study of Condensed Soft Matter. Ph.D., University of Wisconsin-Madison. Experiment, theory, and computation in the multiscale study of soft matter, including both biological and synthetic materials.

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

Segre, Carlo U., Duchossois Leadership Professor of Physics and Director of the Center for Synchrotron Radiation Research and Instrumentation (CSRRI). B.S. (Physics), B.S. (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.

Shibata, Tomohiro, Research Assistant Professor. B.Sc., M.Sc., Doctor of Science, University of Tokyo (Japan).

Faculty continued

Shylnov, Yurii, Lecturer. M.S., Kharkov State University (Ukraine); Ph.D., Tomsk State University (Russia).

Snopok, Pavel, Assistant Professor and Scientist at Fermi National Accelerator Laboratory. M.S., Ph.D., Saint-Petersburg State University (Russia); M.S., Ph.D., Michigan State University. Accelerator physics.

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

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

Sullivan, Zack, Associate Professor. B.A., Johns Hopkins University; M.S., Ph.D., University of Illinois, Urbana-Champaign. Theoretical Particle Physics beyond the Standard Model.

Terry, Jeffrey, Professor. B.S., University of Chicago; Ph.D., Stanford University. Synchrotron radiation techniques.

Torun, Yagmur, Associate Professor. B.S., Middle East Technical University; Ph.D., Stony Brook University. Accelerator and High Energy Physics.

Wereszczynski, Jeff, Assistant Professor. B.S., Rensselaer Polytechnic; Ph.D., University of Michigan. Biophysics.

White, Christopher G., Professor and Vice Provost for Academic Affairs. B.S., University of Illinois, Urbana-Champaign; Ph.D., University of Minnesota. Experimental elementary particle physics.

Yusof, Zikri M., Research Associate Professor. B.Sc., University of Wisconsin in Madison; Ph.D., Illinois Institute of Technology.

Zasadzinski, John, Paul and Suzi Schutt Endowed Chair in Science and Professor of Physics. B.S., Illinois Benedictine College; Ph.D., Iowa State University. Solid state physics.

Zwicker, Earl, Emeritus Professor of Physics. B.S., University of Wisconsin; Ph.D., Illinois Institute of Technology. Physics education.

Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0
TOEFL minimum: 550/213/80*

The Graduate Record Examination (GRE) is required for all applicants. The GRE minimum scores are:

Ph.D.: 310 (quantitative + verbal),
3.0 (analytical writing)
M.S.: 295 (quantitative + verbal),
2.5 (analytical writing)
MAS: 295 (quantitative + verbal),
2.5 (analytical writing)

Applicants to the doctoral program in physics are strongly encouraged, but not required, to take the subject-area GRE exam in 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 the department's program are expected to have a bachelor's 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 MAS or M.S. comprehensive/Ph.D. qualifying examination.

* Paper-based/computer-based/internet-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 officially for the examination a maximum of two 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 master's 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's degree program are required to take and pass a comprehensive exam. Students may sit for the exam a limited number of times.

Degrees

The department offers programs leading to M.S. and Ph.D. degrees in physics, along with a M.S. degree in applied 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 electrodynamics. Classes are generally small and informal, and thesis research is carried out in close collaboration with the faculty advisor.

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 advisor and must obtain the approval of the advisor each semester before registering for any graduate classes.

Bachelor of Science/Master of Health Physics - Co-Terminal Degree

Undergraduate students may register for the co-terminal Bachelor of Science/Master of Health Physics after the fourth semester of study. Students must fulfill the requirements of both the Bachelor of Science and the Master of Health Physics. A full course of study is approximately 10 semesters of study, and graduate coursework

typically begins in the fourth year. For further details, refer to "Co-Terminal Degrees" in Campus Resources, and a full description of the program can be found in the Undergraduate Bulletin.

Master of Health Physics

31 credit hours minimum
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 leadership, 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 http://iit.edu/iit_online/ for more information.

Required Courses

PHYS 561 Radiation Biophysics
PHYS 571 Radiation Physics
PHYS 572 Introduction to Health Physics
PHYS 573 Standards, Statutes, and Regulations
PHYS 575 Case Studies in Health Physics
PHYS 576 Radiation Dosimetry
PHYS 770 Instrumentation for Health Physics
CHEM 513 Statistics for Analytical Chemists
SCI 522 Public Engagement for Scientists
SCI 511 Project Management

OR

INTM 511 Industrial Leadership

Elective Courses (choose one)

PHYS 566 Environmental Health Physics
PHYS 574 Introduction to the Nuclear Fuel Cycle
PHYS 577 Operational Health Physics
PHYS 578 Medical Health Physics

Master of Science in Physics

32 credit hours

Comprehensive examination

Thesis and oral defense (optional)

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 semesters of PHYS 585 or PHYS 685 (Colloquium) and the M.S. core:

Required Courses

PHYS 501 Methods of Theoretical Physics I
 PHYS 505 Electromagnetic Theory
 PHYS 508 Analytical Dynamics
 PHYS 509 Quantum Theory I
 PHYS 510 Quantum Theory II
 PHYS 515 Statistical Mechanics

The remaining course requirements may be satisfied by additional graduate or advanced undergraduate electives.

Master of Science in Applied Physics

32 credit hours

Comprehensive examination

The Master of Science in Applied Physics is a rigorous graduate degree program designed specifically for the undergraduate engineering major. The traditional Bachelor of Science degree in engineering only requires about one year of university physics. This is not enough time to be exposed to the physics of the 20th century. This becomes a serious deficiency for those engineering students seeking careers in the nanotechnology industry or those pursuing advanced degrees in fields where a solid knowledge of physics is required. The fields of laser technology, optics, semi-conductors, nuclear energy, nanofabrication, and biotechnology all demand applied physics. IIT's Master of Science in Applied Physics is designed to provide the undergraduate engineering major with this fundamental knowledge of physics that they need for a successful career.

For students in the IIT-Paris double degree program, the program can be completed in one calendar year by taking classes in the fall, spring, and summer semesters. For students enrolled in undergraduate engineering on IIT's

main campus, there is the option of earning a Bachelor of Engineering and Master of Science in Applied Physics in just five years through a co-terminal degree program.

Required Courses

PHYS 405 Fundamentals of Quantum Theory I
 PHYS 406 Fundamentals of Quantum Theory II
 PHYS 501 Methods of Theoretical Physics I
 PHYS 505 Electromagnetic Theory
 PHYS 508 Analytical Dynamics
 PHYS 515 Statistical Mechanics

AND

PHYS 585 Physics Colloquium (taken twice)

OR

PHYS 685 Physics Colloquium (taken twice)

AND

PHYS 597 Reading and Special Problems

Engineering or Physics Electives (12 credit hours)

Four courses selected in consultation with the academic advisor may be used for elective credits. At least two of these courses must be from an engineering discipline.

Doctor of Philosophy in Physics

72 credit hours

Written qualifying examination

Comprehensive examination

Dissertation and oral defense

The requirements for the degree consist of a program of 72 credit hours approved by the faculty advisor; 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" in this bulletin for rules on how many credit hours may be transferred from another institution. The required coursework includes 4 semesters of PHYS 585 or PHYS 685 (Colloquium) and the graduate core:

Required Courses

PHYS 501 Methods of Theoretical Physics I
PHYS 505 Electromagnetic Theory
PHYS 508 Analytical Dynamics
PHYS 509 Quantum Theory I
PHYS 510 Quantum Theory II
PHYS 515 Statistical Mechanics

AND at least three from the following:

PHYS 502 Methods of Theoretical Physics II
PHYS 507 Electrodynamics
PHYS 510 Quantum Theory II
PHYS 537 Solid State Physics I
PHYS 538 Solid State Physics II
PHYS 539 Physical Methods of Characterization
PHYS 545 Particle Physics I
PHYS 546 Particle Physics II
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 carried out under the direct supervision of a faculty research advisor. Students must have passed the written qualifying examination before registering for PHYS 691 (Ph.D. Thesis Research).

Certificate in Radiological Physics

Required courses (choose three)

PHYS 561 Radiation Biophysics
PHYS 571 Radiation Physics I
PHYS 572 Radiation Physics II
PHYS 573 Standards, Statutes and Regulations
PHYS 575 Case Studies in Health Physics
PHYS 576 Internal Dosimetry
PHYS 770 Instrumentation for Radiation Health Physics

Elective courses (choose one)

PHYS 566 Environmental Health Physics
PHYS 574 Introduction to Nuclear Fuel Cycle
PHYS 577 External Dosimetry
PHYS 578 Therapeutic Medical Physics I

Course Descriptions

Numbers in parentheses indicate class, lab, and credit hours, respectively.

An asterisk (*) designates a course which may be taken concurrently.

PHYS 501

Methods of Theoretical Physics I

Vector analysis including curvilinear coordinates. Tensor algebra. Ordinary differential equations and special functions. Complex variables algebra, Cauchy-Riemann conditions, harmonic functions. Cauchy theorem, Cauchy formula. Laurent series. Residues calculus, calculation of integrals using residues. Partial differential equations: separation of variables, Fourier series methods. Laplace, wave, diffusion equations in Cartesian, cylindrical and spherical systems of coordinates. Special functions and orthogonal polynomials: Bessel functions, Legendre polynomials, associated Legendre polynomials, Hermite, Laguerre, etc. polynomials. (3-0-3)

PHYS 502

Methods of Theoretical Physics II

Green functions. Their connection with a complex variables calculus. Advanced, retarded, causal GF. Group theory. Discrete groups, elementary examples and properties. Lie groups, their fundamental properties, applications in quantum mechanics. $O(3)$, $SU(2)$, $SU(3)$, Lorentz groups and their applications in quantum theory. Basic ideas of differential geometry and topology. Path integrals. Special topics specified on the year-by-year basis. (3-0-3)

PHYS 505

Electromagnetic Theory

Maxwell equations including a derivation of their macroscopic version. Electrostatics, magnetostatics. Electromagnetic waves, dipole radiation, beyond the dipole radiation (quadrupole and magneto-dipole radiation); scattering of electromagnetic waves. Gradient (gauge) invariance, special relativity, Lorentz invariant formulation of electrodynamics, Maxwell equations in relativistic invariant form; Lienard-Wiechert fields, relativistic charge electromagnetic field, basic ideas of synchrotron radiation. (3-0-3)

PHYS 507

Electrodynamics

Covariant formulation of Maxwell's equations. Variational principles of classical field theory. Theory of radiation reactions. Topics in contemporary electrodynamics. Prerequisite(s): [(PHYS 505)] (3-0-3)

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. Undergraduates may take the course with permission of their advisor and their instructor. (3-0-3)

PHYS 509

Quantum Theory I

Survey of solutions to the Schrodinger Equation in one, two, and three dimensions. Hydrogen, helium, and other atoms. Spin $1/2$ particles. Entangled states. EPR Paradox. Bell's Theorem. Formalism of quantum mechanics. Magnetic fields in quantum mechanics. Aharonov-Bohm Effect. Berry's Phase. Time Independent Perturbation Theory. Spin-orbit coupling. Variational method. WKB Method. Many electron wavefunction. Pauli Principle. More detailed look at excited states of helium atom. Time Dependent Perturbation Theory. Fermi's Golden Rule. Lifetime of excited atomic states. (3-0-3)

PHYS 510

Quantum Theory II

Algebra of angular momenta. Rotation Group. Abstract group theory, Lie algebra, generators, structure constants. $O(3)$, $SU(2)$, $SU(3)$, Lorentz group examples. Scattering theory. S-matrix. Lippmann-Schwinger Equation. Partial wave analysis. Second quantization. Its applications. Bogolyubov transformations. Relativistic Quantum Mechanics. Klein-Gordon Equation. Dirac Equation. Prerequisite(s): [(PHYS 405 and PHYS 406) OR (PHYS 509)] (3-0-3)

PHYS 515

Statistical Mechanics

Ensembles and distribution functions. Classical gases and magnetic systems. Ideal Quantum Gases. Interacting systems. Real Space Renormalization group and critical phenomena. Quantum Statistical Mechanics: Superfluidity and superconductivity. Fluctuations and dissipation. (3-0-3)

PHYS 518

General Relativity

Lorentz transformations, Minkowski space, 4D vectors and tensors, kinematics and dynamics of special relativity. Riemann geometry, Christoffel symbols, covariant derivatives, geodesics, curvature tensor, Einstein equations. Classical experiments of general relativity, Schwarzschild solution, physics of black holes. Cosmology, Big Bang theory, gravitational waves. Instructor permission required. (3-0-3)

PHYS 520

Bio-Nanotechnology

In this multidisciplinary course, we will examine the basic science behind nanotechnology and how it has infused itself into areas of nanofabrication, biomaterials, and molecular medicine. This course will cover materials considered basic building blocks of nanodevices such as organic molecules, carbon nanotubes, and quantum dots. Top-down and bottom-up assembly processes such as thin film patterning through advanced lithography methods, self-assembly of molecular structures, and biological systems will be discussed. Students will also learn how bionanotechnology applies to modern medicine, including diagnostics and imaging and nanoscale, as well as targeted, nanotherapy and finally nanosurgery. (3-0-3)

PHYS 537

Solid State Physics I

Crystal structure and crystal binding. Free electron model of metals and semiconductors. Energy band theory. Elastic Properties. Lattice Waves, Dielectric properties. Prerequisite(s): [(PHYS 406)] (3-0-3)

PHYS 538

Solid State Physics II

Higher order susceptibility, spin-orbit coupling, optical absorption, superconductivity. Properties of metals, semiconductors, and insulators. Device physics. Magnetic properties of materials.

Prerequisite(s): [(PHYS 406)]

(3-0-3)

PHYS 539

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. Same as CHEM 509.

(3-0-3)

PHYS 545

Particle Physics I

The course is an introduction to and overview of the field of elementary particle physics. No previous exposure is assumed. The first third of the course is devoted to the symmetries of the strong interaction. The second third is a modern introduction to the gauge theories of the electromagnetic, strong, and weak interactions, and their leading evaluation via Feynman diagrams. The final third introduces topics of current and speculative research.

Prerequisite(s): [(PHYS 509 and PHYS 510)]

(3-0-3)

PHYS 546

Particle Physics II

The course is a continuation of PHYS 545 but is self-contained. The goal is to provide a functional understanding of particle physics phenomenology of QED, QCD, and electroweak physics. Topics include QED: Spin-dependent cross sections, crossing symmetries, C/P/CP QCD: Gluons, parton model, jets Electroweak interactions: W, Z, and Higgs. Weak decays and production of weak bosons Loop calculations: Running couplings, renormalization.

Prerequisite(s): [(PHYS 509 and PHYS 510)]

(3-0-3)

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.

(3-0-3)

PHYS 561

Radiation Biophysics

Energy loss by ionizing radiation. Target theory. Direct and indirect action. Radiation effects in biomolecules. Radiation inactivation of enzymes, nucleic acids, and viruses. Biological effects of ultraviolet radiation. Photosensitization. Radiation protection and sensitization. Radiation effects in vivo, radiation therapy, and phototherapy.

Prerequisite(s): [(PHYS 410)]

(3-0-3)

PHYS 563

Project Management: Business Principles

The course will cover a wide range of business principles highlighting project management and the components of business that employees may encounter. The goal of the course is to help the student understand basic business principles and project management skills, help the student understand the application of organizational behavior in today's workplace and equip the student to function more effectively both independently and as a team in today's organizations.

(2-0-2)

PHYS 566

Environmental Health Physics

Impact of ionizing radiation and radionuclides on the environment. Identifying environmental effects of specific natural and artificial nuclides. Models for deposition and transport of nuclides, including air and water disbursement. Environmental dosimetry and remediation. Facility decommissioning and decontamination.

Prerequisite(s): [(PHYS 572)]

(2-0-2)

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

Radiation Physics

Fundamentals of Radiation Physics will be presented with an emphasis on problem-solving. Topics covered are review of atomic and nuclear physics; radioactivity and radioactive decay law; and interaction of radiation with matter, including interactions of heavy and light charged particles with matter, interactions of photons with matter, and interactions of neutrons with matter.

(3-0-3)

PHYS 572

Introduction to Health Physics

Health Physics profession; Units in radiation protection; Radiation sources; Interaction of ionizing radiation with matter; Detectors for radiation protection; Biological effects of ionizing radiation; Introduction to microdosimetry; Medical health physics; Fuel cycle health physics; Power reactor health physics; University health physics; Accelerator health physics; Environmental health physics; Radiation accidents.

Prerequisite(s): [(PHYS 571)]

(3-0-3)

PHYS 573

Standards, Statutes, & Regulations

This course studies the requirements of agencies that regulate radiation hazards, their basis in law and the underlying US 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 574**Introduction to Nuclear Fuel Cycle**

This course introduces the concept and components of nuclear fuel cycle that originated from the mining of uranium through the production and utilization of nuclear fuel to the nuclear/radioactive waste generation and disposal. The mechanisms of normal operations through the fuel cycle process will be discussed as well as the accidental situations with expanded coverage on nuclear reactor issues. Emphasis will be placed on the radiological health and safety aspects of the operations. The study will also include key regulatory compliance issues.

(2-0-2)

PHYS 575**Case Studies in Health Physics**

This is a non-instructional course designed to promote the understanding of radiation safety through lessons learned from the past incidents. The focus will be on the means for improving the future operations of the facilities/devices. The course is recommended to be among the last courses taken by students who have gained at least one year of academic exposure in health physics and with some level of capability in to address the underlying technical aspects.

Prerequisite(s): [(PHYS 571, PHYS 572, and PHYS 573)]

(3-0-3)

PHYS 576**Radiation Dosimetry**

This course is to study the science and technique of determining radiation dose and is fundamental to evaluating radiation hazards and risks to humans. This course covers both external dosimetry for radiation sources that are outside the human body and internal dosimetry for intake of radioactive materials into the human body. Topics will include: dosimetry recommendations of ICRP for occupational exposure; US NRC and DOE requirements for particular work environments; and MIRD methodology for medical use of radionuclides.

Prerequisite(s): [(PHYS 571 and PHYS 572*)] An asterisk (*) designates a course which may be taken concurrently.

(3-0-3)

PHYS 577**Operational Health Physics**

Covers the basic principles for establishing and maintaining an effective institutional radiation safety program including the following: facility design criteria; organizational management issues; training; internal and external radiation control; radioactive waste disposal; environmental monitoring; radiation safety instrumentation; ALARA program; and emergency response planning. The course will also cover facility licensing/registration with state and federal agencies and legal issues such as institutional and individual liability, fines, violations, and worker rights and responsibilities.

(2-0-2)

PHYS 578**Medical Health Physics**

Medical Health Physics (MHP) profession; sources of radiation in the medical environment; radioisotopes in nuclear medicine; diagnostic use of X-rays (radiography, mammography, CT, fluoroscopy); therapeutic use of X-ray and gamma radiation (Co-60 and LINAC based radiation therapy); radiotherapy using sealed radioisotopes (brachytherapy); radiation protection in diagnostic and interventional radiology; radiation protection in nuclear medicine; radiation protection in external beam radiotherapy; radiation protection in brachytherapy; radiation accidents in medicine.

(2-0-2)

PHYS 585**Physics Colloquium**

Lectures by invited scientists in areas of physics generally not covered in the department. May be taken twice by M. S. students to fulfill course credit requirements.

(1-0-1)

PHYS 591**Research & Thesis M.S.**

(Credit: variable) Prerequisite: Instructor permission required.

(Credit: Variable)

PHYS 597**Reading & 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)

Prerequisite: Instructor permission required.

(Credit: Variable)

PHYS 600**Continuation of Residence**

(0-0-1)

PHYS 685**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. May be substituted by PHYS 585 for M. S. students.

(1-0-0)

PHYS 691**Research & Thesis Ph.D.**

(Credit: Variable)

(Credit: Variable)

PHYS 770**Instrumentation for 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 scalars to high speed multi-channel analyzers is used. Computer linked instrumentation and computer based applications are applied to practical problems.

(3-4-3)

Department of Psychology

Life Sciences Building
3105 S. Dearborn St.
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312.567.3500
psychology@iit.edu
humansciences.iit.edu/psychology

Chair:

Ronald S. Landis

Associate Chair:

Scott B. Morris

Director, Clinical Psychology:

Michael Young

Director, Industrial and Organizational Psychology:

Roya Ayman

Director, Counseling and Rehabilitation Science:

Frank Lane

The Department of Psychology offers graduate programs in Clinical Psychology, Industrial/Organizational (I/O) Psychology, Rehabilitation Counseling Education, and Rehabilitation and Mental Health Counseling. The department'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 and Mental Health Counseling

Master of Science in Rehabilitation and Mental Health Counseling with Advanced Standing
Doctor of Philosophy in Psychology
Doctoral specialty training in:
Clinical
Industrial/Organizational
Rehabilitation Counseling Education
Postdoctoral Retraining in Clinical Psychology

Combined Degree Programs

Bachelor of Science in Psychology/Master of Science in Personnel and Human Resources Development

Certificate Programs

Compensation Management
Psychiatric Rehabilitation
Rehabilitation Engineering Technology

Rehabilitation Counseling

Research Centers

Psychology faculty and students collaborate on applied research projects through the Center for Research and Service (CRS). Founded as the IIT Institute for Psychological Services in 1943, the CRS has an exceptional track record of providing organizations with meaningful metrics for managing human resources and has existed as a consulting unit since 1998. Leveraging the skills of faculty, students, and staff, the CRS evolved into one of the country's premier university-based research and services firm. Today, the CRS employs a staff of four full-time consulting professionals, approximately 30 Ph.D students, and 12 faculty from our industrial/organizational, clinical, and rehabilitation psychology programs.

The National Consortium on Stigma and Empowerment (NCSE) is a research group meant to promote recovery from mental illness by understanding the stigma associated with mental illness and promoting personal empowerment. The consortium (www.ncse1.org), largely funded by NIMH, is located at Illinois Institute of Technology, directed by Patrick Corrigan, and includes a collection of researches at Yale University, the University of Pennsylvania, Rutgers University, Temple University, Dartmouth University, the University of Illinois-Chicago, and New York University.

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. Spe-

cial computer and video equipment is part of the research facilities. There are graduate student offices, a testing library, and a student lounge. Many journals and databases are available through IIT's libraries.

Research Areas

Clinical psychology faculty interests include: health psychology, attachment, child social and emotional development, educational assessment, eating disorders, 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, work-family interface, training design and evaluation, performance appraisal, test development, selection bias, occupational health psychology, and item response theory. Counseling and Rehabilitation Science faculty pursue research in the areas of: mental health counseling, adjustment to disability, vocational rehabilitation, factors affecting job placement, rehabilitation engineering technology, psychiatric rehabilitation, ethics and ethical issues in counseling, and clinical supervision.

Faculty

Ayman, Roya, Professor of Psychology and Director of Industrial/Organizational Training. B.A., M.A., Ph.D., University of Utah. Gender and diversity in the workplace, culture, and organizational behavior.

Corrigan, Patrick, Distinguished Professor of Psychology. 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.

Ditchman, Nicole, Assistant Professor of Psychology. B.S., M.S. University of Illinois, Urbana-Champaign; Ph.D., University of Wisconsin-Madison. School-to-work transition, social relationships, and community engagement of individuals with disabilities and mental health issues.

Ellington, J. Kemp, Assistant Professor of Psychology. B.S., Appalachian State University; M.S., Ph.D., North Carolina State University. Training evaluation and effectiveness, performance appraisal issues such as rater effects, contextual influences, and developmental feedback.

Geist, Glen, Professor Emeritus of Psychology. B.A., Allegheny College; M.S., Ph.D., State University of New York-Buffalo. Private rehabilitation, job placement.

Haedt-Matt, Alissa, Assistant Professor of Psychology. B.S., M.A., Ph.D., University of Iowa. Eating and weight disorders and associated psychopathology.

Hopkins, Joyce, Associate Professor of Psychology. 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.

Houston, Eric, Assistant Professor of Psychology. B.A., Carleton College; M.A., Ph.D., University of Illinois-Chicago. Relationship between health outcomes and psychological factors and treatment motivation.

Huyck, Margaret, Professor Emerita of Psychology. A.B., Vassar College; M.A., Ph.D., University of Chicago. Gerontology, adult development.

Kazukauskas, Kelly A., Clinical Assistant Professor. B.S., Texas A&M University; M.S., Ph.D., Illinois Institute of Technology. Rehabilitation and mental health counselor competency and training, ethics and professional issues in counseling and clinical supervision, sexuality and disability.

Lam, Chow, Professor Emeritus of Psychology. B.S., M.S.ed., University of Wisconsin-Whitewater; Ph.D., University of Wisconsin-Madison. Stages of change, cross-cultural issues in rehabilitation.

Landis, Ronald S., Nambury S. Raju Professor of Psychology and Department Chair. B.A., Pennsylvania State University; M.A., Ph.D., Michigan State University. Quantitative research methods, measurement, philosophy of science, personnel selection, individual and team performance, and recruitment.

Lane, Frank J., Associate Professor of Psychology and Director of the Rehabilitation Program. B.A., St. Leo College; M.H.S., Ph.D. University of Florida. Rehabilitation technology, implant technology, ethics in mental health and rehabilitation counseling, crime and disability.

Larson, Jonathan, Assistant Professor of Psychology. B.A., Western Illinois University; M.S., Southern Illinois University; Ed.D., Roosevelt University. Staff burnout, psychiatric rehabilitation, supported employment, stigma, mental health leadership.

Lee, Eun-Jeong, Associate Professor of Psychology. B.A., M.A., The Catholic University of Korea; Ph.D., University of Wisconsin-Madison. Cognitive Vulnerability Model of Depression for people with disabilities, psychosocial aspects to people with disabilities, positive psychology as it relates to disability and mental health, research methodologies, and epilepsy rehabilitation.

Legate, Nicole, Assistant Professor of Psychology. B.A., University of California-Los Angeles; M.A., University of Rochester.

Miller, Jennifer L., Assistant Professor of Psychology. B.A., University of Tennessee; M.S., Ph.D., Indiana University. Development of communication in complex social networks.

Mitchell, M. Ellen, Professor of Psychology and Deputy Director of the Institute of Science, Law, and Technology. B.A., Hamilton/Kirkland College; Ph.D., University of Tennessee. Social support, family and marital therapy.

Moller, Arlen, Associate Professor of Psychology. B.A., Cornell University; M.A., Ph.D., University of Rochester. Wellness, motivation, use of technology to promote healthy lifestyle.

Morris, Scott, Professor of Psychology and Associate Chair. B.A., University of Northern Iowa; M.A., Ph.D., University of Akron. Personnel selection, employment discrimination, statistics.

Saxena, Mahima, Assistant Professor of Psychology. B.A., University of Delhi (India); M.Sc., Goldsmiths, University of London (United Kingdom), Ph.D., Purdue University. Mindfulness, Occupational health psychology, experience sampling methodology.

Schleser, Robert, Professor of Psychology. B.A., Rutgers University; M.S., Ph.D., Memphis State University. Developmental issues, educational evaluation.

Stanard, Steven, Visiting Associate Professor of Psychology. B.A., Illinois State University; M.A., Xavier University; Ph.D., Illinois Institute of Technology. Executive coaching, managerial assessment, police selection and promotion.

Young, Michael, Professor of Psychology. A.B., University of Chicago; M.A., Ph.D., Adelphi University. Seasonal affective disorder, cognitive models of depression, statistical modeling of psychopathology.

Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0

Typical GRE score minimum for M.S./Ph.D.:

298 (quantitative + verbal) 3.0 (analytical writing)

Minimum TOEFL score: 550/213/80*

3 letters of Recommendation

The master's program in Rehabilitation and Mental Health Counseling does not require the GRE. Each degree program is unique, but the stated minimum requirements are typical values and 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 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 masters in Rehabilitation and Mental Health 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 academic 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, Rehabilitation Counseling Education, and Rehabilitation and Mental Health Counseling). Therefore, a prospective student must designate a specialty area on the appropriate form.

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

Program Descriptions

The Clinical Psychology program offers a Ph.D. degree in Clinical Psychology. The Clinical Psychology Ph.D. program has been fully accredited for over 25 years by the American Psychological Association, and offers training from the cognitive-behavioral framework. 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 and most other states. Graduates typically function as practitioners and researchers in medical centers and multi-disciplinary clinical settings.

The Industrial/Organizational Psychology program offers an M.S. degree in Personnel and Human Resource Development and a Ph.D. in Industrial/Organizational Psychology. The program emphasizes a science-practice model of training. 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 Counseling and Rehabilitation Science program offers an M.S. degree in Rehabilitation and Mental Health Counseling, a Ph.D. in Rehabilitation Counseling Education, and a Ph.D. in combined Clinical/Rehabilitation Psychology. The mission of the Rehabilitation and Mental Health Counseling program is to prepare master's degree students to perform a vital role as counselors who have specialized knowledge and skills for both rehabilitation and clinical mental health counseling service delivery. This includes the ability to serve persons with a diverse array of problems impacting the individual, and/or the family, in a variety of clinical settings and with respect for the influences of multicultural factors such as culture, ethnicity, race, religion, gender, and sexual orientation. Students also receive specialized training in the vocational, educational, and personal adjustment of persons with physical, mental, and emotional disabilities. The objectives of the program are to: (1) Train individuals in the practice of rehabilitation and clinical mental health counseling, which includes specialized knowledge in and experience related to counseling and treatment modalities appropriate for the service of a variety of clients in diverse rehabilitation and mental health counseling settings; (2) Develop mature, capable professionals who are able to relate constructively to clients, to work with clients to facilitate behavior change, demonstrate therapeutic interaction skills, and to facilitate the client's development of problem-solving skills; and (3) Prepare students for professional service and leadership within the fields of rehabilitation and mental health counseling. The program also provides advanced training for persons presently employed in agencies and facilities offering services to persons with disabilities. This program prepares counselors for employment in community mental health facilities; 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.

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 Seminar in Industrial Training
PSYC 556 Organizational Psychology
PSYC 558 Industrial Psychology Internship I
PSYC 559 Industrial Psychology Internship II

These core courses provide a broad understanding of human relations in the workplace through theory and practice. Electives in advanced general psychology, 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" (or appropriate remedial work determined by the college) constitutes the comprehensive requirement. There is no foreign language requirement.

Minimum requirements for admission include a bachelor's degree from an accredited institution, a minimum undergraduate GPA of 3.1/4.0, GRE results, and favorable academic recommendations. Further information can be obtained from the program upon request.

Master of Science in Psychology

32 credit hours

Thesis and oral defense

The M.S. in Psychology is 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.

Required Courses

PSYC 545 Graduate Statistics I
PSYC 546 Graduate Statistics II
PSYC 591 Research and Thesis for the M.S. Degree

Required Courses (must be completed within two years after the sequence is started)

PSYC 501 Biological Bases 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. The remaining courses are planned by the student and advisor according to the requirements of the student's program area as noted below. No more than 12 credit hours may be taken below the 500 level. More detailed information concerning requirements for specialization in the areas of Clinical or psychology is available from the Department.

Upon completion of the thesis, the student must satisfactorily complete an oral examination, which is limited to a defense of the thesis.

Additional courses for Clinical students:

PSYC 510 Clinical Assessment I
PSYC 518 Basic Clinical Skills
PSYC 519 Therapy I-A
PSYC 526 Psychopathology

Additional courses for I/O students:

PSYC 529 Personnel Selection & Evaluation
PSYC 556 Organizational Psychology

AND one elective course

Master of Science in Rehabilitation and Mental Health Counseling

60 credit hours

Project

The Rehabilitation and Mental Health Counseling education program, fully accredited by the Council on Rehabilitation Education since 1975, is designed to prepare students to function as rehabilitation and/or clinical mental health counselors for persons with a variety of needs including mental health issues impacting the individual and/or family, and persons with physical or mental disabilities who need psychosocial and vocational readjustment. The program is grounded in a strengths-based philosophy of client empowerment where the counselor's role is to assist individuals to realize their optimum level of mental health and personal wellness, including vocational adjustment and independent living. This is done through the use of a variety of therapeutic interventions, including individual, group and/or family counseling, diagnosis, case management, the provision or coordination of evaluation, physical restoration, training, placement, and follow-up services. The demand for rehabilitation and clinical mental health 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 fields of rehabilitation and mental health counseling. These include counseling theory, rehabilitation and mental health counseling principles and practices with an emphasis on psychiatric rehabilitation, individual and group counseling, assessment in rehabilitation and mental health counseling, diagnosis of mental disorders, evidence-based treatment of mental disorders, job placement, medical and psychosocial aspects of disability, human growth, behavior and career development, and research methods.

Concurrently, field work of progressively increasing complexity takes place at a variety of community based mental health and rehabilitation facilities in the Chicago area. These include mental health and counseling centers, community rehabilitation facilities, the state department of vocational rehabilitation, rehabilitation centers, mental health centers, medical hospitals, and other facilities for persons with mental health concerns and/or disabilities.

This is a two-year 60-credit-hour program.

Required Courses

- PSYC 410 Introduction to Rehabilitation & Mental Health Counseling
- PSYC 411 Medical Aspects of Disabling Conditions
- PSYC 412 Multicultural & Psychosocial Issues in Rehabilitation & Mental Health Counseling
- PSYC 513 Assessment in Rehabilitation & Mental Health Counseling
- PSYC 523 Introduction to Theories of Psychotherapy
- PSYC 526 Psychopathology
- PSYC 557 Pre-Practicum in Rehabilitation & Mental Health Counseling
- PSYC 561 Applied Counseling Techniques: Group Counseling
- PSYC 562 Job Placement
- PSYC 563 Human Growth and Career Development
- PSYC 564 Rehabilitation & Mental Health Counseling Research Seminar
- PSYC 583 Rehabilitation Engineering Technology I: Survey of Interdisciplinary Application of RET
- PSYC 588 Graduate Psychology Seminar
- PSYC 590 Psychiatric Rehabilitation

Community-based clinical experience includes the following:

- PSYC 549 Practicum in Rehabilitation & Mental Health Counseling
- PSYC 578 Rehabilitation & Mental Health Counseling Internship I
- PSYC 579 Rehabilitation & Mental Health Counseling Internship II

Students are also required to complete a rehabilitation and mental health counseling research project. (PSYC594 or PSYC 576).

For individuals currently working in the rehabilitation and mental health counseling field who are interested in pursuing a M.S. in Rehabilitation and Mental Health Counseling at a slower pace, there is a part-time option available which is designed to meet the needs of the working professional. Courses are generally offered in the evening and via distance education, and the required fieldwork experiences (practicum and internship) are typically worked out with the student's place of employment. The part-time program takes approximately three years to complete.

Full and part-time students admitted to the program may be eligible for Rehabilitation Services Administration (RSA) traineeships that help cover the cost of tuition and include a stipend for books and supplies. Traineeships are awarded on the basis of economic need and academic performance. The precise numbers of traineeships vary from year to year and cannot be guaranteed to any student at the time of acceptance in the program.

Master of Science in Rehabilitation and Mental Health Counseling with Advanced Standing

45-60 credit hours
Project

Candidates who hold a B.A. or B.S. in psychology or other relevant degree or international students holding a relevant professional degree from outside the U.S.; and who have completed the equivalent of the first semester's required courses may qualify for up to 15 credit hours of advanced standing in the Master of Science in Rehabilitation and Mental Health Counseling program.

Admission with Advanced Standing may allow the candidate to complete the Master of Rehabilitation and Mental Health Counseling degree in 1.5 years (three semesters), depending on prior preparation. The regular master's program in Rehabilitation and Mental Health Counseling requires 60 credit hours post bachelors usually completed over the course of 2 years. However, applicants who meet the admissions requirements and already have some qualifying graduate-level coursework from another university may be eligible for Advanced Standing. In addition, IIT undergraduate students who meet the criteria for regular admission to the master's program can consider completing their master's degree more quickly by smart use of their electives. In the junior and senior years, qualified students can take graduate courses to meet their undergraduate elective requirements.

For a course to be accepted towards advanced standing, the student needs to obtain a grade of B or better. Candidates may be asked to provide additional evidence on their previous coursework, including projects and course syllabi, to determine eligibility for Advanced Standing. Candidates will be notified upon admission as to their acceptance of Advanced Standing.

Interested students should submit a formal application to the Rehabilitation and Mental Health Counseling Program in the fall of their sophomore or junior year and work closely with the Head of the Division of Counseling and Rehabilitation Science and their undergraduate academic advisor throughout to ensure proper course sequencing.

The following courses may be considered towards advanced standing in the M.S. degree in Rehabilitation and Mental Health 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 junior and senior year, and in consultation with the Head of Division of Counseling and Rehabilitation Science, students may take the following courses:

- PSYC 410 Introduction to Rehabilitation & Mental Health Counseling
- PSYC 411 Medical Aspects of Disabling Conditions
- PSYC 412 Multicultural & Psychosocial Issues in Rehabilitation & Mental Health Counseling
- PSYC 513 Assessment in Rehabilitation & Mental Health Counseling
- PSYC 523 Introduction to Theories of Psychotherapy
- PSYC 562 Job Placement
- PSYC 563 Human Growth and Career Development
- PSYC 564 Rehabilitation & Mental Health Counseling Research Seminar
- PSYC 583 Rehabilitation Engineering Technology I: Survey of Interdisciplinary Application of RET
- PSYC 590 Psychiatric Rehabilitation

Except as noted above, the requirements for this degree are the same as the Master of Science in Rehabilitation and Mental Health Counseling.

Doctor of Philosophy

The department of Psychology grants a single Ph.D. in Psychology with specialization in Clinical, I/O, or Rehabilitation Counseling Education. There are both common and unique requirements across the three specializations and are described separately for each.

Common Requirements

All Ph.D. students must complete the sequence of PSYC 501, PSYC 502, PSYC 503, and PSYC 504 with a minimum of "B" average and no more than one "C" in these four courses.

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 dissertation research, a student must present a dissertation 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 dissertation and conducted by a committee nominated by the department and appointed by the Dean of Graduate Studies.

Clinical

The Ph.D. program with specialization in Clinical Psychology is accredited by the American Psychological Association. Completion typically requires six 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 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 underserved 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 and most other states. Graduates typically function as practitioners and researchers in medical centers and multi-disciplinary clinical settings.

Students may elect to further specialize in the Rehabilitation Track. This specialization requires practica in a rehabilitation settings. In addition, students complete their 5 elective seminars in the Rehabilitation Program curriculum and their research with Rehabilitation Program faculty. The specialization in the Rehabilitation Track occurs in addition to the standard program of the Clinical specialization.

A Clinical Respecialization Program 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 respecialization students, the program is tailored to the individual's specific training needs.

107 credit hours minimum

Comprehensive exam

Dissertation and oral defense

Internship (1 year, full-time)

Required Courses (including those required for M.S. degree)

Foundational Courses

PSYC 501 Biological Bases of Behavior
 PSYC 502 Social Bases of Behavior
 PSYC 503 Learning, Cognition, and Motivation
 PSYC 504 Individual and Cultural Differences
 PSYC 505 History and Systems of Psychology
 PSYC 540 Research Methods
 PSYC 545 Graduate Statistics I
 PSYC 546 Graduate Statistics II
 PSYC 554 Survey of Multivariate Statistics

Base Clinical Courses

PSYC 508 Ethics and Professional Issues I
 PSYC 509 Ethics and Professional Issues II
 PSYC 525 Developmental Psychopathology
 PSYC 523 Theories of Psychotherapy
 PSYC 526 Psychopathology

Clinical Practice Courses

PSYC 507 Therapy II
 PSYC 510 Clinical Assessment I
 PSYC 512 Clinical Assessment II
 PSYC 518 Basic Clinical Skills
 PSYC 519 Therapy I-A
 PSYC 533 Clinical Practicum
 PSYC 599 Clinical Internship

Elective Seminars (15 credit hours). Some offerings in recent years: Health Psychology, Affective Disorders, Neuropsychological Assessment, Eating & Weight Disorders, Assessment and Treatment of Young Children, Child Cognitive Development, Psychology of Sport, Performance and Health; Structural Equation Modeling, Psychometric Theory, Hierarchical Linear Models

Research

PSYC 591 Research and Thesis M.S.
 PSYC 691 Research and Thesis Ph.D.

Doctor of Philosophy (continued)

I/O

The Ph.D. program in I/O Psychology includes coursework in both personnel and organizational psychology. Two semesters of internship in an organizational setting are required. Students in this program frequently are advised to supplement departmental offerings with selected courses in management, or other related fields.

96 credit hours minimum

Comprehensive exam

Dissertation and oral defense

Internship

Required Courses (including those required for M.S. degree)

PSYC 501 Biological Bases of Behavior

PSYC 502 Social Bases of Behavior

PSYC 503 Learning, Cognition, and Motivation

PSYC 504 Individual and Cultural Differences

PSYC 511 Psychometric Theory

PSYC 529 Personnel Selection and Evaluation

PSYC 545 Graduate Statistics I

PSYC 546 Graduate Statistics II

PSYC 554 Survey of Multivariate Statistics

PSYC 555 Seminar in Industrial Training

PSYC 556 Organizational Psychology

PSYC 558 Industrial Psychology Internship I

PSYC 559 Industrial Psychology Internship II

PSYC 591 Research and Thesis M.S.

PSYC 691 Research and Thesis Ph.D. (minimum of 24 hours)

Elective Courses (27 hours from the following courses, all courses are 3 credits except as noted)

PSYC 517 Performance Appraisal Seminar

PSYC 530 Contemporary Issues in Industrial Organizational Psychology

PSYC 531 Organizational Attitudes and Behavioral Seminar

PSYC 535 Seminar in Personnel Selection

PSYC 540 Research Methods

PSYC 552 Legal Issues in Human Resource Management

PSYC 571 Seminar in Quantitative Psychology

PSYC 580 Seminar in Leadership

PSYC 588 Graduate Psychology Seminar

PSYC 711 Multi-Level Data Analysis (1.5 credits)

PSYC 714 Assessment Centers (1.5 credits)

Courses may also be selected from Stuart School of Business offerings.

Rehabilitation Counseling Education

The curriculum for the Ph.D. program with specialization in Rehabilitation Counseling Education includes core counseling courses (e.g., individual and group counseling theories and microskills), and rehabilitation-specific coursework (e.g., vocational counseling and evaluation, job placement, medical and psychosocial aspects of disability), which provide the basic knowledge and skills necessary to rehabilitation counseling practice. Practicum and internships are taken at rehabilitation and social service agencies in the Chicago area.

96 credit hours minimum

Comprehensive exam

Dissertation and oral defense

Curriculum

Psychological Foundations

PSYC 505 History and Systems of Psychology

PSYC 501 Biological Bases of Behavior

PSYC 502 Social Bases of Behavior

PSYC 503 Learning, Cognition, and Motivation

PSYC 504 Individual and Cultural Differences

Statistics and Research Design

PSYC 540 Research Methods

PSYC 545 Graduate Statistics I

PSYC 546 Graduate Statistics II

PSYC 554 Survey of Multivariate Statistics

Rehabilitation Core

PSYC 573 Psychosocial Bases: Disability and Behavior

PSYC 575 Adult Career Development and Vocational Behavior

PSYC 577 Professional and Ethical Issues in Rehabilitation Counseling Psychology

Experiential Components of Rehabilitation

PSYC 586 Concepts of Supervision

PSYC 597 Special Problems

Minor

In consultation with their academic advisor, students will also select 12 credits of courses in fulfillment of their minor.

Special Fellowships

Since its inception, the Rehabilitation Services Administration (RSA) of the U.S. Department of Education has continuously funded IIT's Rehabilitation Counselor Education programs. The RSA traineeships are designed to increase the number of practicing rehabilitation counselors by covering the cost of tuition and books. Trainee-

ship grants, when available, may cover up to full tuition plus a monthly stipend. To a limited number of students, the Department 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.

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 in this bulletin). However, IIT psychology majors who meet the criteria for regular admission to the master's program can consider completing their master's 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 Head of the 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

OR

PSYC 504 Individual and Cultural Differences

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 master's 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 the summer with the Director of the I/O Program.

Certificate Programs

Compensation Management

Required Courses

PSYC 710 Compensation and Benefit Application
PSYC 716 Base Pay Management
PSYC 717 Variable Pay Programs
PSYC 719 Fundamentals of Employee Benefits Programs

AND one of the following:

PSYC 529 Personnel Selection and Evaluation
PSYC 556 Organizational Psychology

Psychiatric Rehabilitation

Required Courses

PSYC 526 Psychopathology
PSYC 588 Graduate Psychology Seminar
PSYC 590 Psychiatric Rehabilitation

Rehabilitation Engineering Technology

Required courses

PSYC 583 Rehabilitation Engineering Technology I:
Survey of Interdisciplinary Application of
RET
PSYC 584 Rehabilitation Engineering Technology II:
Access to Independence Through Assistive
Technology
PSYC 585 Rehabilitation Engineering Technology III

Rehabilitation Counseling

Required courses

PSYC 410 Introduction to Rehabilitation and Mental
Health Counseling
PSYC 513 Assessment in Rehabilitation and Mental
Health Counseling
PSYC 523 Introduction to Theories of Psychotherapy
OR
PSYC 557 Pre-Practicum in Rehabilitation and Mental
Health Counseling

PSYC 562 Job Placement

OR

PSYC 563 Human Growth and Career Development

OR

PSYC 575 Adult Career Development and Vocational
Behavior

PSYC 411 Medical Aspects of Disabling Conditions

OR

PSYC 588 Graduate Psychology Seminar

PSYC 578 Rehabilitation and Mental Health Counseling
Internship I

OR

PSYC 599 Clinical Internship

Course Descriptions

Numbers in parentheses indicate class, lab and credit hours, respectively.

PSYC 501

Biological Bases 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, & 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 & 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 505

History & Systems of Psychology

Critical and conceptual evaluation of influential philosophical and psychological theories of human behavior: From the Greek bronze age to the modern era.

(3-0-3)

PSYC 506

Therapy I

Basic clinical skills including intake, suicide assessment, case formulation, differential diagnosis, and basics of conducting cognitive behavioral therapy. Taken when not preceded by PSYC 518 (Basic Clinical Skills).

(3-0-3)

PSYC 507

Therapy 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. Requires active standing in the clinical program and approved clinical placement.

Prerequisite(s): [(PSYC 506)]

(3-0-3)

PSYC 508

Ethics & Professional Issues I

This is an introductory course designed around ethical issues confronting clinical psychologists. It is offered to incoming first year clinical students to allow them to think about ethical issues in treatment, assessment, and professional behavior. Using the APA ethics code as a guide, students present and respond to ethical dilemmas that they may face as they embark upon their career as clinical psychologists. Other professional issues are also discussed including the transition to graduate school, course selection decisions, and any other general graduate school questions that may arise.

(2-0-2)

PSYC 509

Ethics & Professional Issues II

This is a continuation of PSYC 508 but offered to second semester, third year students. It is designed to prepare students for the later parts of the graduate student experience. Topics include dissertation research, the internship experience, early job and career decisions, supervision, and consultation. Barriers to successful completion of the program are discussed and problem solved. Ethical issues such as those confronting new Ph.D.'s are also introduced.

(1-0-1)

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, and writing reports. Requires active standing in the clinical program. Instructor permission required.

(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.

Prerequisite(s): [(PSYC 545 and PSYC 546)]

(3-0-3)

PSYC 512

Clinical Assessment II

Seminar and supervised training in personality assessment of adults and children. Research, psychometric characteristics, conceptual foundations, clinical applicability, administration, scoring and interpretation of major assessment instruments, and writing reports.

Prerequisite(s): [(PSYC 510)]

(3-0-3)

PSYC 513

Assessment in Rehabilitation & Mental Health Counseling

An overview of test selection, administration, and interpretation through synthesis, integration, and evaluation of assessment data used in rehabilitation and mental health counseling. Includes historical perspectives in assessment, statistical concepts, an orientation to standardized and non-standardized tests, and the process and practice of assessing adults with disabling conditions for rehabilitation plan development and vocational decision-making.

(3-0-3)

PSYC 514**Vocational Evaluation II: Report Development & 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(s): [(PSYC 513)]
(3-0-3)

PSYC 515**Vocational Evaluation Laboratory**

Practical skills in vocational evaluations including application of work samples and situational assessment at a vocational evaluation site in the community.

(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 PA system in an organization.

Prerequisite(s): [(PSYC 529 and PSYC 556)]
(3-0-3)

PSYC 518**Basic Clinical Skills**

This course covers introductory therapy skills including intake, suicide assessment, case formulation, and differential diagnosis.

Prerequisite(s): [(PSYC 526)]
(1-0-1)

PSYC 519**Therapy I-A**

Basics of conducting cognitive behavioral therapy following PSYC 518 (Basic Clinical Skills).

Prerequisite(s): [(PSYC 518)]
(2-0-2)

PSYC 520**Health Psychology**

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.

(3-0-3)

PSYC 524**Assessment & Treatment of Infants & Young Children**

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**Developmental Psychopathology**

This course covers theory and research on developmental processes and their functions to promote health and as risk factors for psychopathology.

(3-0-3)

PSYC 526**Psychopathology**

Critical examination of clinical and experimental research in psychopathology and diagnostic classification systems.

(3-0-3)

PSYC 529**Personnel Selection & Evaluation**

Principles and techniques of employee selection and placement. Analysis of test data which will maximize the effectiveness of such techniques.

(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.

Prerequisite(s): [(PSYC 529 and PSYC 556)]
(3-0-3)

PSYC 531**Organizational Attitudes & Behavioral Seminar**

The course is an in-depth study of factors that affect Organizational behavior and attitude (motivational theories). The various key attitudes and behaviors that 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 stresses on today's employees' life and discuss some ways to manage them (e.g. job stress, work-family conflict, minority and immigrant worker).

Prerequisite(s): [(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 to 20 hours per week, per semester. Students obtain supervised experience in the provision of psychological services and related professional activities. Must be in an approved clinical placement site.

(Credit: Variable)

PSYC 534**Attachment Theory Throughout the Lifespan**

Provides an in depth understanding of attachment theory and research, as well as clinical applications throughout the life span. Instructor permission required.

(3-0-3)

PSYC 535**Seminar in Personnel Selection**

A critical review of advanced techniques in personnel selection. Includes such topics such as validity generalization, utility analysis, and applications of latent trait theory.

Prerequisite(s): [(PSYC 511)]
(3-0-3)

PSYC 536

Affective Disorders

Examination of current theory and research regarding affective disorders. Covers cognitive, behavioral, biological, and cultural perspectives. The relationship of affective symptomatology and diagnosis to other types of psychopathology are considered.

Prerequisite(s): [(PSYC 526)]
(3-0-3)

PSYC 537

Child Cognitive Development

The course is designed to be a practical primer on the changes in cognition that occur from ages five to seven when there is a major change in how children perceive their world and how the world perceives them.

(3-0-3)

PSYC 538

Psychology of Sport, Performance, & Health

The course examines the clinical and research literature on the physical and psychological benefits of the following: regular physical activity; psychological, social, and environmental aspects of exercise non-adherence; and mental and behavioral strategies for promoting motivation, confidence, concentration, and enhanced sport performance.

(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.

(3-0-3)

PSYC 545

Graduate Statistics I

Basic course in elementary statistics Introduction to inferential statistics and statistical analysis of psychological data. Emphasis on hypothesis testing procedures and computer applications.

(3-0-3)

PSYC 546

Graduate Statistics II

Statistical procedures used in the prediction and explanation of psychological data, including multiple regression. Emphasis on computer applications.

Prerequisite(s): [(PSYC 545)]
(3-0-3)

PSYC 547

Evidence-Based Practice in Rehabilitation & Mental Health Counseling

The objective of this course is to familiarize students with evidence-based practice (EBP) in the field of rehabilitation and mental health counseling. Students will be introduced to a variety of evidence-based models in rehabilitation and mental health counseling as well as current issues in EBP. The historical development of EBP will be explored, and current empirical research will be examined.

(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

Practicum in Rehabilitation & Mental Health Counseling

Seminar and supervised experience in rehabilitation and mental health counseling with an emphasis on development of individual counseling skills. Students work in a field-based rehabilitation and mental health counseling capacity carrying a small client caseload while participating in weekly individual and group supervision. Includes topics related to counseling processes, procedures, and theories; ethics; and crisis prevention, assessment, and intervention.

Prerequisite(s): [(PSYC 410, PSYC 523, and PSYC 557)]
(Credit: Variable)

PSYC 550

Couples Research & 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 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(s): [(PSYC 529)]
(3-0-3)

PSYC 553

Family & Couples Therapy

Surveys the major theoretical perspectives for understanding and intervening with family and marital problems.

(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.

Prerequisite(s): [(PSYC 545) OR (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.

Prerequisite(s): [(PSYC 529 and 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 & Mental Health Counseling

Study of the counseling process within a multicultural society. Includes essential interviewing and counseling techniques, counselor characteristics and behaviors, and ethical considerations in counseling with an orientation toward wellness and empowerment.

(3-0-3)

PSYC 558**Industrial Psychology Internship I**

Supervised experience in psychological practices in an industrial setting. (Credit: variable)
(Credit: Variable)

PSYC 559**Industrial Psychology Internship II**

Supervised experience in psychological practices in an industrial setting. (credit: Variable)
(Credit: Variable)

PSYC 561**Applied Counseling Techniques: Group Counseling**

Methods and techniques in the group counseling process including group facilitation and leadership. Provides a theoretical and experiential understanding of group purpose, development, dynamics, theories, methods, skills, and other group approaches in a multicultural society with an emphasis on working with persons with disabilities within a family/systems framework.

Prerequisite(s): [(PSYC 523*)] An asterisk (*) designates a course which may be taken concurrently.
(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.
(3-0-3)

PSYC 563**Human Growth & Career Development**

Presentation and discussion of human growth and career development theories across life span with special emphasis on persons with disabilities. Includes the nature and needs of persons at all developmental levels and in multicultural contexts with specific focus on biological bases of behavior, learning and personality development, transitioning, career decision making, and the family/system influences on vocational choice.
(3-0-3)

PSYC 564**Rehabilitation & Mental Health Counseling Research Seminar**

The primary objective of this course is to help students become familiar with rehabilitation and mental health counseling 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 and mental health counseling research in order to inform evidence-based practice. Includes an overview of various research designs, data analysis techniques, and the use of SPSS for statistical analysis as well as principles and models of program evaluation and the use of findings to effect program modifications.
(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. Instructor permission required.

Prerequisite(s): [(PSYC 554)]
(3-0-3)

PSYC 573**Psychosocial Bases: Disability & Behavior**

Presentation and discussion of psychological and social issues of disability and human behavior. Somatopsychology, field integrative theories and psychological aspects of disabilities. Consent of instructor
(3-0-3)

PSYC 575**Adult Career Development & 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. Instructor permission required.
(3-0-3)

PSYC 576**Research in Rehabilitation & Mental Health Counseling**

This course teaches students to develop a preliminary research proposal for a research project based in areas of rehabilitation and mental health counseling. This course also prepares students for designing research investigations, collecting data sets, utilizing data analytic techniques, and interpreting empirical research.

Prerequisite(s): [(PSYC 564)]
(3-0-3)

PSYC 577**Professional & 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. Instructor permission required.
(3-0-3)

PSYC 578**Rehabilitation & Mental Health Counseling Internship I**

Supervised experience in rehabilitation and mental health counseling, which is intended to reflect the comprehensive work experience of a professional counselor. Students are provided the opportunity to become familiar with a variety of professional activities and resources in addition to direct service (e.g., record keeping, assessment instruments, supervision, information and referral, in-service, and staff meetings).

Prerequisite(s): [(PSYC 549)]
(Credit: Variable)

PSYC 579**Rehabilitation & Mental Health Counseling Internship II**

Supervised experience in rehabilitation and mental health counseling, which is intended to reflect the comprehensive work experience of a professional counselor. Students are provided the opportunity to become familiar with a variety of professional activities and resources in addition to direct service (e.g., record keeping, assessment instruments, supervision, information and referral, in-service, and staff meetings).

Prerequisite(s): [(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. Requires certification as K-12 teacher or approval of instructor.

Prerequisite(s): [(PSYC 556)]
(3-0-3)

PSYC 581

Neuropsychological Assessment

Seminar in neuropsychological assessment. A review of neuroanatomy followed with a review of the conceptual foundations of brain-behavior relationships. Major assessment instruments will be covered.

(3-0-3)

PSYC 582

Applied Psychophysiology & Biofeedback

Reviews applications of physiological measures to practical problems. Clinical applications of biofeedback are discussed and demonstrated. Special emphasis on electromyographic techniques.

(3-0-3)

PSYC 583

Rehabilitation Engineering Technology I: Survey of Interdisciplinary Application 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. Instructor permission required.

(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(s): [(PSYC 583)]
(3-0-3)

PSYC 585

Rehabilitation Engineering Technology III

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(s): [(PSYC 583 and PSYC 584)]
(3-0-3)

PSYC 586

Concepts of Supervision

Explores formulations of the supervisory relationship and critical issues in the supervision of clinicians.

(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. (Credit: Variable)

Prerequisite(s): [(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 & Thesis M.S.

Instructor permission required.
(Credit: Variable)

PSYC 594

Special Projects

Instructor permission required.
(Credit: Variable)

PSYC 595

Graduate Research Project

Independent research for PhD students who are required to complete a thesis equivalent project. Instructor permission required.

(Credit: Variable)

PSYC 597

Special Problems

Instructor permission required.
(Credit: Variable)

PSYC 599

Clinical Internship

Ph.D. Comprehensive Exam Participation in full-time internship accredited by the American Psychological Association, or, in exceptional cases, approved by the clinical Psychology program. Approval of dissertation proposal and instructor permission required.

(0-0-1)

PSYC 600

Continuation of Residency

Continuation of residency.
(0-0-1)

PSYC 691

Research & Thesis Ph.D.

Research and thesis for Ph. D. students.
(Credit: Variable)

PSYC 710

Compensation & Benefit Application

Compensation and benefit application.
(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 will cover conceptual issues, statistical models, and data analysis using computer software.

(3-0-1.5)

PSYC 712**Bayley Scales of Infant Development**

Bayley Scales of Infant Development.
(3-0-1)

PSYC 714**Assessment Centers**

This course will develop the knowledge and skills needed for the design and implementation of assessment centers and other individual assessment methods.
(1.5-0-1.5)

PSYC 715**Organizational Assessment & 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. Requires 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.
(1.5-0-1.5)

PSYC 717**Variable Pay Programs**

This course provides an in-depth review of variable pay programs within 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.
(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 720**Individual Assessment for Industrial/Organizational Psychology**

This course is designed to teach students how to assess individuals for hire, promotion, and development. Students will develop a testing protocol including a structured interview, cognitive ability, and personality testing. The course will provide applied experience conducting assessments of executives who have volunteered to serve as testing subjects. Interviewing skill, test interpretation, and report writing are the primary learning objectives of the course.
(1.5-0-1.5)

PSYC 721**Network Analysis**

Network analyses focuses on relationships between social entities (e.g. individuals, groups, businesses) and has been used in a number of fields including the social and behavioral sciences. The primary focus will center on social network analysis, which has been developed from an interdisciplinary approach from sociology, psychology, and economics. This course will present an introduction to various methods and concepts of social network analysis including applications in the social and behavioral sciences using these methods. Topics include, but are not limited to, graph theory, properties of individuals, subgroups/cliques, blockmodels, and dyad/triad analysis. An introduction to network models and applications in common software programs will also be given.
Prerequisite(s): [(PSYC 545 and PSYC 546)]
(1.5-0-1.5)

PSYC 722**Consulting Fundamentals**

The course will focus on identifying customer groups, developing products or services, pricing, proposal writing, and ethics in consulting.
(1.5-0-1.5)

PSYC 782**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. Instructor permission required.
(1.5-0-1.5)

PSYC 783**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. Instructor permission required.
(1.5-0-1.5)

Undergraduate Courses Available to Graduate Students

Note: Students may take up to an approved number of the following courses.

PSYC 406**History and Systems of Psychology****PSYC 409****Psychological Testing****PSYC 410****Psychological Testing****PSYC 411****Psychological Testing****PSYC 412****Psychological Testing****PSYC 414****Neural and Biological Bases of Behavior****PSYC 420****Single Subject Design and Applied Behavior Analysis**

PSYC 426
Cognitive Processes

PSYC 431
Measurement of Attitudes

PSYC 435
Early Development

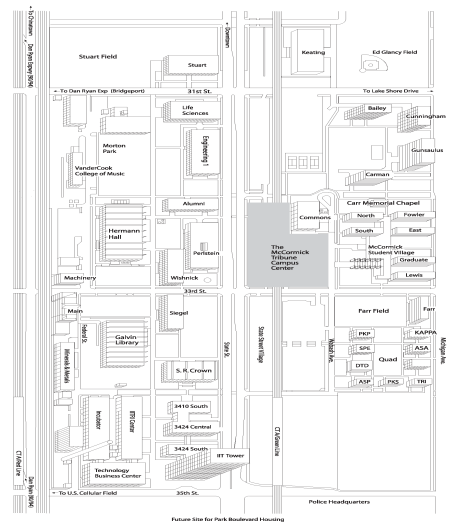
PSYC 436
Early Development

PSYC 449
Practicum in Rehabilitation Services

PSYC 452
Personality Theory

PSYC 456
Engineering Psychology

Institute of Design



Getting to Main Campus

Airports

IIT and Chicago are served by O'Hare International Airport and Midway International Airport. Public and private transportation is available from the airports to downtown Chicago and IIT campuses.

Train

Metra Rail Rock Island District line to 35th Street/Lou Jones/Bronzeville station.

Other commuter railroad lines to Union and North-western train stations (both off Canal Street), then public transportation, taxi, or IIT shuttle bus from the Downtown Campus at 565 West Adams Street to Main Campus.

Bus

To Greyhound or Continental Trailways 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). Metered parking is located along Federal Street north and south of 33rd Street, and in the Visitor's Parking Lot (Lot A4) at 32nd Street and State Street, on the east side of State Street.

From South: Dan Ryan Expressway west to 35th Street exit, continue north to 33rd Street, turn right (east). Metered parking is located along Federal Street north and south of 33rd Street, and in the Visitor's Parking Lot (Lot A4) located at 32nd Street and State Street, on the east side of State Street.

From Lake Shore Drive: Exit at 31st Street, go inland (west) to State Street, turn left (south). Metered parking is available in the Visitor's Parking Lot (Lot A4) located at 32nd Street and State Street on the east side of State Street.

Parking

Metered parking is available to all visitors and is located along Federal Street north and south of 33rd Street, and in the Visitor's Parking Lot (Lot A4) located at 32nd Street and State Street, on the east side of State Street. Special event parking may be available in other parking lots on campus. Please contact the Access, Card, and Parking Services Office for more details on parking, or visit the parking web page for current parking locations at www.iit.edu/~parking. Please call the parking administrator at 312.567.8968 if you need assistance in finding parking.



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