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Graduate study in Industrial and Systems Engineering at the University of Minnesota is a stimulating and professionally rewarding experience. This publication supplements information provided in both the University of Minnesota-Graduate School Catalog (available at the Graduate School in 309 Johnston Hall, or online at: http://www.grad.umn.edu/catalog/index.html). You are responsible for all information contained here and in the catalog that is pertinent to your graduate study and to your specific field.

When appropriate, the Student Information and Advising Office (1120 Mech Eng) will send information to you at your email address, your campus mailbox, if you have one, or your home address. Therefore, it is important that you notify the payroll staff in 101ME of any address changes as soon as possible.

Faculty and staff of the Department of Industrial and Systems Engineering wish you a rewarding experience in your graduate study, and we look forward to working with you during your enrollment here. For additional assistance, consult any of the following:

Mr. John K. Gardner
Student Advising and Information Office
1120 Mech Eng
University of Minnesota
111 Church Street SE
Minneapolis, MN 55455
(612) 625-2009
jgardner@me.umn.edu

Dr. William L. Cooper
Director of Graduate Studies
Department of Industrial & Systems Engineering
130-F Mech Eng
University of Minnesota
111 Church St. S.E.
Minneapolis, MN 55455
(612) 624-4322
billcoop@umn.edu

EQUAL OPPORTUNITY STATEMENT

The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation.

In adhering to this policy, the University abides by the Minnesota Human Rights Act, Minnesota Statute Ch. 363; by the Federal Civil Rights Act, 42 U.S.C. 2000e; by the requirements of Title IX of the Education Amendments of 1972; by Sections 503 and 504 of the Rehabilitation Act of 1973; by the Americans With Disabilities Act of 1990; by Executive Order 11246, as amended; by 38 U.S.C. 20221, the Vietnam Era Veterans Readjustment Assistance Act of 1972, as amended; and by other applicable statutes and regulations relating to equality of opportunity.

Deborah S. Petersen-Perlman, Director
UMD Office of Equal Opportunity
255 Darland Administration Building
1049 University Drive
Duluth, MN 55812-2496
(218) 726-6849
Preamble

A major purpose of graduate education at the University of Minnesota is to instill in each student an understanding of and capacity for scholarship, independent judgment, academic rigor, and intellectual honesty. Graduate education is an opportunity for the student to develop into a professional scholar. Graduate research and teaching assistantships offer an “apprenticeship” experience in the academic profession as well as financial support. It is the joint responsibility of faculty and graduate students to work together to foster these ends through relationships that encourage freedom of inquiry, demonstrate personal and professional integrity, and foster mutual respect. This shared responsibility with faculty extends to all of the endeavors of graduate students, as students, employees, and members of the larger academic community.

High quality graduate education depends on the professional and ethical conduct of the participants. Faculty and graduate students have complementary responsibilities in the maintenance of academic standards and the creation of high quality graduate programs. Excellence in graduate education is achieved when both faculty and students are highly motivated, possess the academic and professional backgrounds necessary to perform at the highest level, and are sincere in their desire to see each other succeed.

The following principles illustrate what students should expect from their programs and what programs should expect from their students, to help achieve this excellence.

Principle 1: INFORMATION ABOUT POLICIES AND PROCEDURES.

The Graduate School and graduate programs are responsible for providing students and prospective students with access to information about their graduate program, areas of specialization, degree requirements, and average time to completion of degrees. Graduate programs are responsible for providing access to information about graduate student financial support in the program, such as the prospects for fellowships, assistantships or other financial support and the proportion of students receiving financial support. In addition, graduate programs should provide students and applicants with information about career experiences of graduates of the program. All such information should be presented in a format that does not violate the privacy of individual students. Programs are encouraged to provide relevant information in their handbooks, websites or other readily accessible formats.

Students are responsible for keeping themselves informed about current policies of their program and the Graduate School that affect graduate students. Students and alumni also have a responsibility to respond to program inquiries about their career development.

Principle 2: COMMUNICATION ABOUT ACADEMIC STATUS.

The Graduate School and graduate programs are responsible for providing students with information about their individual academic status: who in the Graduate School and in their graduate program is responsible for communicating to them about admission issues and progress through the
degree program, how the communication will take place, and the possibility for appeal to a third party for assistance in resolving disputed issues.

Students are responsible for communicating with the Graduate School and their graduate program about changes in their circumstances that affect their status and progress toward the degree.

**Principle 3: RESEARCH CONTRIBUTIONS.**

Individual faculty as research directors are responsible for providing students with appropriate recognition for their contributions at conferences, in professional publications, or in applications for patents. It is the faculty member’s responsibility to clarify the principles for determining authorship and recognition at the beginning of any project.

Students are responsible for discussing their expectations regarding acknowledgment of research contributions or intellectual property rights with the appropriate person(s) in the research team, preferably early in the project.

**Principle 4: UNIVERSITY GOVERNANCE.**

Departments and graduate programs are responsible for defining specific opportunities for student participation on committees as they deem appropriate. The University recognizes that graduate students make important contributions to governance and decision making at the program, department, college, Graduate School and University level; specific roles for participation are defined at each level by the relevant governing bodies. For example, University Senate policy requires student membership on faculty search committees.

Students are responsible for participating in University governance and decision making that enrich the campus community.

**Principle 5: RESPECTFUL EMPLOYMENT CONDITIONS.**

University faculty and staff are responsible for assuring that graduate students are able to conduct their work, as students or students/employees, in a manner consistent with professional conduct and integrity, free of intimidation or coercion. Students who are employees also have the protection of all University employment policies and laws. Graduate programs are responsible for providing clear communication to students about the possibility for appeal to a third party for assistance in resolving disputed issues.

Students are responsible for reporting unprofessional conduct to the appropriate body or person, as defined in the academic or employment grievance policy; they should be able to do so without fear of reprisal. Students are responsible for acting in a respectful and fair manner toward other students, faculty, or staff in the conduct of their academic work or work they may do in connection with an assistantship.

**Principle 6: CONDITIONS OF EMPLOYMENT.**

The University (through its departments, research projects or other employing units) is responsible
for providing to prospective graduate assistants a written offer of financial support before a response to the offer is required. Such communication must indicate their salary and the terms and conditions of their appointment, including the general nature of the work they will be performing, duration of employment, and whether and how this employment is tied to their academic progress. The details of specific teaching or research assignments may need to await later written clarification.

Students are responsible for accepting the conditions of employment only if they believe they are qualified and able to complete the tasks assigned. Students have a responsibility for communicating in writing any changes in their circumstances that affect their ability to fulfill the terms and conditions of their employment.

**Principle 7: SAFE WORKING ENVIRONMENT.**

Supervisors are responsible for providing a safe working environment for graduate students, and for developing and publicizing safety policies and training programs to achieve that goal.

Graduate students are responsible for helping to maintain a safe working environment, for adhering to safety policies, for participating in training programs and for reporting safety violations to the proper authority.

**OTHER UNIVERSITY DOCUMENTS** may provide information and guidance relevant to the graduate education experience.

- Board of Regents, Code of Conduct, adopted 7/12/96.  
  [www.regents.umn.edu/policies/academic/Conduct.pdf]
- Board of Regents, Academic Freedom and Responsibility, adopted 9/8/95  
  [www.regents.umn.edu/policies/academic/AcademicFreedom.pdf]
- Graduate Assistant Office, Handbook for Graduate Assistants  
  [www.umn.edu/OHR/GAO/]

**DIVERSITY STATEMENT**

*Graduate School Commitment to Diversity*

The Graduate School embraces the University of Minnesota’s position that promoting and supporting diversity among the student body is central to the academic mission of the University. We define diversity to encompass many characteristics including economic disadvantage, special talents, evidence of leadership qualities, race or ethnicity, a strong work record, and disability. A diverse student body enriches graduate education by providing a multiplicity of views and perspectives that enhance research, teaching, and the development of new knowledge. A diverse mix of students promotes respect for, and opportunities to learn from, others with the broad range of backgrounds and experiences that constitute modern society. Higher education trains the next generation of leaders of academia and society in general, and such opportunities for leadership should be accessible to all members of society. The Graduate School and its constituent graduate programs are therefore committed to providing equal access to educational opportunities through recruitment, admission, and support programs that promote diversity, foster successful academic experiences, and cultivate the leaders of the next generation.
I. DIRECTORY

INDUSTRIAL & SYSTEMS ENGINEERING PROGRAM ADMINISTRATION

Director of Graduate Studies  Graduate Coordinator
Dr. William Cooper  Mr. John K. Gardner
130F Mech Eng  1120 Mech Eng
624-4322  625-2009

ISyE Department Hend
Dr. Shuzhong Zhang
130E Mech Eng
624-8406
## INDUSTRIAL & SYSTEMS ENGINEERING GRADUATE FACULTY

<table>
<thead>
<tr>
<th>Professors</th>
<th>Office</th>
<th>Telephone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arora, Sant Ram**</td>
<td>130D</td>
<td>625-3023</td>
<td><a href="mailto:arora001@tc.umn.edu">arora001@tc.umn.edu</a></td>
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<tr>
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<tr>
<td>Kvalseth, Tarald**</td>
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</tr>
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<td>Leder, Kevin</td>
<td>130A</td>
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</tr>
<tr>
<td>Miller, Lisa</td>
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</tr>
<tr>
<td>Stoffregen, Thomas*</td>
<td>100 CookeH</td>
<td>626-1056</td>
<td><a href="mailto:tas@umn.edu">tas@umn.edu</a></td>
</tr>
<tr>
<td>Wang, Zizhuo</td>
<td>387 Shep Lab</td>
<td>624-7539</td>
<td><a href="mailto:zwang@umn.edu">zwang@umn.edu</a></td>
</tr>
<tr>
<td>Zhang, Shuzhong</td>
<td>130E</td>
<td>624-8406</td>
<td><a href="mailto:zhangs@umn.edu">zhangs@umn.edu</a></td>
</tr>
</tbody>
</table>

* Denotes affiliate senior, or affiliate member.
** Denotes emeritus

## GRADUATE SCHOOL OFFICES

<table>
<thead>
<tr>
<th>Contact</th>
<th>Office</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prospective students</td>
<td>309 Johnston</td>
<td>625-3014</td>
</tr>
<tr>
<td>Previously registered students</td>
<td>160 Williamson</td>
<td>626-3490</td>
</tr>
<tr>
<td>Graduate Scholarships, Grants-in-Aid, Fellowships</td>
<td>314 Johnston</td>
<td>625-7579</td>
</tr>
<tr>
<td>Student Services</td>
<td>160 Williamson</td>
<td>625-3490</td>
</tr>
<tr>
<td>Change of Status - Readmit / Change of Major or Degree.</td>
<td>309 Johnston</td>
<td>626-8060</td>
</tr>
<tr>
<td>Student Degree Programs / Graduate Files</td>
<td>160 Williamson</td>
<td>625-5833</td>
</tr>
<tr>
<td>Doctoral Preliminary Oral Exam Scheduling</td>
<td>160 Williamson</td>
<td>625-4019</td>
</tr>
<tr>
<td>Doctoral Final Exam Scheduling</td>
<td>160 Williamson</td>
<td>625-0168</td>
</tr>
<tr>
<td>Graduation Doctoral</td>
<td>160 Williamson</td>
<td>625-0168</td>
</tr>
<tr>
<td>Graduation Masters</td>
<td>160 Williamson</td>
<td>625-4019</td>
</tr>
<tr>
<td>Student Progress, Petitions, Registration</td>
<td>160 Williamson</td>
<td>625-0068</td>
</tr>
</tbody>
</table>
II. REGISTRATION

Registration Steps - all new students

1. Check in with the Industrial and Systems Engineering Department.
   
   **Student Advising & Information Office - 1120 M.E.**

2. Consult with Director of Graduate Studies or appropriate faculty member to establish first semester’s courses.

3. All new international students - check in with the International Student & Scholar Services Office, 190 Hubert H. Humphrey Center, West Bank.

4. Register - follow the registration procedures on One Stop: http://www.onestop.umn.edu/registrar/registration/index.html

5. Obtain student I.D. card.
   
   **U-Card Office - G22 Coffman Memorial Union**

Registration Steps - current / previous students

Register at One Stop Science Teaching and Student Services (STSS) Building or on-line through the Student Access System (onestop.umn.edu), according to the registration queue published in the Class Schedule. Class Schedules are available through the Web via: http://www.onestop.umn.edu/registrar/registration/courses.html

Registration Notes

- Students are charged a late fee if they register after classes begin and may register after the first week of the semester only with special permission. See the Class Schedule for further details.

- You must take all courses placed in the ‘major’ category on your program of study (Degree Program Form) on an A/F basis, with the exception of departmental seminars and the Plan B class. You are also expected to take the great majority of non-major course on an A/F basis. If you request to include a non-major course on an S/N basis, you must clear it with your adviser and the Director of Graduate Studies. At that time, it is desirable that you bring a copy of your program of study to identify the strength of your entire program.

- For the University calendar and registration information, refer to the University’s semester Class Schedule or the Summer Session Bulletin.
• The **Graduate School Catalog** details Graduate School regulations, requirements, and procedures; lists some available financial aid, scholarships, and fellowships; and provides program and course descriptions. This may be picked up at the Graduate School in 309 Johnston Hall or viewed online at: [http://www.catalogs.umn.edu/grad/index.html](http://www.catalogs.umn.edu/grad/index.html).

• **You must register every Fall and Spring term in the Graduate School in order to maintain active graduate status.** If you have not registered in the Graduate School, you must apply for readmission and must register before you can resume work on a master’s or doctoral thesis or on master’s Plan B papers, take written or oral examinations, or file for graduation. The Department reserves the right to reject a readmission application based on enrollment load and the quality of academic history.

• The University requires that graduate students holding appointments as teaching assistants, research assistants, and administrative fellows must register for at least 6 credits during each term for which he or she holds an appointment of greater than 12.5%. (This does not apply to summer terms if you were registered the preceding spring quarter.) If you have to satisfy other criteria for full-time status (i.e., some student loan deferrals may require 7-credit registration) you should check with that individual entity.

<table>
<thead>
<tr>
<th></th>
<th>FULL-TIME</th>
<th>PART-TIME</th>
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</thead>
<tbody>
<tr>
<td>Graduate Student</td>
<td>6 or more credits</td>
<td>Less than 6 credits</td>
</tr>
<tr>
<td>Research / Teaching Assistant</td>
<td>6 or more credits</td>
<td>Less than 6 credits</td>
</tr>
<tr>
<td>- still working on coursework</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Advanced Student Standing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- M.S. (coursework/thesis cr. completed)</td>
<td>At least 1 credit of IE 8333</td>
<td>N/A</td>
</tr>
<tr>
<td>- Ph.D. (w/24 Thesis Credits)</td>
<td>At least 1 credit of IE 8444</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**More Registration Notes - M.S. Students**

Master's students who have completed all of their course credits (including thesis credits, if pursuing a Plan A) may register for a special one credit option and still be counted as a full-time student. This registration will satisfy the full-time requirement for federal student loan deferrals as well as fulfill the assistantship registration requirement. In order to receive permission to register for this 1-credit course (IE 8333, FTE: Master's), a student must fill out the *Application for Full-time Status With One Credit* form from the Student Advising & Information Office - 1120 M.E., and have it signed by their adviser. They must also submit a *Request for Advanced Master's Tracking Flag* form to the Graduate School to grant eligibility for this option.
More Registration Notes - Ph.D. Students

- Doctoral students must register for 24 doctoral thesis credits (IE 8888) at the University of Minnesota beginning the semester after they have passed the preliminary oral examination.

- The requirement of 24 doctoral thesis credits cannot be reduced by transfer of master’s thesis credits, or thesis credits taken at another institution.

- You are permitted to register for thesis credits during the current semester if you pass the preliminary oral examination and if the signed report form is delivered to 160 Williamson Hall no later than 1 p.m. on the last day of registration for that semester. While this deadline will permit you time to register before the Registration Center closes that day, we strongly urge you not to wait until the last minute to bring the signed report to the Graduate School.

III. PROGRAMS

The Graduate Program in Industrial & Systems Engineering (hereafter ISyE program) offers MS degree in two tracks; The Industrial Engineering (IE) track and the Systems Engineering (SE) track, as well as a Ph.D. degree. M.S. degree applicants must indicate which track they are applying for on the application form. Note that the admission requirements for the two tracks are different. In addition, the ISyE program also offers an integrated BME/MSISyE-IE track program and an ISyE option for students enrolled in the BME program. Brief descriptions can be found below. Additional detail are available in section VIII.

M.S.I.Sy.E-IE Track and Ph.D. degree in ISyE

The M.S.—IE track allows three options: MS Plan A, requiring coursework and a thesis; a MS Plan B, requiring ten course credit hours beyond the Plan A and no thesis; and a MS Plan C, requiring 32 course credits. The Ph.D. degree is a research intensive degree consisting of coursework and a doctoral thesis. Exceptional students may apply directly to the Ph.D. program. Students specialize in one or more areas of study:

- Production, Inventory, and Distribution Systems
- Operations Research
- Information Systems
- Engineering Management
- Human Factors

M.S.I.Sy.E.-SE Track

The M.S.—SE track is a coursework only program. It consists of a core curriculum of 17 credits that introduces students to the key elements of SE practice such as:

- Defining the requirements for a system to satisfy multiple stakeholders and organizations throughout the life of a system.
• Developing a systems architecture—arrangement of elements and subsystems and allocation of functions to them to meet systems requirements.
• Integrating various elements/subsystems and deploying the system in an operational environment.

Students may choose from a rich assortment of sample programs to achieve breadth in a variety of application areas. Examples include Health Informatics, Nano-Engineering, Biomedical Engineering, and Industrial Mathematics.

Integrated B.M.E/M.S.I.Sy.E.-IE Track

The BME/MSISyE program offers several benefits: a streamlined admissions process from the undergraduate to the graduate program; graduate student status granted in the senior year; eligibility for teaching and research assistantships; and flexibility in fulfilling required courses for both degrees simultaneously in the last two years of study. The program makes it possible for students to earn a Bachelor’s degree in Mechanical Engineering and a Master’s degree in Industrial & Systems Engineering (IE track) in five years.

B.M.E. with Industrial & Systems Engineering Option

Undergraduate students who select the ISyE option complete the same set of required courses as other mechanical engineering students, but their technical electives are selected from the Industrial & Systems Engineering course options and in consultation with a faculty adviser.

Students should refer to the Mechanical Engineering Technical Elective Program in room ME 1120, also see:

http://www.isye.umn.edu/program/bme-ieoption.shtml
Plan A master’s degree provides you the opportunity to execute research on a topic selected in consultation with your adviser. You gain an understanding of research techniques by applying relevant technologies to an engineering problem which extends understanding of an aspect of the field. The quality of your performance in this degree path is based heavily upon your success in thesis research.

14 Major (IE) Credits + 6 Non-Major Credits + 10 thesis Credits (IE 8777) = 30 total credits (minimum)

Including:

- 3 of the 5 Required IE Courses* • IE 5531
  - Engineering Optimization I (4 cr.)
  - IE 5545
  - Decision Analysis (4 cr.)
  - IE 5551
  - Production Planning and Inventory Control (4 cr.)
  - IE 8532
  - Stochastic Processes and Queuing Systems (4 cr.)
  - IE 5511
  - Human Factors and Work Analysis (4 cr)

- 1 Seminar Credit
  May be a major or non-major seminar; if major, count in 'major' credits; if non-major, count in 'other program' credits

Research Ethics and Professional Conduct
ME 8001
0 credits.

*Two out of these 3 must be IE 5531 and IE 8532, or their qualifying replacements (see page 33).
Plan B master’s degree accents course work, requiring a minimum of 10 course credits beyond the Plan A requirement and has no thesis. Course study is augmented by a Plan B project (See page 21 item #9)

16 Major (IE) Credits + 6 Non-Major Credits + 8 course credits (IE or non-IE) = 30 total credits (minimum)

Including:

4 of the 5 Required IE Courses*
- IE 5531 Engineering Optimization I (4 cr.)
- IE 5545 Decision Analysis (4 cr.)
- IE 5551 Production Planning and Inventory Control (4 cr.)
- IE 8532 Stochastic Processes and Queuing Systems (4 cr.)
- IE 5511 Human Factors and Work Analysis (4 cr)

Research Ethics and Professional Conduct
ME 8001 0 credits.

1 Seminar Credit
May be a major or non-major seminar; if major, count in 'major' credits; if non-major, count in 'other program' credits

*Two out of these 4 must be IE 5531 and IE 8532, or their qualifying replacements (see page 33).
MASTER OF SCIENCE IN INDUSTRIAL & SYSTEMS ENGINEERING – Plan C -IE TRACK

16 Major Credits (ISyE Systems Engineering core courses) + 6 Non-Major Credits + 10 remaining Credits (major or non major) = 32 Total Credits (minimum)

Including:

4 of the 5 Required IE Courses*

- **IE 5531** Engineering Optimization I (4 cr.)
- **IE 5545** Decision Analysis (4 cr.)
- **IE 5551** Production Planning and Inventory Control (4 cr.)
- **IE 8532** Stochastic Processes and Queuing Systems (4 cr.)
- **IE 5511** Human Factors and Work Analysis (4 cr)

1 Seminar Credit

May be a major or non-major seminar; if major, count in 'major' credits; if non-major, count in 'other program' credits

Research Ethics and Professional Conduct
ME 8001
0 credits.

*Two out of these 4 must be IE 5531 and IE 8532, or their qualifying replacements (see page 33).
MASTER OF SCIENCE IN INDUSTRIAL & SYSTEMS ENGINEERING -
SYSTEMS ENGINEERING TRACK

Our core curriculum comprises of five courses. Students who wish to increase depth in one or more of these tropics can take advanced courses from the menu of ISyE graduate courses. They can also choose from a rich assortment of sample programs to achieve breadth in a variety of application areas. Examples include Health Informatics, Nano-Engineering, Biomedical Engineering, and Industrial Mathematics (see pages 34-42 for details).

= 30 Total Credits (minimum)

**5 Required (core) Courses:**

- **IE 5111** Systems Engineering I (2 cr).
- **IE 5112** Introduction to Operations Research (3cr.)
- **IE 5113** Systems Engineering II (4cr.)
- **IE 5541** Project Management (4 cr.)
- **IE 5553** Simulation (4 cr)

Research Ethics and Professional Conduct
ME 8001
0 credits.
The Doctor of Philosophy degree program develops advanced research competence. Close affiliation between you and your adviser is pivotal in this program, and close rapport is important at all stages. Faculty may wish to observe your approach to open-ended research at an early stage before consenting to serve as your adviser. If so, you can accomplish this in a variety of ways: the Plan A thesis at the

Major (IE) Credits + A minimum of 12 Non-Major Credits + 24 thesis credits (IE 8888) = 44 total course credits (minimum) + 24 thesis credits (IE 8888)

Including:

4 of the 5 Required IE Courses*
- **IE 5531**
  Engineering Optimization I (4 cr.)
- **IE 5545**
  Decision Analysis (4 cr.)
- **IE 5551**
  Production Planning and Inventory Control (4 cr.)
- **IE 8532**
  Stochastic Processes and Queuing Systems (4 cr.)
- **IE 5511**
  Human Factors and Work Analysis (4 cr)

Research Ethics and Professional Conduct
ME 8001
0 credits.

2 Seminar Credits
May be major or non-major seminars; if major, count in 'major' credits; if non-major, count in 'other program' credits

*Two out of these 4 must be IE 5531 and IE 8532, or their qualifying replacements (see page 33 for further details)
Dual Master's Degree in Industrial and Systems Engineering and Civil Engineering

Students interested in industrial and systems engineering and civil engineering can combine their studies in a dual master's degree program sponsored by the Departments of Civil Engineering and Industrial and Systems Engineering. The program allows students to complete a master's degree in civil engineering (MSCE) and a master's degree in industrial and systems (MS-ISYE) in 45 credits.

New students must apply separately to both programs, but may begin in one program and apply to the other at a later date. Each program maintains its own admissions criteria and students must meet the requirements of each to qualify for the dual degree program. Students who are currently enrolled in the M.S. in civil engineering program or the MS-ISYE program are also eligible for the dual-degree program. Current students will need to submit a change-of-status form to the Graduate School to be considered for admission to the other program.

Students must fulfill all the program requirements for each degree. However, students can apply up to fifteen credits in common to both degrees. This reduces the total number of credits needed from total number needed to complete the programs separately. Faculty and staff in both programs advise students on course selection so they can graduate in approximately three years rather than four.
IV GRADUATE FACULTY ADVISER

Selection of an adviser is your responsibility. Your acceptance into the ISyE graduate program occurred because you have shown promise to satisfactorily execute graduate study. Hence you are expected to procure an adviser by demonstrating clear objectives, diligence, and a cooperative spirit.

The new graduate student orientation, held the week before class starts in the fall, will for many students provide the first opportunity to become acquainted with faculty and their research interests. You can become better acquainted with potential advisors by making appointments to meet with specific faculty, and you are encouraged to do so. You may also wish to take courses from a potential adviser to learn more about his or her research and technical interests before reaching a formal advising agreement. Also browse the ISyE program website for specific research activities at www.isye.umn.edu.

*It is essential that you gain an adviser no later than the end of your first semester of full-time enrollment, or second semester of part-time enrollment*

Some students commit to an adviser upon, or shortly after, arrival here. Part-time graduate students may take somewhat longer than two terms to gain an adviser. However, they may not delay this process beyond approximately 1/4 - 1/3 of their study program.

**Your adviser serves as your advocate to the faculty.** For both master’s and doctor of philosophy degrees, you develop your program of study through consultation with your adviser. Your adviser guides dissertation research and orchestrates qualifying examination procedures to meet degree objectives. For such important reasons, gaining an adviser early in the course of study is essential.

If you make the mistake of not getting a faculty adviser until late in your course of study, you can expect to encounter progressive difficulty in gaining one and in gaining faculty commitment to a formal program of study.

You may change your graduate adviser during the course of study. It is undesirable to do this as your program matures and should only be done judiciously and with discretion. Consult with both a potential new adviser and with your earlier one if you anticipate this step. If you need additional consultation about this, consult the Director of Graduate Studies.
V. FINANCIAL SUPPORT

Financial support opportunities available to students include:

- Fellowships
- Research Assistantships
- Teaching Assistantships
- Graduate Work-Study Program

Graduate assistantships are financial aid academic appointments reserved for graduate students. The ISyE program offers appointments for teaching assistant and research assistant positions. If you accept an offer of financial aid, you are entering into a contract, which cannot be terminated unless both parties consent, in writing, to terminate the contract. Refer to the Registration Notes section to avail yourself of the registration requirements for students who are receiving financial assistance. If you receive an appointment or fellowship, be sure to view the Graduate Student Employment Website at: http://www1.umn.edu/ohr/gao/. Stipend rates are set by the Industrial & Systems Engineering Graduate Faculty each spring for the following fiscal year. Ph.D. candidates will receive an increase in their stipend once they pass their preliminary oral examination and complete 24 credits of thesis registration. The stipend is increased by 10%, or up to the maximum rate the University may set, whichever is lower.

Fellowships

This booklet does not present the full range of fellowship opportunities available at the University of Minnesota. Please consult one or more of the following for further information:

Fellowship Office of the Graduate School
321 Johnston Hall
625-7579

John K. Gardner
Student Information & Information Center
1120 Mech Eng
625-2009

Graduate fellowships are awards based on academic merit and are available to new and currently enrolled graduate students. Consult the Graduate School Catalog for more details. Fellowships are offered on a competitive basis and require excellent academic records for consideration. Doctoral Dissertation Fellowships are also available for qualifying doctoral candidates.

Fellowship competitions follow strict timetables and guidelines, and students are advised to obtain information early in the fall semester. Typically, the Fellowship Committee offers fellowships early in the school year following their deliberations. You can apprise yourself of these timetables from the above sources.
Research Assistantships

Research assistantships are typically obtained from faculty members who hold research contracts and grants. These appointments usually materialize through direct discussions with individual faculty where the research assignment, required expertise and expectations are addressed. Faculty may also offer research appointments to students prior to their arrival on campus. Faculty providing support may expect to serve as your academic adviser and can be expected to indicate over what time period a research assistantship will be made. Periods vary, depending on the availability of grant funds and your progress. Maintain communication with faculty to update them on your needs and interests. Research assistantship assignments are made at any time in the calendar year depending on funding and other factors.

Teaching Assistantships

Positions are available each academic semester for graduate students to assist in departmental course instruction. Students must register in the semesters they hold teaching assistantships (except during the summer session providing they were registered the preceding spring semester).

All students interested in teaching assistantships are advised to contact the department head who makes TA assignments in the ISyE program for IE graduate courses. It is advisable to leave relevant personal data with the department head so he may contact you as appointments materialize.

Teaching appointments outside the Department of Industrial and Systems Engineering may be available.

TA offers will be made only to students who have documented adequate English skills. Current University of Minnesota policy requires that all nonnative English speaking TAs or prospective TAs who are or will be assigned to teaching, tutoring, or advising duties (including office hours) must:

1. Score at least 50 points out of 60 points on the Test of Spoken English (TSE) exam to receive a passing score and be eligible for assignment to teaching, tutoring, or advising duties. Students who pass the TSE are given a campus rating of “1” and are thus certified to carry out the responsibilities of a Teaching Assistant (contact the Center for Teaching and Learning Services - CTLS - for further information on ratings).

   Background notes: The TSE is a national test that was first introduced by the Educational Testing Service in 1981; this test measures the ability of nonnative speakers to communicate orally in English.

2. Take the SPEAK Test, an institutional version of the TSE, developed by the Educational Testing Service and administered here on campus by CTLS.

   If nonnative speakers of English do not pass the SPEAK Test or the TSE and they want to serve as Teaching Assistants, they must contact CTLS regarding their options.
Teaching assistantship appointments are usually made before the onset of each new academic term; the assignments are typically one semester in duration, but can be for one academic year. Teaching appointments hold no guarantee for continuation unless stated in the Departmental offer.

Once notified of a teaching assistantship opportunity, it is your responsibility to complete paperwork that will allow the Department to process your appointment. Contact the accounting office in 101 ME, to begin that process.

Academic progress and duration of study toward a degree are considered as appointment rosters are generated. The faculty person responsible for the course is consulted when appointment recommendations are developed. Teaching assistantship assignments naturally require demonstrated expertise in the course subject matter to which assignment is made.

Teaching assistant responsibilities vary with course assignments. They may involve grading, recitation lecture, laboratory, homework problem solution, office hour consultation, or a mix of these. The teaching assistant is not ultimately responsible for course grades; that is a Faculty responsibility.

A very modest number of teaching appointments may be available in the Extension Division and in the summer programs. Consult the department head for information.

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**Appointment Scope**

Whereas teaching assistantship appointments are typically of one semester duration, after which a new assignment can be made, it is possible to hold simultaneous teaching and research assistantships within any academic term. If simultaneous appointments are made, then each is typically a 25% appointment. Appointments are occasionally combined at other than 25% levels to total 50% overall.

Maximum appointments to teaching assistantship and/or research assistantship positions are 50%, except in unusual cases where graduate students who have qualified for doctoral candidacy may receive 75% appointments if a distinct service need exists.

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**Appointment Calendar**

This department attempts to assign all teaching assistantships leaving ample lead time to permit students to receive their initial paychecks on schedule.

If yours is a last minute appointment, verify your first paycheck date with the accounting office, 101 ME (624-3355). Also contact this office if you have recently been made an assistantship offer, to supply all required appointment information.

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**Tuition**

Consult the *Graduate School Catalog* and the *Graduate Assistant Website* (http://www1.umn.edu/ohr/gao/) describing tuition policy in relation to course credits and assistantship appointments. Also refer to the registration classification chart in the *Registration Notes* section.
The College Work-Study Program

Students who are U.S. Citizens or who hold a permanent resident status qualify for the Work-Study program. Federal funds from the U.S. Department of Education, plus some state funds underwrite 70% of qualifying student support; 30% is covered by a research grant or teaching base.

To qualify, you must complete a financial aid form (the ACT form), after which a “qualifying maximum support base” (including all sources of support) is identified. Parental support is excluded which allows more students to qualify.

As this is a Federal program, accounting and auditing are conducted. Misuse of funds can result in a request for repayments.

Upon approval, a “certification” is issued, after which a payroll form can be issued. You must register for 3 credits (not including Independent Research, IE 8794) per term. Financial assistance assessment is made for the entire academic year.

Contact the Work Study Office at 626-8608 (170 Donhowe Building) for more information.

VI. APPROVAL PROCESS STEPS IN DEGREE STUDY

The Graduate School approves certain steps as you progress towards your degree, which are listed by degree on the following pages. As an overview, it is important for you to know the two principle academic units involved in your Industrial & Systems Engineering graduate education:

- Industrial & Systems Engineering Graduate Faculty
- Graduate School

Submit your degree program form plus any relevant petitions to the Graduate Advising Assistant, 1120 Mech Eng, for faculty approval. You should plan to submit material with adequate lead time for approval (which may take up to 2 months).

The Graduate School approves all committee assignments. You receive notification from the Graduate School regarding your committee assignments. Committee changes must be petitioned through John Gardner, 1120 Mech Eng.

Committee changes for exams that would occur during the summer vacation break are strongly discouraged. Try not to schedule an exam during this time period.
1. Obtain admission into the graduate program from baccalaureate program in engineering, science, or mathematics.

2. Check in with the Student Advising & Information Office, 1120 Mech Eng.

3. Read this handbook and the relevant sections of the Graduate School Catalog, if you have not done so already.

4. Course study (see Section III. Degree Programs for detailed course requirements)

5. Choose an adviser soon after beginning your studies. An adviser should be chosen no later than the end of your first semester of full-time registration or the second semester of part-time registration.

6. Submit committee members with the Graduate School to the following link:
   
   http://www.grad.umn.edu/students/forms/masters/index.html

   This is due right before the submission of a student’s degree program form, which is due after one full-time academic semester or after completing 10 credits. Plan C students do not need to submit a committee.

7. Complete the degree program form with adviser approval and submit it to the DGS Assistant. The form is due after one full-time academic semester or after completing 10 credits.

   http://policy.umn.edu/forms/otr/otr198.pdf

   Complete all blanks on the program form: courses, major/minor-related field, ethics seminar, calendar time taken, credits, etc. Attach a transcript.

   If a student wants to change their degree program form, it is done with a petition form, available at:

   http://www.grad.umn.edu/current_students/forms/gs59.pdf

8. Define your thesis topic/thesis research with your adviser. This is optimally done concurrently with course work.

9. Download Graduation Packet which includes the final oral exam form, and other graduation materials, including the application for degree, via the web at:

   http://www.grad.umn.edu/students/masters/index.html

   If circumstances require a change of a committee member, simply resubmit your new committee:
Each student must have an approved degree program form on file with the Department and the Graduate School, before he or she can execute this step.

The application for degree form must be submitted to the Student Services Office (STSS Building) by the first working day of one’s expected graduation month.

10. Schedule final oral examination. Be sure committee is informed of impending examination, and schedule it to accommodate all examining members. For available rooms, see the receptionist in 1100 Mech Eng.

11. File the signed thesis reviewers report in 160 Williamson Hall and obtain the final examination report form from that office.

12. Take final oral examination.

13. File approved final examination form with the Graduate School - 160 Williamson Hall.


15. Bind thesis - three copies (See Binding Information, Appendix A).

Two unbound copies are due in the Graduate School, 160 Williamson Hall, by the last working day of the month you want to graduate. One hardbound copy (maroon binding with white lettering) is also to be submitted to the Industrial and Systems Engineering Department Graduate Advising Assistant, 1120 Mech Eng.

16. Check-out / distribute thesis

To verify completion of graduate work for a degree and to allow for control of inventory, keys, and office space, you must complete a Departmental Check-out Form (available in 1120 Mech Eng) prior to departure from the Department or prior to beginning another degree objective within the Department.

You must submit one hardbound copy of the dissertation to the Industrial and Systems Engineering Department. The Department will reimburse you for the copying and binding of this copy. We request that the thesis submitted to the Department be a maroon-bound thesis with white lettering. When ordering the copying and binding of your thesis, please request a separate receipt for one copy. To obtain reimbursement (which will be mailed to your home address) submit an original receipt to the purchase order desk in 101 ME.
1. Obtain admission into the graduate program from baccalaureate program in engineering, science, or mathematics.

2. Check in with the Student Advising & Information Center, 1120 Mech Eng.

3. Read this handbook and the relevant sections of the Graduate School Catalog, if you have not done so already.

4. Course study (see Section III. Degree Programs for detailed course requirements) Up to 4 Independent Research credits are allowed (IE 8794)

5. Choose an adviser soon after beginning study. An adviser should be chosen no later than the end of your first semester of full-time graduate registration (or second semester of part-time graduate registration).

6. Submit committee members with the Graduate School to at the following link:  
   http://www.grad.umn.edu/students/forms/masters/index.html  
   This is due right before the submission of a student’s degree program form, which is due after one full-time academic semester or after completing 10 credits. Plan C students do not need to submit a committee.

7. Complete the degree program form with adviser approval and submit it to the DGS Assistant. The form is due after one full-time academic semester or after completing 10 credits.  
   http://policy.umn.edu/forms/otr/otr198.pdf  
   Complete all blanks on the program form: courses, major/minor-related field, ethics seminar, calendar time taken, credits, etc. Attach a transcript.

If a student wants to change their degree program form, it is done with a petition form, available at:  
   http://www.grad.umn.edu/current_students/forms/gs59.pdf
8. Students complete their Plan B project(s) independently under the guidance of one or more faculty advisers. In that case up to 4 credits of Independent Research (IE 8794) may be applied to the course requirements for the MS Plan B degree.

9. IE 8794, "Industrial Engineering Research," can be included on a Program of Study for an M.S. Plan, but cannot be included on a Program of Study for either an M.S. Plan A or a Ph.D.

10. Download Graduation Packet which includes the final oral exam form, and other graduation materials, including the application for degree, via the web at:

http://www.grad.umn.edu/students/masters/index.html

If circumstances require a change of a committee member, simply resubmit your new committee:

http://www.grad.umn.edu/students/examiningcommitteesnew/index.html

Each student must have an approved degree program form on file with the Department and the Graduate School, before he or she can execute this step.

The application for degree form must be submitted to the Student Services Office (STSS Building) by the first working day of one’s expected graduation month.

11. Schedule final oral examination. Be sure committee is informed of impending examination, and schedule it to accommodate all examining members. For available rooms, see the receptionist in 1100 Mech Eng.

12. Take final oral examination.

13. File approved final examination form with Graduate School (160 Williamson Hall).

14. Check-out. To verify completion of graduate work for a degree and to provide control of inventory, keys, and office space, you must complete a Departmental Check-out Form (available in 1120 Mech Eng) prior to departure from the Department or prior to beginning another degree objective within the Department.
1. Obtain admission into the graduate program from baccalaureate program in engineering, science, or mathematics.

2. Check in with the Student Advising & Information Center, 1120 Mech Eng.

3. Read this handbook and the relevant sections of the Graduate School Catalog, if you have not done so already.

4. Course study (see Section III. Degree Programs for detailed course requirements)

7. Complete the degree program form with adviser approval and submit it to the DGS Assistant. The form is due after one full-time academic semester or after completing 10 credits.

   [Link to form]

   Complete all blanks on the program form: courses, major/minor-related field, ethics seminar, calendar time taken, credits, etc. Attach a transcript.

   If a student wants to change their degree program form, it is done with a petition form, available at:

   [Link to petition form]

8. Download Graduation Packet which includes the final oral exam form, and other graduation materials, including the application for degree, via the web at:

   [Link to graduation materials]

   If circumstances require a change of a committee member, simply resubmit your new committee:

   [Link to committee change form]

   Each student must have an approved degree program form on file with the Department and the Graduate School, before he or she can execute this step.

   The application for degree form must be submitted to the Student Services Office (STSS Building) by the first working day of one’s expected graduation month.

9. Check-out. To verify completion of graduate work for a degree and to provide control of inventory, keys, and office space, you must complete a Departmental Check-out Form (available in 1120 Mech Eng) prior to departure from the Department or prior to beginning another degree objective within the Department.
1. Obtain admission into the graduate program from baccalaureate program in engineering, science, or mathematics.

2. Check in with the Student Advising & Information Center, 1120 Mech Eng.

3. Read this handbook and the relevant sections of the Graduate School Catalog, if you have not done so already.

4. Course study (see Section III. Degree Programs for detailed course requirements)

5. Complete the degree program form with adviser approval and submit it to the DGS Assistant. The form is due after one full-time academic semester or after completing 10 credits.

   http://policy.umn.edu/forms/otr/otr198.pdf

   Complete all blanks on the program form: courses, major/minor-related field, ethics seminar, calendar time taken, credits, etc. Attach a transcript.

   If a student wants to change their degree program form, it is done with a petition form, available at:

   http://www.grad.umn.edu/current_students/forms/gs59.pdf

6. Download Graduation Packet which includes the final oral exam form, and other graduation materials, including the application for degree, via the web at:

   http://www.grad.umn.edu/students/masters/index.html

   If circumstances require a change of a committee member, simply resubmit your new committee:

   http://www.grad.umn.edu/students/examiningcommitteesnew/index.html

   Each student must have an approved degree program form on file with the Department and the Graduate School, before he or she can execute this step.

   The application for degree form must be submitted to the Student Services Office (STSS Building) by the first working day of one’s expected graduation month.

8. Check-out. To verify completion of graduate work for a degree and to provide control of inventory, keys, and office space, you must complete a Departmental Check-out.
1. Admission into the Ph.D. program usually requires a master of science degree program in an engineering or science field. Exceptional students are admitted directly from a baccalaureate program in engineering, science or mathematics.

2. Check in with the Student Advising & Information Center, 1120 Mech Eng.

3. Read this handbook and relevant sections of the Graduate School Catalog, if you have not done so already.

4. Course study: Follow the requirements given in Section III (see Core Program Criteria section and Section III. Degree Programs for detailed course requirements).
   - credit count beyond baccalaureate typically ranges from 44-55 credits
   - consult adviser

   Graduate School requires 12 credits (beyond your bachelor’s degree) in your minor or supporting program and 24 thesis credits (IE 8888).

5. Choose an adviser (often done prior to beginning doctoral study).

6. Submit committee members with the Graduate School to at the following link:
   
   http://www.grad.umn.edu/students/forms/masters/index.html

   This is due right before the submission of a student’s degree program form, which is due after one full-time academic semester or after completing 10 credits. Plan C students do not need to submit a committee.

7. Complete the degree program form with adviser approval and submit it to the DGS Assistant. The form is due after one full-time academic semester or after completing 10 credits.

   http://policy.umn.edu/forms/otr/otr198.pdf

   Complete all blanks on the program form: courses, major/minor-related field, ethics seminar, calendar time taken, credits, etc. Attach a transcript.

   If a student wants to change their degree program form, it is done with a petition form, available at:

   http://www.grad.umn.edu/current_students/forms/gs59.pdf
8. Define your thesis topic/thesis research with your adviser. This is optimally done concurrent with course work.

9. Take your qualifying exam (see Section XII, Preliminary Examination Procedures) within one semester of completing core course requirements.

10. Schedule your preliminary examination within two semesters of passing the qualifying exam (see Section XII, Preliminary Examination Procedures, for details). The preliminary exam has two parts: a written part and an oral part. The written part is also your Ph.D. thesis proposal. The same committee will evaluate both written and oral parts. It consists of 4 members and must be selected at the time of approval of the degree program form.

11. Submit your preliminary written exam report to the Graduate Program Student Personnel Worker, 1120 Mech Eng, asserting passing quality. This is forwarded to 160 Williamson before your preliminary oral examination is scheduled.

12. Schedule preliminary oral exam as soon as possible after successfully completing the Preliminary Written Examination. It must be scheduled at least 1 academic term or fifteen weeks before final oral examination. Schedule this exam with the Graduate School at least one week in advance (call 625-0084 or go to 160 Williamson Hall). The Graduate School will then send the examination report form to your committee chair.

13. Take your oral preliminary exam. All requirements for the doctoral degree must be completed and the degree awarded within five calendar years after passing the preliminary oral examination. (See the Graduate School Bulletin for more details.)

14. Submit your preliminary oral exam form to 160 Williamson Hall.

15. Conduct your thesis research.

17. Pick up and file thesis proposal document (located in the cabinet outside 160 Williamson Hall) no later than the first semester after passing the preliminary oral examination.

18. Download Graduation Packet which includes the Reviewers Report Form, and other graduation materials including the application for degree, via the web at:

   http://www.grad.umn.edu/students/doctoral/index.html

   The application for degree form must be submitted to the Student Services Office(STSSBuilding) by the first working day of one’s expected graduation month.
19. Submit your thesis to reviewers (check with reviewers to ascertain their required reading
time frame—usually a minimum of 2 weeks).

20. Submit your signed thesis reviewers report to 160 Williamson at least one week
before your final oral examination.

21. Schedule final oral exam at least one week before your exam date by calling 625-0168 or
by going to 160 Williamson Hall. (The Graduate School will pass the final oral
examination report to your committee chairperson).

22. Take your final oral exam. A minimum of 4 committee members are required to serve
on your final examining committee (three from the major and one from outside).

23. File your final oral exam report (Graduate School, 160 Williamson Hall).


25. Bind thesis - three copies (see *Binding Information, Appendix A*).

   One unbound copy is due in the Graduate School, 160 Williamson Hall, by the last
   working day of the month you want to graduate. One bound copy (black binding
   with white lettering) is also to be submitted to the Industrial and Systems Engineering
   Department Graduate Advising Assistant, 1120 Mech Eng.


   You must submit one unbound copy of the thesis to the Graduate School and one bound
   thesis to the Graduate Advising Assistant, 1120 Mech Eng.

   The Department will reimburse you for the copying and binding of one copy. When
   ordering the copying and binding of your thesis, please request a separate receipt for
   one copy. To obtain reimbursement (which will be mailed to your home address)
   submit an original receipt to the purchase order desk in 101 ME.
VII. PROGRAM OF STUDY

As each graduate program is tailored to the individual, a proposed program of study is required prior to extensive coursework completion. Each graduate student is expected to submit a Degree Program Form to the Director of Graduate Studies for approval by the Departmental Graduate Faculty and the Graduate School. It is essential that you complete this program of study form **no later than your second full-time semester (or your third part-time semester)**, to ensure that guidance and perspective of your program direction can be provided and that difficulties are avoided when you are preparing for graduation. Hence, the need exists for early selection of a faculty adviser. The degree program form is available at http://policy.umn.edu/forms/otr/otr198.pdf.

**Special Points of Interest**

- For IE Track MSISyE Plan A, 3 of the 5 following courses are required. For MSISyE Plans B and C, and Ph.D. degrees, 4 of the 5 are required. Two of these courses must be IE 5531 and IE 8532 unless an exception is granted. Further details can be found on page 34.
  - IE 5531 Engineering Optimization I
  - IE 5545 Decision Analysis
  - IE 5551 Production Planning and Inventory Control
  - IE 8532 Stochastic Processes and Queuing Systems
  - IE 5111 Human Factors and Work Analysis

- For SE Track, MSISyE students are required to take the following courses.
  - IE 5111 Systems Engineering I
  - IE 5112 Introduction to Operations Research
  - IE 5113 Systems Engineering II
  - IE 5441 Project Management
  - IE 5553 Simulation

- Note that 4xxx-level courses are **not** acceptable for programs of coursework.

- One graduate-level seminar is required of the master’s student, and two (beyond the baccalaureate) of doctoral students. Include seminar credits in the course credit count on the degree program form. Seminars may be taken in other departments or technical disciplines.

- Students in the IE Track of the MS program or in the PhD program may not use IE 5112 Intro to Operations Research on their Degree Program.

- You must take all courses placed in the ‘major’ category on your program of study (Degree Program Form) on an A/F basis, with the exception of departmental seminars and the Plan B class. You are expected to take the great majority of non-major courses on an A/F basis. If you request to include a non-major course on an S/N base, you must clear it with your adviser and the Director of Graduate Studies. At that time, it is desirable that you bring a copy of your program of study to identify the strength of your entire program.

- Courses on the program of study must meet a minimum GPA requirement. **For MS students, the minimum program GPA is 2.8; for PhD students, the minimum program GPA is 3.0.**
• The Director of Graduate Studies will sign the form after graduate adviser approval. Turn the form in for that approval to 1120 Mech Eng, after obtaining adviser approval. Note: if you are officially declaring a minor, you will also need to gain the approval of the DGS from your minor department prior to submitting to 1120 Mech Eng.

• Permissible transfer of credit is explained in the Graduate School Catalog.

• If questions exist on the graduate caliber of courses taken elsewhere, you will be asked to demonstrate that such courses are contained in the Graduate School Catalog, if the prior institution has an accredited graduate program. You may also need to produce course syllabi and class notes for courses in question.

• You may place courses from departments outside of industrial and systems engineering into your major course category if they can be defended as central to the major concentration. Do this in close consultation with your faculty adviser. Ph.D. students in particular, please note the guiding principles we use to transfer credits and to evaluate programs of study.

• You are encouraged to include 8000-level courses in your programs of study. However, there is no set minimum number of such credits in a program.

• Whereas no formal credit count is stated for the doctoral degree in the Graduate School Catalog (other than the 12 credits required in the supporting program or minor), the Industrial & Systems Engineering Program observes a nominal minimum standard between 44 and 50 semester credits including master’s course credits as a hallmark of adequate course study.

• Do not confuse Industrial Engineering Research courses with thesis credit registration: (IE 8777 / 8888).

• Beginning with students who enter the graduate program in Industrial & Systems Engineering in fall semester, 2002, all students are required to take a 0-credit course that is offered by the Department on Research Ethics and Professional Practice. This course is required, but does not appear on your program of study. Current graduate students who entered the program before fall, 2002, are also encouraged to take the course.

• **Guiding Principles for Ph.D. Degree Programs**

  1. The program of study should consist of an overall coherent set of courses that can be justified on the basis of the research topic that the student plans to pursue in his/her doctoral thesis.

  2. In case of a transfer of credits, courses list in the degree program should be taken from a recognized graduate program whose rigor can be ascertained.

  3. When courses are taken form an institution other than the U of M, the student should be willing to provide necessary background materials. Such materials will be used to assess whether transfer is appropriate.
4. Students should be encouraged to take course in the ISYE program.

5. Ph.D. students should be encouraged to take 8xxx level courses.

We do not expect students pursuing interdisciplinary work to take introductory courses from several different programs. Not all such courses belong in the degree program. For example, we do not allow undergraduate courses on the degree programs, although in some cases, such courses may be needed by the student to learn the necessary background.

**Petitions**

Petitions are submitted along with or after a Degree Program has been approved by the Graduate School, depending on the reason for the petition. If a change in the content of a program is desired, but the program has already been approved by the Graduate School, you will need to submit a petition. If you are requesting special transfer of coursework or an extension of time, you may submit your petition along with your Degree Program Form.

- Submit a petition form signed by your adviser, to the Director of Graduate Studies, to request a program of study variance.

- Fill in all requested information.

- If you propose large scale changes in your program — conversion from Plan A to B, B to A, or course changes exceeding approximately three courses — submit a new degree program form with the old program appended.

- Submit petitions in a timely fashion.

- The Director of Graduate Studies acts upon degree program form submissions unless major variations from policy are requested. Such programs are referred to a scholastic standards committee or to the assembled Graduate Faculty.
VIII. CORE PROGRAM CRITERIA-UNDERGRADUATE

ISyE Option

A Bachelor's of Mechanical Engineering from the University of Minnesota prepares students for rewarding careers in industry and for graduate work. A strong background in mathematics, physics and chemistry is balanced with courses in engineering science and applied engineering.

Undergraduate students who select the ISyE option complete the same set of required courses as other mechanical engineering students, but their technical electives are selected from the Industrial Engineering course options and in consultation with a faculty adviser.

The ISyE option gives students an understanding of managerial and human factor issues involved in designing products and running manufacturing, logistics, and service operations. Students also learn additional skills for analysis, optimization and simulation of large-scale systems such as factories, logistical systems, and organizational networks.

Refer to the Mechanical Engineering Undergraduate Program web site for information about admission, curriculum, advising, graduation, honors program, ME Co-op and other degree programs, study abroad, scholarships and financial aid, and professional development.

B.M.E. Required Courses

ME 2011 Introduction to Engineering
ME 3031 Basic Mechanical Measurements Laboratory
ME 3221 Design and Manufacturing I
ME 3222 Design and Manufacturing II
ME 3281 System Dynamics and Control
ME 3321 Thermodynamics
ME 3322 Heat Transfer and Fluid Flow
ME 4054 Design Projects
IE 4521 Statistics, Quality, and Reliability
ME 4x,3x Senior Laboratory

Industrial & Systems Engineering Technical Electives: Choose one course from each area

Area 1 - Human Factors
IE 5511 Human Factors and Work Analysis
IE 5512 Applied Ergonomics
IE 5513 Engineering Safety

Area 2 - Engineering Management
IE 5441 Engineering Cost Accounting Analysis and Control
IE 5522 Quality Engineering and Reliability
IE 5541 Project Management
IE 5545 Decision Analysis
Area 3 - Production Systems
IE 5551 Production Planning and Inventory Control
IE 5552 Design and Analysis of Manufacturing Systems

Area 4 - Operations Research
IE 5531 Engineering Optimization I
IE 5553 Simulation
IE 8532 Stochastic Processes and Queueing Systems

Integrated BME/MSISyE-IE Track

The BME /MSISyE program offers Industrial & Systems Engineering majors several benefits: a streamlined admissions process from the undergraduate to the graduate program; graduate student status granted in the senior year; eligibility for teaching and research assistantships; and, flexibility in fulfilling required courses for both degrees simultaneously in the last two years of study. The program makes it possible for students to earn a Bachelor's degree in Mechanical Engineering and a Master's degree in Industrial & Systems Engineering in five years.

Eligibility Requirements

1. Students must be enrolled in the Mechanical Engineering undergraduate program at the University of Minnesota Twin Cities campus.
2. We prefer students with a GPA of 3.25 or greater. For students who have transferred from another institution, at least one semester must be completed at the University of Minnesota Twin Cities Campus, before admission to the program will be granted.
3. Students who are within 32 semester credits of completing the requirements for the BME degree are eligible to apply.

Application Procedure

Students who wish to apply for admission into the program must submit the following:
Submit to the Graduate School

1. Completed Graduate School application form
2. Necessary application fee
3. Original transcripts from post-secondary education institutions
4. Statement of purpose including planned area of concentration
Submit directly to the ISyE Program office:

1. Completed departmental application form that includes: a) planned courses necessary to complete the B.M.E. degree requirements (the semester and year in which the courses will be taken should also be noted as some courses are offered alternate years b) planned graduate level courses necessary to complete the M.S. degree requirements (the semester and year in which the courses will be taken should also be noted as some courses are offered alternate years) photocopy of completed
2. Photocopy of Graduate School application form
3. Photocopies of all post secondary education transcripts
4. Photocopy of the statement of purpose
5. One letter of recommendation from a full-time faculty member in the Mechanical Engineering Department
6. Completion of the GRE is not required for admission to this program. However, because students must complete the GRE to be considered for certain fellowships or for admission to the Ph.D. program, we recommend that the GRE be taken.

Application Deadlines

Admission is twice per year, in the fall and spring semesters. All materials must be submitted to the Graduate School and the ISyE program by June 15 for admission the subsequent fall semester, and October 15 for admission the subsequent spring semester.

Anticipated Enrollment

The Program will admit fifteen students each year for a total of thirty students enrolled at any given time.

Financial Support

The Program anticipates providing financial support similar to what is provided to our graduate students presently. Support will be in the form of departmental or external fellowships, teaching assistantships and research assistantships. Additional support may be in the form of corporate funding in cases where the student is working on a project sponsored by a company.

Advising Students

Students enrolled in this program will select an advisor by the end of the first semester of enrollment. This faculty advisor will ensure that the student meets all requirements for both degrees. The advisor will work with the student on the thesis for a Plan A or the paper for a Plan B Masters degree track.
Graduate students in industrial & systems engineering prepare for professional participation in a field associated with wide diversity and rapid flux. Programs of study are flexible enough to meet individual student/adviser aspirations, while providing a framework which facilitates an education with sufficient versatility to gain perspective of the profession beyond tightly focused subspecialty goals.

M.S.I.Sy.E.-I.E. TRACK and Ph.D. in ISYE

Core Course Requirements:

We expect all graduate students (MS Plan B and PhD) to take 4 out of the 5 core courses (reduced to 3 out of 5 for Plan A) listed in the curriculum. Two out of these must be IE 5531 and IE 8532, or qualifying replacements. Students may replace core courses with more advanced courses if they have already taken the equivalent of the core course elsewhere. A list of acceptable replacements is shown below (possible replacement courses are indented).

- **IE 5531** Engineering Optimization I
  - **IE 8531** Engineering Optimization II
  - **IE 8534** Advanced Topics in Operations Research

- **IE 8532** Stochastic Processes and Queueing Systems
  - **IE 8533** Advanced Stochastic Processes and Queueing Systems
  - **IE 8534** Advanced Topics in Operations Research

- **IE 5551** Production and Inventory
  - **IE 8552** Advanced Topics in Production, Inventory, and Distribution Systems

- **IE 5545** Decision Analysis
  - This course has no advance replacement.

- **IE 5511** Human Factors and Work Analysis Control
  - **IE 8538** Advanced Topics in Information Systems
  - **IE 8541** Decision Support Systems

M.S.I.Sy.E.-SE TRACK

We expect all graduate students to take the following five core courses. Exemptions may be granted for those students who have taken an equivalent course elsewhere. We may require that the student pass a qualifying exam if exemption is requested on the basis of a not for credit, or undergraduate course. Even when an exemption is granted students must complete a 30 credit degree program course.

Depending on a student's preparation, a different sequence of taking these courses may be optional. Please contact the Director of Graduate Studies for ISYE for specific advice.
• IE 5111  Systems Engineering I
• IE 5112  Introduction to Operations Research
• IE 5113  Systems Engineering II
• IE 5441  Project Management
• IE 5553  Simulation

For students convenience a variety of sample programs of study have been prepared. Some examples are shown below.

**MS in SE, with focus in Industrial Mathematics**

**Credits:** 17 from SE core courses; up to 14—16 from Math.

**Semester 1**
- **IE 5111** Systems Engineering I, 2 cr.
- **IE 5112** Introduction to Operations Research, 3 cr.
- **IE 5541** Project Management, 4 cr.

**Semester 2**
- **IE 5113** Systems Engineering II, 4 cr.
- **IE 5553** Simulation, 4 cr.
- Research Ethics and Professional Conduct, 0 cr.

**Semester 3**
- **Computational Methods**
  One of:
  - **Math 5485** Introduction to Numerical Methods I, 4 cr.
  - **Math 8441** Numerical Analysis and Scientific Computing I, 3 cr.

- **Complex Systems**
  One (or more) of:
  - **Math 5535** Dynamical Systems and Chaos, 4 cr.
  - **Math 5587** Elementary Partial Differential Equations I, 4 cr.

**Semester 4**
- **Advanced Computational Methods**
  One of:
  - **Math 5486** Introduction to Numerical Methods II, 4 cr.
  - **Math 8442** Numerical Analysis and Scientific Computing II, 3 cr.

- **Random Systems**
  One (or more) of:
  - **Math 5651** Basic Theory of Probability and Statistics, 4 cr.
  - **Math 5652** Introduction to Stochastic processes, 4 cr.
MS in SE, with focus in EE (Communication)

Credits: 17 from SE core courses, 9-15 from EE, 0-4 from IE

Semester 1
- IE 5111 Systems Engineering I, 2 cr.
- IE 5112 Introduction to Operations Research, 3 cr.
- IE 5541 Project Management, 4 cr.

Semester 2
- IE 5113 Systems Engineering II, 4 cr.
- IE 5553 Simulation, 4 cr.
- Research Ethics and Professional Conduct, 0 cr.

Semester 3
- EE 5381 Telecommunication Networks, 3 cr.
- One of the following two:
  - EE 5531 Probability and Stochastic Processes, 3 cr.
  - IE 8532 Stochastic Processes and Queueing Systems, 4 cr.
- EE 5581 Information Theory and Coding, 3 cr.

Semester 4
- EE 5501 Digital Communication, 3 cr.
- EE 5542 Adaptive Digital Signal Processing, 3 cr.

* Note that if a student takes IE 8532, then (s)he need only take three courses from among EE 5381, 5581, 5501, and 5542 to reach 30 credits.
MS in SE, with focus in EE (Computation)

Credits: 17 from SE core courses, 12 from EE, 1-4 from IE

Semester 1
- IE 5111 Systems Engineering I, 2 cr.
- IE 5112 Introduction to Operations Research, 3 cr.
- IE 5541 Project Management, 4 cr.

Semester 2
- IE 5113 Systems Engineering II, 4 cr.
- IE 5553 Simulation, 4 cr.
- Research Ethics and Professional Conduct, 0 cr.

Semester 3
- EE 5364 Advanced Computer Architecture, 3 cr.
- EE 5391 Computing with Neural Networks, 3 cr.
- XX XXXX Elective, 1-4 cr.

Semester 4
- EE 5239 Introduction to Nonlinear Optimization, 3 cr.
- EE 5371 Computer Systems Performance Measurement and Evaluation, 3 cr.
MS in SE, with focus in EE (Control Systems)

Credits: 17 from SE core courses, 12 from EE, 1-4 from IE

Semester 1
• IE 5111 Systems Engineering I, 2 cr.
• IE 5112 Introduction to Operations Research, 3 cr.
• IE 5541 Project Management, 4 cr.

Semester 2
• IE 5113 Systems Engineering II, 4 cr.
• IE 5553 Simulation, 4 cr.
• Research Ethics and Professional Conduct, 0 cr.

Semester 3
• EE 5231 Linear Systems and Optimal Control, 3 cr.
• EE XXXX Elective from EE, 3 cr.
• XX XXXX Elective, 1-4 cr.

Semester 4
• EE 5235 Robust Control System Design, 3 cr.
• EE 5821 Biological System Modeling and Analysis, 3 cr.
MS in SE, with focus in Operations Management

Credits: 17 from SE core courses; up to 15 from OMS.

Semester 1
- **IE 5111** Systems Engineering I, 2 cr.
- **IE 5112** Introduction to Operations Research, 3 cr.
- **IE 5541** Project Management, 4 cr.

Semester 2
- **IE 5113** Systems Engineering II, 4 cr.
- **IE 5553** Simulation, 4 cr.
- Research Ethics and Professional Conduct, 0 cr.

Semester 3
- **MBA6220**
  - OM Core (3 credits)
- **OMS 6059**
  - Quality Management and Six Sigma (4 Credits)

Semester 4
- **OMS 6059**
  - Managing Supply Chain Operations (4 Credits)
- **OMS 6072**
  - Managing Technology in Supply Chains (4 credits)
MS in SE, with focus in
Health Informatics

Credits: 17 from core courses; 9 from Health Informatics Stream; 4 from electives. Elective credits could come from BioInformatics Minor program, MHA program, or from the Health Informatics Topics course (HInf 5494). See attachments for details.

Semester 1
• IE 5111 Systems Engineering I, 2 cr.
• IE 5112 Introduction to Operations Research, 3 cr.
• IE 5541 Project Management, 4 cr.

Semester 2
• IE 5113 Systems Engineering II, 4 cr.
• IE 5553 Simulation, 4 cr.
• Research Ethics and Professional Conduct, 0 cr.

Semester 3
• HInf 5430 Health Informatics I (4 credits)
• One (or more) BioInformatics core course:
  See UM Minor in BioInformatics for more information

Semester 4
• HInf 5431 Health Informatics II (4 credits)
• HInf 5436 Health Informatics Seminar (1 credits)
• One (or more) of BioInformatics core course:
  See UM Minor in BioInformatics for more information
MS in SE, with focus in Bio-Medical Engineering

Credits: 17 from core courses; 16 from BMEn
Possible foci in bio-mechanical device design, bio-electrical device design, or bio-instrumentation.

Semester 1
- IE 5111 Systems Engineering I, 2 cr.
- IE 5112 Introduction to Operations Research, 3 cr.
- IE 5541 Project Management, 4 cr.

Semester 2
- IE 5113 Systems Engineering II, 4 cr.
- IE 5553 Simulation, 4 cr.
- Research Ethics and Professional Conduct, 0 cr.

Semester 3
- BMEn 8630 Bio-medical Engineering Graduate Seminar, 1 cr.
- BMEn/ME 8221 New Product Design & Development I, 4 cr.
- One (or more) BMNe core course:
  - BMEn 5101 Advanced Bioelectricity/Instrumentation, 3 cr. or
  - BMEn 5201 Advanced Biomechanics, 4 cr.

Semester 4
- BMEn/ME 8222 New Product Design & Development II, 4 cr.
  (prerequisite ME 8221)
- One (or more) of:
  - BMEn 5102 Bioelectric Measurements and Therapeutic Devices
  - BMEn 5501 Biology for Biomedical Engineers
  - Phsl 5061 Principles of Physiology for Biomedical Engineering
MS in SE, with focus in Nano-Engineering

Credits: 17 from core courses; 15 from Nanoparticle Science and Engineering

Semester 1
- **IE 5111** Systems Engineering I, 2 cr.
- **IE 5112** Introduction to Operations Research, 3 cr.
- **IE 5541** Project Management, 4 cr.

Semester 2
- **IE 5113** Systems Engineering II, 4 cr.
- **IE 5553** Simulation, 4 cr.
- Research Ethics and Professional Conduct, 0 cr.

Semester 3
- **NPSE 8101** Nanoparticle Science and Engineering Seminar, 1 cr.
- **NPSE 8001** Introduction to Nanoparticle Science and Engineering, 3 cr.
- **EE 5171** Microelectronic Fabrication, 4 cr.
  Or any of the electives listed on the Nanoparticle Science and Engineering webpage: http://www.nanoigert.umn.edu/Education.htm

Semester 4
- **PHYS 5701** Solid State Physics for Engineers and Scientists, 4 cr.
  Or any of the electives listed on the Nanoparticle Science and Engineering webpage: http://www.nanoigert.umn.edu/Education.htm
- **NPSE 8002** Nano-particle Science and Engineering Laboratory, 3 credits,
  (requires NPSE8001)
MS in SE, with focus in Computer Science

Credits: 17 from core courses; 13 from CSci

[Minor in Computer Science requires 9 credits in CSci, must have at least one CSci level course with a 5xxx level (or higher) pre-requisite]

Semester 1 (Fall year 1)
- IE 5111 Systems Engineering I, 2 cr.
- IE 5112 Introduction to Operations Research, 3 cr.
- IE 5541 Project Management, 4 cr.

Semester 2 (Spring year 1)
- IE 5113 Systems Engineering II, 4 cr.
- IE 5553 Simulation, 4 cr.
- Research Ethics and Professional Conduct, 0 cr.

Semester 3 (Fall year 2)
- CSci 5707
  Principles of Database Systems, 3 cr., offered spr., fall, summer (pre-req 4041)
- CSci 5115
  User Interface Design, 3 cr. Offered fall (pre-req 4041)
  pre-req CSci 4041

Semester 4 (Spring year 2)
- IE 5551
  Simulation, 4 cr., offered spring.
- CSci 5116
  GUI toolkits and Their Implementation, 3 cr., offered spring (pre-req: CSci 5115)
Students may build custom programs (requires DGS approval) with a variety of electives from other departments around the campus. A list of possible electives (which is not exhaustive) is provided below.

**Aerospace Engineering and Mechanics**
AEM 5431 Trajectory Optimization (3 cr)
AEM 5451 Optimal Estimation (3 cr)
AEM 8421 Robust Multivariate Control Design (3 cr)

**New Product Development**
ME 8221 & 8222 New Product Design & Development (8 cr)
ME 5221 Computer Assisted Product Realization (4 cr)
ME 5241 Computer Aided Engineering (4 cr)
ME 5243 Advanced Mechanism Design (4 cr)

**Supply Chain Management**
IE 5551 Production Planning and Inventory Control (4 cr)
MKTG 6060 Distribution and Supply Chain Systems (4 cr)
OMS 6056 Managing Supply Chain Operations (4 cr)
MKTG 6020 Advanced Logistics and Supply Chain Management (2 cr)
MKTG 6065 Strategic Supply Chain Management (2 cr)

**Operations Research**
IE 5531 Engineering Optimization I (4 cr)
IE 5545 Decision Analysis (4 cr)
IE 8532 Engineering Optimization II (4 cr)
IE 8532 Stochastic Processes and Queueing (4 cr)

**Human Factors**
IE 5511 Human Factors (4 cr)
IE 5513 Engineering Safety (4 cr)
IE 5511 Human Factors and Work Analysis (4 cr)

**Engineering Management**
IE 5522 Quality Engineering and Reliability (4 cr)
IE 5441 Engineering Cost Accounting (4 cr)
IE 5545 Decision Analysis (4 cr)
IE 5551 Production Planning and Inventory Control (4 cr)
X. THESIS CREDIT REGISTRATION
For M.S.I.Sy.E.-IE Track and Ph.D. Candidates

- Students completing a Plan A master’s degree in engineering are required to enroll for 10 master’s thesis credits (IE 8777) before receiving the degree.

- Master’s thesis credits may be registered for at any time in the student’s semesters of study. List thesis credits on the degree program form but do not include them in the credit totals at the bottom of the degree program form.

- Students completing a doctoral degree are required to enroll for 24 doctoral thesis credits (IE 8888) before receiving a degree (students can register for a maximum of 18 in one semester). Doctoral students may not register for thesis credits until the semester after they have passed their preliminary oral examination (see Section XII Preliminary Examination Procedure). List thesis credits on the degree program form but do not include them in the credit totals at the bottom of the degree program form.

Ph.D. students are urged to track their thesis enrollment to ensure that graduation criteria are met as graduation becomes imminent. Thesis credits cannot be transferred from M.S. programs.

XI. MASTER'S FINAL EXAMINATION-IE TRACK ONLY

A final examination is required for all master’s Plan B candidates in the IE Track. This is an oral examination, usually one hour in length. It is conducted by a minimum of three members of the graduate faculty assigned at the time your degree program form is approved. At least two faculty members must be from the major field and one from the minor or supporting program area. The final oral for the master’s degree is conducted as a closed examination, attended by only the student and the examining committee.

It is your responsibility to schedule the oral exam in consultation with your adviser and committee members. You must notify the Graduate School at least one week prior to your examination date and obtain the necessary forms from them.

This examination may relate to a combination of both dissertation content (for Plan B programs, project and paper content) and technical course competence. Your adviser will propose strategy for the examination and present this to the examiners when they convene. The committee will then indicate its preference. However, it is wise to talk with examining committee members as the time for the examination approaches near.
All Ph.D. students will be required to take two exams: a Qualifying Examination and a Preliminary Examination. Procedures for each exam are described below.

Qualifying Examination Procedure

The qualifying exam will consist of a single examination for each student covering up to three areas represented by the student’s choice of core courses. Students may not choose the areas in which they will be tested.

**Timing:** Students are required to take the exam within one semester of completing the core course requirement.

**Committee composition:** The exam committee for each student consists of two members, one of which must be a full member of the ISyE graduate faculty. The committee may not include the student’s advisor. However, exceptions may be made if the advisor is the only faculty available to represent a specific subject area.

**Form of the exam:** The exam has two parts: one written and one oral. The written part is in the form of a take home exam; the exam questions are provided to all students 24 hours prior to when the written responses are due. The oral exams will be typically scheduled within a day or two after students’ submissions are received. Each student comes prepared to the oral exam to answer additional questions from the examining committee. These questions will primarily pertain to the topic(s) of the exam.

**Evaluation of the exams:** At the end of each oral examination, the committee deliberates and writes a short summary of their deliberations with a pass/fail recommendation. A final pass/fail decision is taken in a meeting of the entire ISyE graduate faculty which would then be communicated to the student. The ISyE graduate faculty meeting will take place soon after the completion of all oral exams. The ISyE graduate faculty will also decide whether the student will be permitted to retake the qualifying, if (s) he does not pass.

Preliminary Examination Procedure

**Written Part:** The written preliminary exam will be the doctoral thesis research proposal of the student.

**Timing**
After passing the oral qualifying exams students are eligible to take the written preliminary exam. *Students will be required to take the preliminary examination within two semesters of successfully completing their qualifying examination.*

**Form of exam**
The written preliminary exam will consist of a written thesis proposal. This proposal must
explain the motivation and significance of the research, must state the research objective, challenges in reaching the objectives, and the major literature on the topic of the proposal. This review should indicate the current state of understanding of the topic and should describe how the proposed research, if successful, will contribute to that understanding.

**Examining committee**

The committee for the written preliminary exam will consist of the adviser(s) and at least two other members of the ISyE graduate faculty. Normally the same faculty members will subsequently serve on the student’s oral preliminary exam committee. Note that the written exam committee does not include the Faculty member who represents the minor or supporting program in the oral examination committee.

The Director of Graduate Studies will approve your oral preliminary committee with input from your adviser. This committee is selected so that its membership represents expertise related to your research. It is expected that this committee will become your final thesis defense committee if you successfully complete the oral preliminary examination. Your adviser must be the chair of your preliminary oral exam committee, but not of your final oral exam committee.

**Evaluation of the exam**

The written preliminary exam must be judged satisfactory by all members of the examining committee before the student can take the oral preliminary exam. All members of the committee must indicate (form to be designed) that they approve the exam. If one or more members of the committee deem the exam unsatisfactory, then the committee must meet to decide what improvements will be required, and the adviser must convey this information to the student in writing. In that case, the student must submit a revised thesis proposal to his/her committee by a date to be specified (for example, three months from the date of the letter). If the committee still finds the proposal to be unsatisfactory, determined by a majority vote, then the student will be terminated from the program.

**Oral Part:**

The oral preliminary exam can be scheduled only after the written thesis proposal has been approved.

**Timing**

The oral preliminary exam should be taken as soon as possible, preferably the same semester if that can be scheduled, after the student has passed the written preliminary exam.

**Form of exam**

The exam will consist of an oral presentation by the student on his or her proposed research, and of questioning by the committee about the proposed research. The length of the presentation should be approximately 30 minutes, if it were not interrupted by questioning. The total length of the exam should not exceed two hours.

**Examining committees**

The examining committee will be the same as for the written preliminary exam, with the addition of at least one member from the minor or supporting program.

**Evaluation of the exam**

Following Graduate School rules, the committee will initially take a closed-ballot vote,
where each member votes pass, fail, or pass with reservations. There will then be discussion, followed by a second closed-ballot vote. If the committee consists of four members, a passing verdict requires at least a 3-1 vote; if the committee consists of five members, a passing verdict requires at least a 4-1 vote. If any of the votes required to achieve the minimum for a passing verdict is a “pass with reservations,” then the result of the exam will be pass with reservations. In that case, the committee must decide what the student must do to remove the reservations, and this must be conveyed in a formal letter that goes both to the student and to the Graduate School. Additional details are provided below.

**Oral Preliminary Examination**

- Your oral preliminary examination will consist of two parts:
  
  (a) A 25 minute presentation by you on your doctoral research proposal/plans, consistent with the written proposal which must be approved before the oral part can be scheduled. This oral presentation should emphasize why your subject is important, how it relates to the present state-of-the-art and existing limitations, a description of the methodologies to be used, and what important conclusions one will be able to derive from the results.
  
  (b) After the presentation a question and answer period during which you must demonstrate your ability to respond to critical questioning of your work and related subject matter. The subject matter is not restricted to the area of the proposed thesis.

- Emphasis for your oral preliminary exam:
  
  (a) understanding of research topic
  (b) ability to formulate a hypothesis or research plan
  (c) demonstration of independence and creativity in solving problems
  (d) ability to think logically
  (e) ability to communicate
  (f) ability to adequately respond to critical questioning by faculty
  (g) demonstration of fluency with the basic concepts that apply to your selected research area, etc.

- Your adviser cannot take any role in presenting the material to the rest of the committee or interpreting and responding to questions.

- It is up to your committee to decide whether to allow anyone other than committee members to attend the presentation portion of the oral preliminary examination. Under normal circumstances, this examination is closed to the public.

- This examination is immediately followed by a deliberation of the committee on whether you have passed, passed with reservations, or failed. Voting complies with Graduate School policies:

  “The outcome of the examination, with all committee members present and voting, is recorded in one of three ways: pass, pass with reservations, or fail. The voting proportions
necessary for these decisions are as follows: if the committee consists of four members, a favorable verdict for passing consists of either a unanimous vote or 3-1; if the committee consists of five members, a favorable verdict for passing consists of either a unanimous vote or a vote of 4-1; if the committee consists of six members, a unanimous vote or a vote of 5-1 or 4-2 is needed. Candidates who do not earn committee votes in these proportions fail the examination. If, in order to achieve the minimum number of votes to reach a verdict of pass, any vote of pass with reservations is included, then the outcome will be recorded as a pass with reservations. A vote to pass the student with reservations still constitutes a passing vote.”

• Note that the Graduate School requires the following procedures if the committee decides that the student has PASSED THE EXAMINATION WITH RESERVATIONS:

“...the student is informed immediately, but the committee is permitted one week in which to convey its reservations to the student in writing, informing the student of the steps that must be taken to remove them. A copy of this letter must be sent to the Graduate School. When the student has satisfied the committee’s reservations, a second letter informing the student and the Graduate School that the reservations have been removed and that the student may proceed toward the degree is also required. Both letters should be written by the committee chair. The final oral examination may not be scheduled until the Graduate School has received a copy of the letter indicating that the reservations have been removed.

“If the committee members disagree as to whether the reservations have been satisfactorily removed, the committee chair asks for another vote, the results of which are subject to the same voting proportions as the initial vote. If the student is unable to satisfy the committee’s reservations, his or her doctoral candidacy and graduate student status may be terminated.”

• It is within the prerogative of the preliminary oral examining committee to decide on additional steps required to remove those reservations. If the committee so chooses, you can retake part(s) of the oral preliminary exam, but only one repetition is allowed. Your committee will specify the format and the date for that exam. This examination will be held as soon as possible.

• Contents of visual aids used in any presentation, including slides, overheads, etc., must be your work. All visual aids must be readable from the back of your examination room.

• You are allowed to avail yourself of editorial assistance only with regard to spelling and correct grammatical usage in your visual aids. If such assistance is used, you must certify that no assistance was provided other than in correcting the spelling and grammar and you must identify the person who provided this assistance. Do not ask your adviser to provide this assistance since he or she may inadvertently make other editorial comments.
Final Thesis Examining Committee

• Your final thesis examining committee is assigned within three months after the successful completion of your doctoral preliminary exams by filing your thesis proposal form with the Graduate School. The Director of Graduate Studies will approve the members of this committee based on your adviser’s recommendation and normally consist of faculty members who served on the Preliminary Oral Examination committee. The final oral examining committee requirement requires 4 members (three departmental examining members and one outside examining member).

• You are encouraged to present your progress to your thesis examining committee at least once each year, with the first meeting to take place no later than one year after successfully completing the oral preliminary examination.

XIII. CHANGE OF STATUS

The Graduate School charges a fee for all Change of Status requests. You must file a Change of Status form with the Graduate School, 309 Johnston Hall, if you meet one of the following criteria:

• You have completed your M.S. and want to pursue a Ph.D.
• You are majoring in M.S.I.Sy.E. and would rather major in something else.
• You are majoring in M.S. I.Sy.E. and want to add a second major.
• You have not completed your M.S. but want to switch to a Ph.D.
• You have not registered in the Graduate School within the past fall or spring term.
• You have completed your Ph.D., but would still like to take more courses.
XIV. ANNUAL REVIEWS OF GRADUATE STUDENTS PROGRESS

The performance and progress of all graduate students in the ISyE Program is evaluated annually by their advisers. This evaluation occurs during the latter part of spring semester, in a meeting between the student and the adviser. Around April 1 all advisers receive a form for each of their advisees, which contains information such as the student’s beginning date in the graduate program, number of credits completed, GPA, and milestones such as filing of program of study, completion of Ph.D. preliminary exams, and so forth. This form is meant to inform the adviser and also to serve as the starting point for a discussion of the student’s progress. The adviser indicates, if appropriate, whether performance in research is satisfactory, and is asked to comment. The form is then signed by the adviser, the student, and finally the DGS, and is added to the student’s file.

XV . MAIL. MAILBOXES, BUILDING KEYS

Each full-time graduate student who is on appointment by the Industrial and Systems Engineering Department is given a mailbox upon check-in. You will automatically be assigned a mailbox by the payroll office.

Postings are distributed through mailboxes and electronic mailboxes. If you do not have a departmental email account, please see section XVI Computing Facilities.

The department supplies building and room keys by having the division chair or faculty member responsible for the laboratory area, contacting Jeanne Sitzmann at jeanne@me.umn.edu. Jeanne Sitzmann, 1120 Mech. Eng., can then give you the keys that have been requested.

XVI. COMPUTING FACILITIES

Two major computer facilities are available for graduate students within the Industrial and Systems Engineering Department: the Institute of Technology Instructional Computing Committee Labs (ITICCC), and the Mechanical Engineering Department Computing Labs. Graduate students in industrial and systems engineering may request usage of either or both facilities, as described below.

There are two main departmental computing labs which are accessible to graduate students - ME 10 and ME 472. They are fully networked; registered users are invited to freely move between the labs. Accounts for these facilities are requested by printing out a New Account Request Form from http://www.menet.umn.edu and submitting it to the ME Net Office in ME 152. Users must also pick up an access card from Jeanne Sitzmann, 1120 M.E. You must bring a deposit check for $15.00, payable to the University of Minnesota, and your U-card to obtain an access card.

All workstations and personal computers are networked into the campus-wide Ethernet TCP/IP fiber-optic-based network. From the network, the workstations have access to other computing resources, such as the supercomputer facilities of the Minnesota Supercomputer Center and the Army High Performance Computing Research Center. Access the ME Webpage for an up-to-date list of accessible facilities.
Graduate students obtain accounts for using the labs of the Institute of Technology Instructional Computing Committee (ITICC) by paying the semester ITICC computing fee. The fee-payment procedure is described in the Class Schedule. All fee-paying students receive a permanent, personal file space of 10MB. Additional space of up to 50MB per class per semester is allocated to students enrolled in classes utilizing ITICC labs.

The lab in ME 308 is equipped with Silicon Graphics workstations, IBM Pentium-based personal computers, Hewlett-Packard high-capacity laser printers, color printers, and a CAD plotter. Both the workstations and personal computers are networked to dual UNIX servers. All machines are equipped with sufficient local memory and disk resources to meet the demands of all software used in the lab. Students can also access general-purpose computational software such as “Mathematica” and “MATLAB” for course and project usage.

The IBM Personal Computers provide access to general-purpose office software. All machines are equipped with “Word” for word processing, “Excel” for spreadsheet analysis, “PowerPoint” for professional-quality viewgraph preparation, and “Mathematica” for symbolic manipulation. These programs are available for preparing student reports, presentations, and homework for any class. Additionally, the Personal Computers are used to run engineering-based computer applications.

All software available in the Mechanical Engineering and ITICC labs is strictly limited to academic usage only. The software may be used for coursework and research directly attributed to your graduate program only. The software cannot be used for consulting under any circumstances. No licensed software may be copied or removed from the labs.

APPENDIX A: Thesis Binding Information
There are two recommended local establishments who offer binding/photocopying services:

U of MN Bindery 625-1092
G-14 Coffman Memorial Union

Kinko’s 651-687-0890
Business Office