

03/24/2017

Industrial & Systems Engineering



2016-2017 Graduate Student Handbook

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PREFACE

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
gardn032@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

MUTUAL RESPONSIBILITIES POLICY

Mutual Responsibilities in Graduate Education at the University of Minnesota
Approved by the Graduate School Executive Committee 5/28/97

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

Dr. William Cooper
130F Mech Eng
624-4322

Graduate Coordinator

Mr. John K. Gardner
1120 Mech Eng
625-2009

ISyE Department Head

Dr. Shuzhong Zhang
130E Mech Eng
624-8406

INDUSTRIAL & SYSTEMS ENGINEERING FACULTY

<i>Professors</i>	<i>Office</i>	<i>Telephone</i>	<i>Email</i>
Arora, Sant Ram**	1101	n/a	arora001@umn.edu
Benjaafar, Saifallah	130G	626-7239	saif@umn.edu
Cooper, William	130F	624-4322	billcoop@umn.edu
Donohue, Karen*	3-237CSOM	625-6320	donoh008@umn.edu
England, Darin	130A	625-6742	engl0124@umn.edu
Gupta, Diwakar	130B	625-1810	guptad@umn.edu
He, Qie	585 Shep Lab	625-3828	qhe@umn.edu
Hill, Arthur*	3-229 CSOM	624-4015	ahill@umn.edu
Kong, Guangwen	391 Shep Lab	624-6610	kgong@umn.edu
Kvalseth, Tarald**	1101	n/a	kvals001@umn.edu
Leder, Kevin	130C	624-7965	kevin.leder@me.umn.edu
Luo, Zhi-Quan*	4-178 Keller	625-0242	luoxx032@umn.edu
Mani, Ankur	389 Shep Lab	624-7539	amani@umn.edu
Miller, Lisa	130D	625-7397	lisamiller@umn.edu
Mitchell, Dan	233 Vincent	625-6380	damitche@umn.edu
Negoescu, Diana	589 Shep Lab	624-0217	negoescu@umn.edu
Stoffregen, Thomas*	202B CookeH	626-1056	tas@umn.edu
Wang, Zizhuo	387 Shep Lab	624-6752	zwang@umn.edu
Zhang, Shuzhong	130E	624-8406	zhangs@umn.edu

* Denotes affiliate member of graduate faculty.

** Denotes emeritus

GRADUATE SCHOOL OFFICES

<i>Contact</i>	<i>Office</i>	<i>Telephone</i>
Prospective students	309 Johnston	625-3014
Previously registered students	One Stop	625-3490
Graduate Scholarships, Grants-in-Aid, Fellowships	314 Johnston	625-7579
Student Services	One Stop	625-3490
Change of Status - Readmit / Change of Major or Degree..	309 Johnston	626-8060
Student Degree Plans / Graduate Files	One Stop	625-3490
Doctoral Preliminary Oral Exam Scheduling	One Stop	625-3490
Doctoral Final Exam Scheduling	One Stop	625-3490
Graduation Doctoral	One Stop	625-3490
Graduation Masters	One Stop	625-3490
Student Progress, Petitions, Registration	One Stop	625-3490

II. REGISTRATION

Registration Steps - all new students

- _____1. Obtain student I.D. card.

U-Card Office - G22 Coffman Memorial Union

- _____2. All new international students - check in with the *International Student & Scholar Services Office, 190 Hubert H. Humphrey Center, West Bank.*

- _____3. Consult with Director of Graduate Studies or appropriate faculty member to establish first semester's courses.

- _____4. Register - follow the registration procedures on One Stop:

<https://onestop.umn.edu/registration/>

Registration Steps - current / previous students

Register at One Stop 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:
https://www.myu.umn.edu/psp/psprd/EMPLOYEE/CAMP/c/SA_LEARNER_SERVICES.CLASS_SEARCH.GBL

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 plan of study (Graduate Degree Plan) 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 plan of study to identify the strength of your entire plan.
- For the University calendar and registration information, refer to the University's semester *Class Schedule* or the *Summer Session Bulletin*.

- **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.

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

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 One Stop 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 (ISyE) 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. 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.

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:

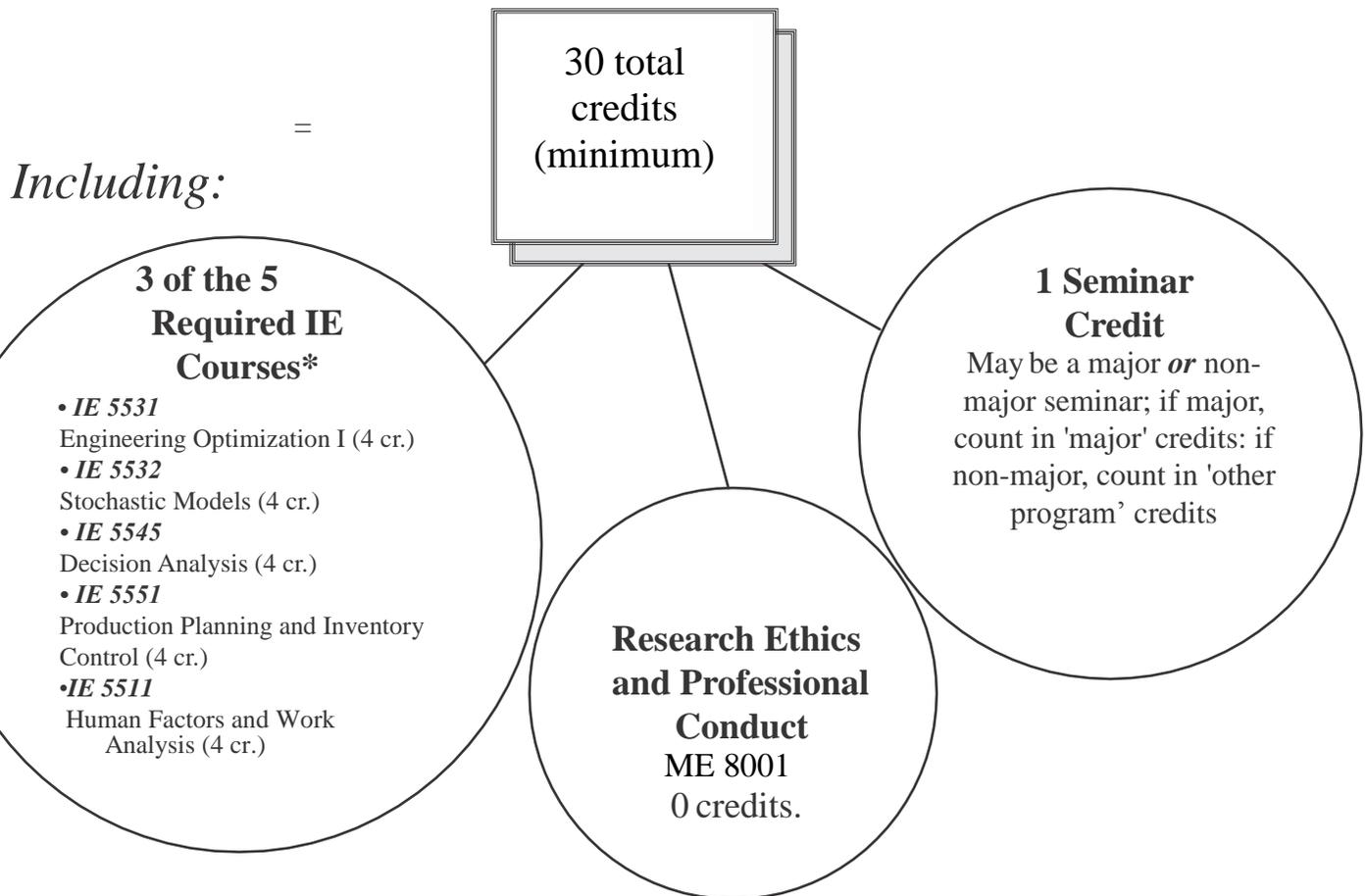
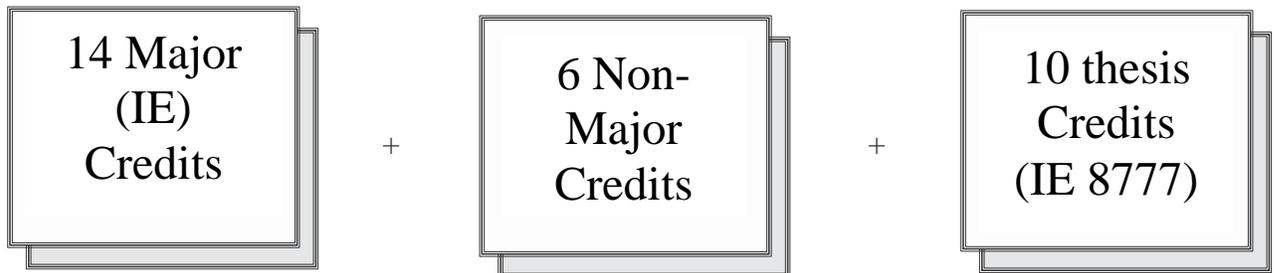
- Defining the requirements for a system to satisfy multiple stakeholders and organizations throughout the life of a system.
- Developing a systems architecture-arrangement of elements and subsystems and allocation of functions to them to meet systems requirements.

- 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.

MASTER OF SCIENCE IN INDUSTRIAL & SYSTEMS ENGINEERING - PLAN A -IE TRACK

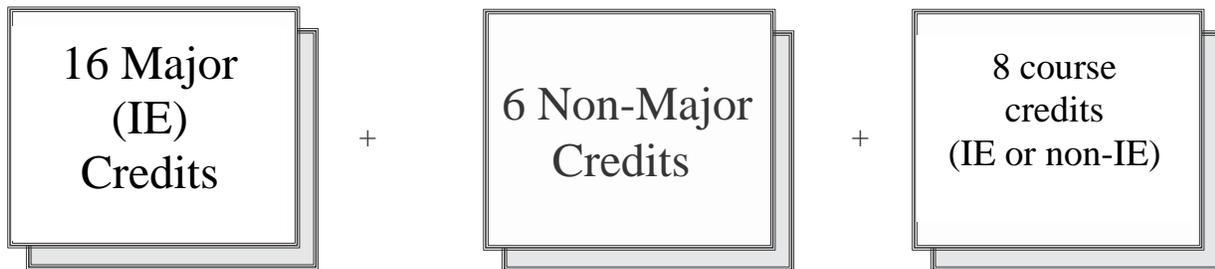
Plan A master's degree provides you the opportunity to execute research on a topic selected in consultation with your adviser. You gain an understanding of research techniques by applying relevant technologies to an engineering problem which extends understanding of an aspect of the field. The quality of your performance in this degree path is based heavily upon your success in thesis research.



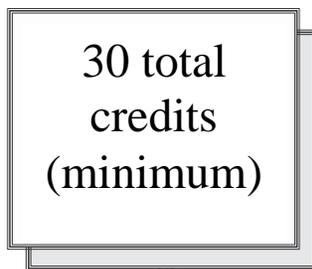
*Two out of these 3 must be IE 5531 and IE 5532, or their qualifying replacements (see pages 30-31).

MASTER OF SCIENCE IN INDUSTRIAL & SYSTEMS ENGINEERING - PLAN B -IE TRACK

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)



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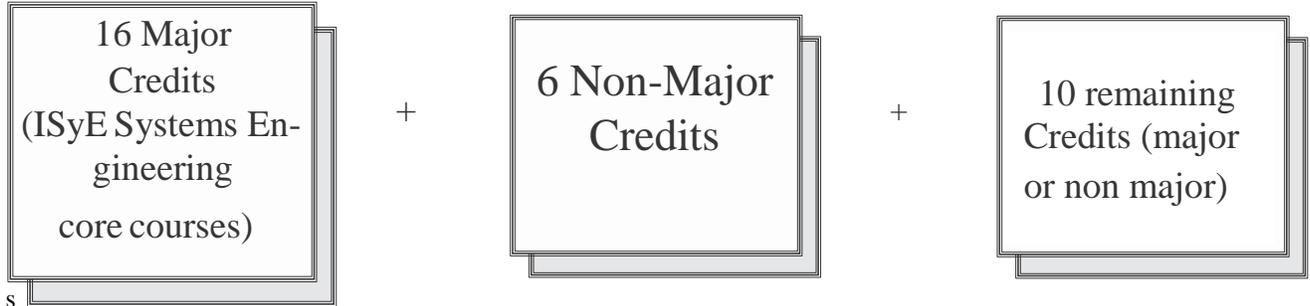


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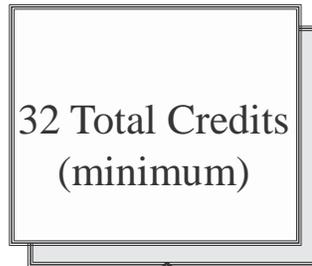


*Two out of these 4 must be IE 5531 and IE 5532, or their qualifying replacements (see pages 30-1).

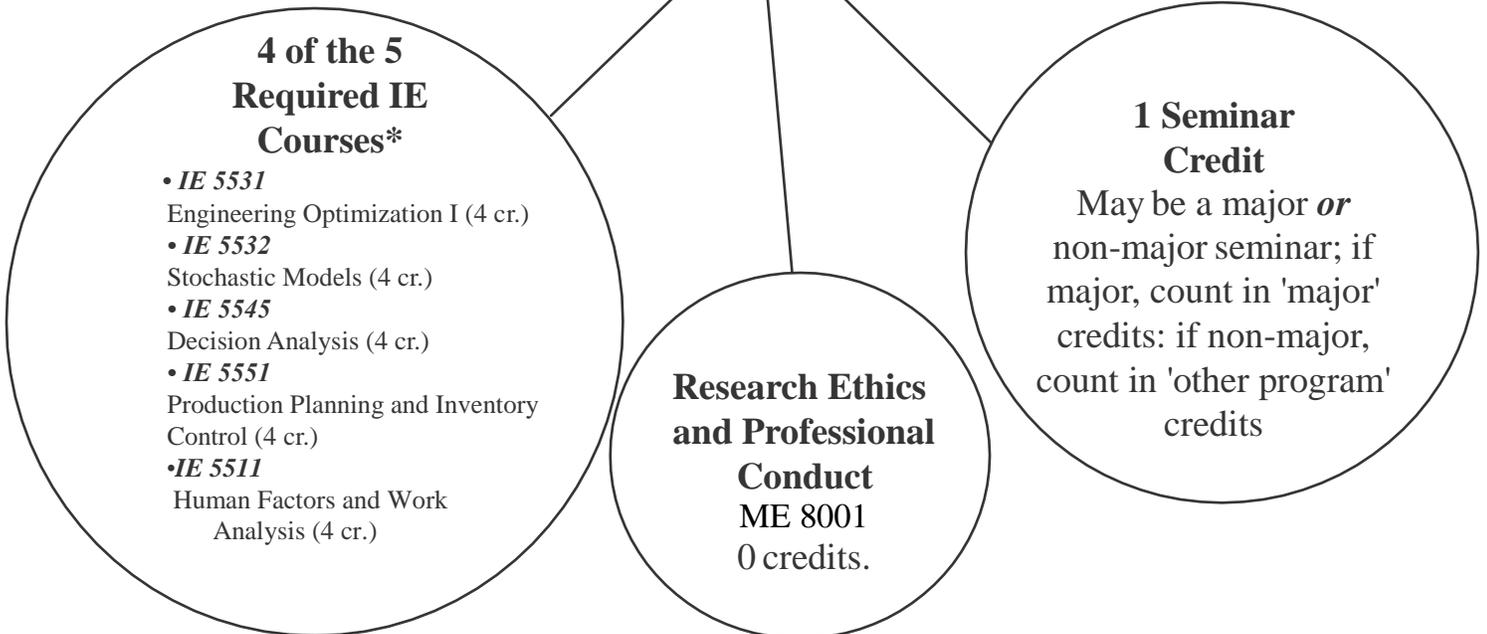
**MASTER OF SCIENCE IN INDUSTRIAL & SYSTEMS ENGINEERING –
Plan C -IE TRACK**



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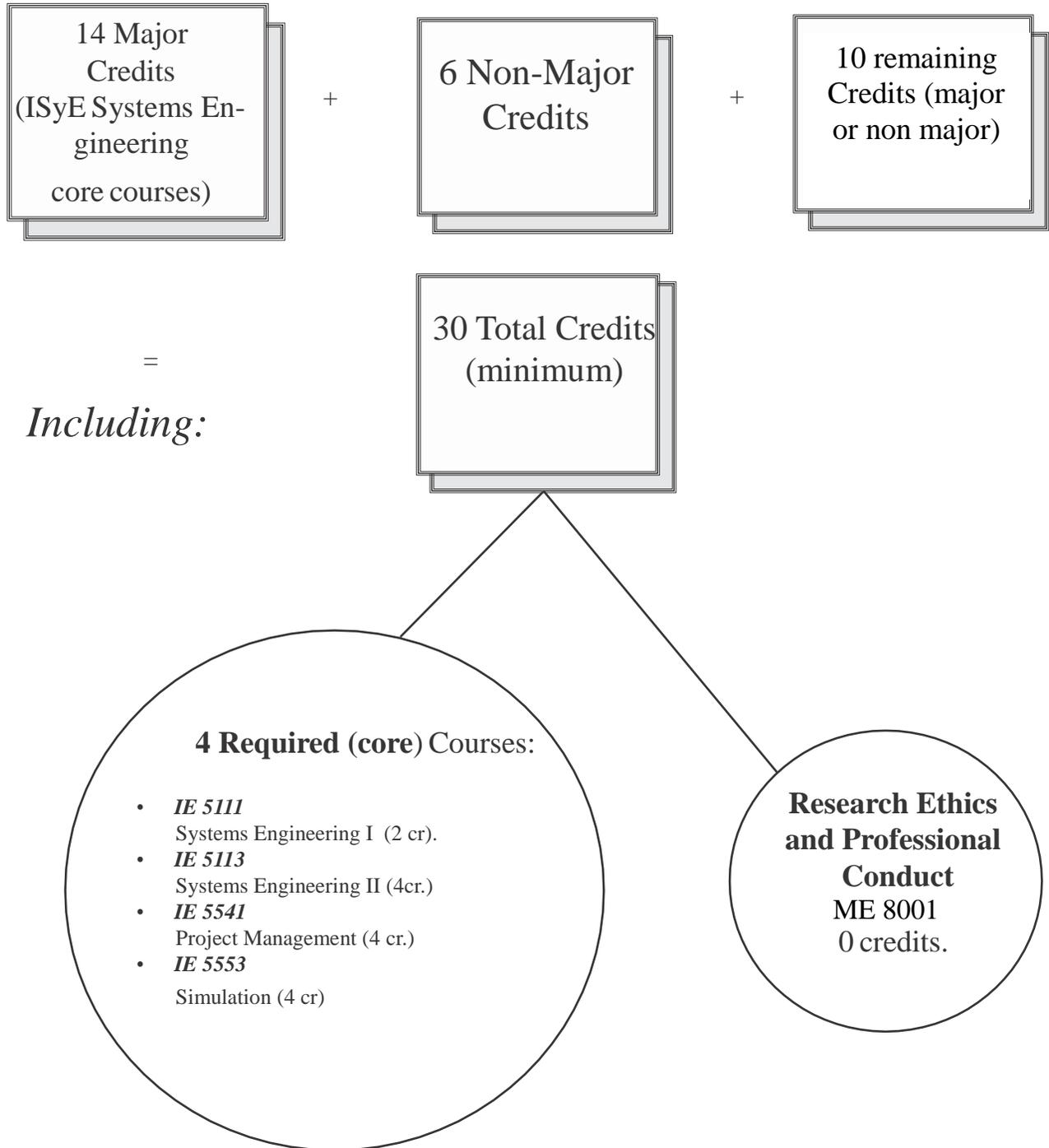
Including:



*Two out of these 4 must be IE 5531 and IE 5532, or their qualifying replacements (see pages 30-31).

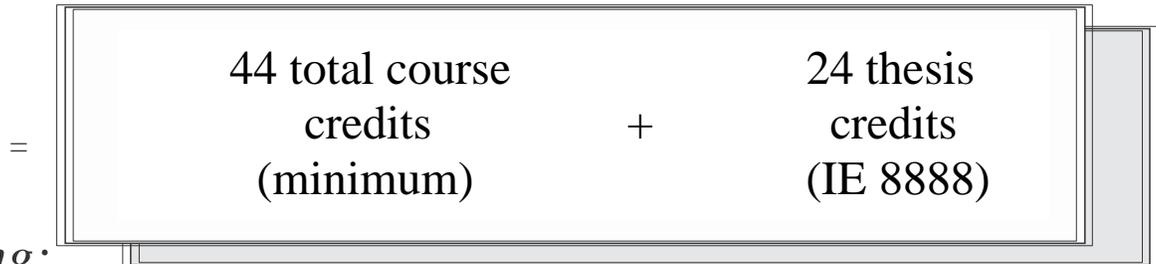
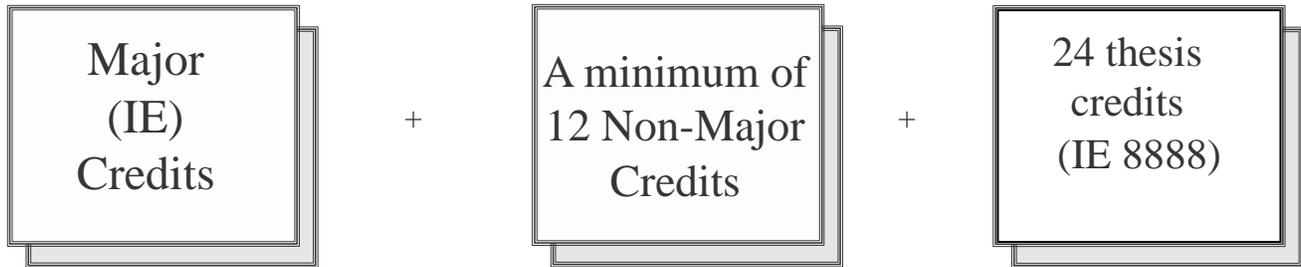
MASTER OF SCIENCE IN INDUSTRIAL & SYSTEMS ENGINEERING - SYSTEMS ENGINEERING TRACK

Our core curriculum comprises of five courses. Students who wish to increase depth in one or more of these topics 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 Medical Informatics, Design, Service Operations, and Computer Science (see pages 33-38 for details).

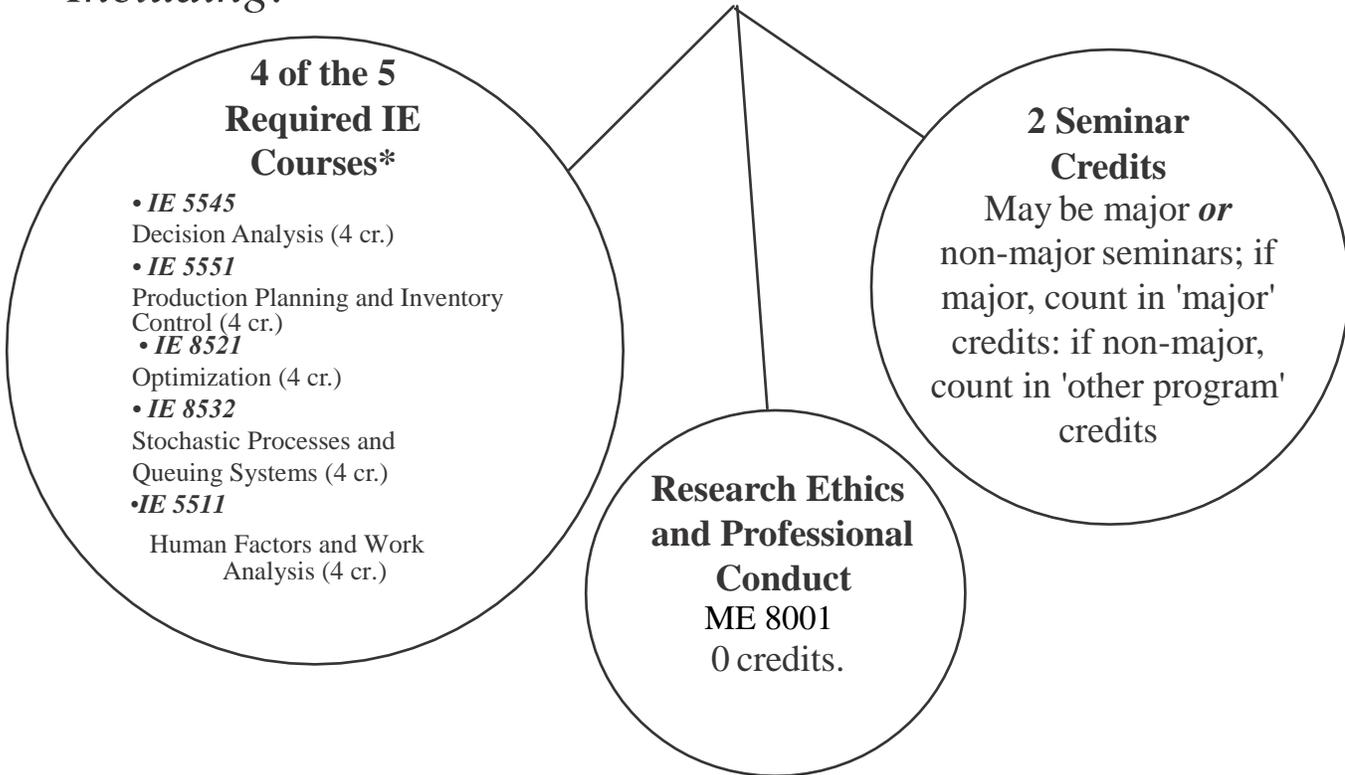


DOCTOR OF PHILOSOPHY IN INDUSTRIAL & SYSTEMS ENGINEERING

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.



Including:



*Two out of these 4 must be IE 8521 and IE 8532, or their qualifying replacements (see page 30 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 advisers 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 complete the online TA application (an announcement is sent out before each semester with a link)

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:

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.

or

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, 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.

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.

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, (624-3355). Also contact this office if you have recently been made an assistantship offer, to supply all required appointment information.

Tuition

Consult the *Graduate School Catalog* and the *Graduate Assistant Website* <http://www1.umn.edu/ohr/gae/> 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 Graduate Degree Plan (GDP) 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 assigned through the Graduate School at www.grad.umn.edu

MASTER OF SCIENCE DEGREE: PLAN A-IE TRACK

- _____ 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. Complete the Graduate Degree Plan 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 Graduate Degree Plan form: courses, major/minor-related field, ethics seminar, calendar time taken, credits, etc. Attach a transcript.

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

<http://policy.umn.edu/sites/policy.umn.edu/files/forms/otr190.pdf>

- _____ 7. Submit committee members with the Graduate School to at the following link:

<http://www.grad.umn.edu/current-students-graduate-student-services-progress-masters/assignmasterscommittee>

This is due right before the submission of a student's degree plan 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.

- _____ 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:

<http://www.grad.umn.edu/current-students-graduate-student-services-progress-masters/assignmasterscommittee>

Each student must have an approved degree plan 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 (Bruininks Hall) 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 One Stop 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 - One Stop.
- _____ 14. Complete final edit of your examined thesis.
- _____ 15. Bind thesis - three copies (See *Binding Information, Appendix A*).

Two unbound copies are due in the Graduate School, One Stop, 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 allow for control of inventory, keys, and office space, you must complete a Departmental Check-out Form (<http://isye.umn.edu/students/>) 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.

MASTER OF SCIENCE DEGREE: PLAN B -IE TRACK

- _____ 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. Complete the Graduate Degree Plan 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 plan 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://policy.umn.edu/sites/policy.umn.edu/files/forms/otr190.pdf>

- _____ 7. Submit committee members with the Graduate School to at the following link:

<http://www.grad.umn.edu/current-students-graduate-student-services-progress-masters/assignmasterscommittee>

This is due right before the submission of a student's degree plan 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.

- _____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 Graduate Degree Plan for an M.S. Plan, but cannot be included on a Plan 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/current-students-graduate-student-services-progress/masters>

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

<http://www.grad.umn.edu/current-students-graduate-student-services-progress-masters/assignmasterscommittee>

Each student must have an approved degree plan 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 (Bruininks Hall) 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 (One Stop).
- _____14. Check-out.

To allow for control of inventory, keys, and office space, you must complete a Departmental Check-out Form (<http://isye.umn.edu/students/>) prior to departure from the Department or prior to beginning another degree objective within the Department.

MASTER OF SCIENCE DEGREE: PLAN C -IE TRACK

- _____ 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 Graduate Degree Plan 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 plan form: courses, major/minor-related field, ethics seminar, calendar time taken, credits, etc. Attach a transcript.

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

<http://policy.umn.edu/sites/policy.umn.edu/files/forms/otr190.pdf>

- _____ 8. 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/current-students-graduate-student-services-progress/masters>

Each student must have an approved degree plan 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 (Bruininks Hall) by the first working day of one's expected graduation month.

- _____ 9. Check-out.

To allow for control of inventory, keys, and office space, you must complete a Departmental Check-out Form (<http://isye.umn.edu/students/>) prior to departure from the Department or prior to beginning another degree objective within the Department.

MASTER OF SCIENCE DEGREE: SE TRACK

- _____ 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 Graduate Degree Plan 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 plan form: courses, major/minor-related field, ethics seminar, calendar time taken, credits, etc. Attach a transcript.

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

<http://policy.umn.edu/sites/policy.umn.edu/files/forms/otr190.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/current-students-graduate-student-services-progress/masters>

Each student must have an approved degree plan 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 (Bruininks Hall) by the first working day of one's expected graduation month.

- _____ 8. Check-out.

To allow for control of inventory, keys, and office space, you must complete a Departmental Check-out Form (<http://isye.umn.edu/students/>) prior to departure from the Department or prior to beginning another degree objective within the Department.

DOCTOR OF PHILOSOPHY DEGREE

- _____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. Complete the Graduate Degree Plan 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 plan form: courses, major/minor-related field, ethics seminar, calendar time taken, credits, etc. Attach a transcript.

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

<http://policy.umn.edu/sites/policy.umn.edu/files/forms/otr190.pdf>

- _____7. Submit committee members with the Graduate School to at the following link:

<http://www.grad.umn.edu/current-students-graduate-student-services-progress-doctoral/assign-prelim-committee>

This is due right before the submission of a student's degree plan 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.

- _____ 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 plan 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 One Stop before your preliminary oral examination is scheduled.
- _____ 12. Schedule preliminary oral exam as soon as possible after successfully completing the Preliminary Written Examination

<http://www.grad.umn.edu/current-students-graduate-student-services-progress/preliminary-scheduling>

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 One Stop.
- _____ 15. Conduct your thesis research.
- _____ 17. Submit your Final Exam Committee:

<http://www.grad.umn.edu/current-students-graduate-student-services-progress-doctoral/assign-doc-final-committee>

- _____ 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/current-students-graduate-student-services-progress/doctoral>

The application for degree form must be submitted to the Student Services Office (Bruinink Hall) 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 One Stop at least one week before your final oral examination.
- _____21. Schedule final oral exam at least one week before your exam date

<http://www.grad.umn.edu/graduate-student-services-progress/final-schedule>

- _____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, One Stop).
- _____24. Edit your examined thesis.
- _____25. Bind thesis - three copies (see *Binding Information, Appendix A*).

One unbound copy is due in the Graduate School, One Stop, 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.

- _____27. Check-out / distribute thesis.

To allow for control of inventory, keys, and office space, you must complete a Departmental Check-out Form (<http://isye.umn.edu/students/>) prior to departure from the Department or prior to beginning another degree objective within the Department.

VII. GRADUATE DEGREE PLAN

As each graduate program is tailored to the individual, a proposed plan of study is required prior to extensive coursework completion. Each graduate student is expected to submit a Graduate Degree Plan to the Director of Graduate Studies for. It is essential that you complete this plan 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 plan form is available at <http://policy.umn.edu/forms/otr/otr198.pdf>.

Special Points of Interest

- For MS Track Plan A, 3 of the 5 following courses are required. Two of these 3 courses must be IE 5531 and IE 5532. For MS IE Track Plan B or C, 4 of the 5 following courses are required. Two of these 4 must be IE 5531 and IE 5532.
 - **IE 5531** Engineering Optimization I
 - **IE 5532** Stochastic Models
 - **IE 5545** Decision Analysis
 - **IE 5551** Production Planning and Inventory Control
 - **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 5113** Systems Engineering II
 - **IE 5441** Project Management
 - **IE 5553** Simulation

- For the PhD program, 4 of the 5 following courses are required. Two of these 4 must be IE 8521 and 8532.
 - **IE 5545** Decision Analysis
 - **IE 5551** Production Planning and Inventory Control
 - **IE 8521** Optimization
 - **IE 8532** Stochastic Processes and Queueing Systems
 - **IE 5111** Human Factors and Work Analysis

- 4xxx-level courses cannot be placed on the Graduate Degree Plan.

- 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 plan 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 Graduate Degree Plan.

- Students in the Ph.D. program may not use IE 5531 or IE 5532 on their Graduate Degree Plan.
- You must take all courses placed in the ‘major’ category on your plan of study (Graduate Degree Plan) 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 plan of study to identify the strength of your entire program.
- Courses on the plan of study must meet a minimum GPA requirement. **For MS students, the minimum plan GPA is 2.8; for PhD students, the minimum plan 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 plan of study.
- You are encouraged to include 8000-level courses in your plan 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 plan 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 plan 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 plan should be taken from a recognized graduate program whose rigor can be ascertained.
3. When courses are taken from 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 plan. For example, we do not allow undergraduate courses on the degree plan, 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 Plan has been approved by the Graduate School, depending on the reason for the petition. If a change in the content of a plan is desired, but the plan 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 Graduate Degree Plan Form.

- Submit a petition form signed by your adviser, to the Director of Graduate Studies, to request a plan of study variance.
- Fill in all requested information.
- If you propose large scale changes in your plan — conversion from Plan A to B, B to A, or course changes exceeding approximately three courses — submit a new degree plan form with the old plan appended.
- Submit petitions in a timely fashion.

- The Director of Graduate Studies acts upon degree plan 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-GRADUATE

Graduate students in industrial & systems engineering prepare for professional participation in a field associated with wide diversity and rapid flux. Plans 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.

Ph.D.in ISyE

Core Course Requirements:

All PhD students take 4 out of the 5 core courses listed below. Two out of these must be IE 8521 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 8521** Optimization
 - **IE 8531** Discrete Optimization
 - **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 Planning and Inventory Control
 - **IE 8552** Advanced Topics in Production, Inventory, and Distribution Systems
- **IE 5545** Decision Analysis
 - This course has no advanced replacement.
- **IE 5511** Human Factors and Work Analysis
 - **IE 8538** Advanced Topics in Information Systems
 - **IE 8541** Decision Support Systems

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

Core Course Requirements:

MS students who choose Plan B or C of the IE Track take four out of the five core courses listed below, and those who choose Plan A take three out the five. In all cases, two of the selected courses must be IE 5531 and IE 5532, 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 8521** Optimization
 - **IE 8531** Discrete Optimization
 - **IE 8534** Advanced Topics in Operations Research

- **IE 5532** Stochastic Models
 - **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 Planning and Inventory Control
 - **IE 8552** Advanced Topics in Production, Inventory, and Distribution Systems

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

- **IE 5511** Human Factors and Work Analysis
 - **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 four 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 plan 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 5113** Systems Engineering II
- **IE 5441** Project Management
- **IE 5553** Simulation

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

MS in SE, with focus on Computer Science

Semester 1 (fall)

- IE 5111 Systems Engineering I (core course, 2 credits)
- IE 5541 Project Management (core course, 4 credits)
- CSCI 5421 Advanced Algorithms and Data Structures (3 credits)

Semester 2 (spring)

- IE 5113 Systems Engineering II (core course, 4 credits)
- IE 5553 Simulation (core course, 4 credits)

Semester 3 (fall)

- CSCI 5707 Principles of Database Systems (3 credits)
- CSCI 5115 User Interface Design, Implementation and Evaluation (3 credits)

Semester 4 (spring)

- CSCI 5116 GUI toolkits and Their Implementation (3 credits)
- CSCI 5XXX Elective (4 credits)

Note: Each student selects an individualized set of electives in consultation with the Director of Graduate Studies. The program above is an example and need not be followed exactly.

MS in SE, with focus on Design

Semester 1 (fall)

- IE 5111 Systems Engineering I (core course, 2 credits)
- IE 5541 Project Management (core course, 4 credits)
- PDES 5701 Creativity, Idea Generation, and Innovation (3 credits)

Semester 2 (spring)

- IE 5113 Systems Engineering II (core course, 4 credits)
- PDES 5704 Innovative Computer Modeling & Rendering for Design (3 credits)

Semester 3 (fall)

- PDES 5706 Designing for Manufacture (4 credits)
- IE 5511 Human Factors and Work Analysis (4 credits)

Semester 4 (spring)

- MGMT 6050 Management of Innovation & Change (2 credits)
- IE 5553 Simulation (core course, 4 credits)

Note: Each student selects an individualized set of electives in consultation with the Director of Graduate Studies. The program above is an example and need not be followed exactly.

MS in SE, with focus on Industrial Engineering and Operations Research

Semester 1 (fall)

- IE 5111 Systems Engineering I (2 credits)
- IE 5541 Project Management (4 credits)

Semester 2 (spring)

- IE 5113 Systems Engineering II (4 credits)
- IE 5553 Simulation (4 credits)

Semester 3 (fall)

- MATH 5711 Linear Programming and Combinatorial Optimization (4 credits)
- HumF 5211 Human Factors and Work Analysis (4 credits)

Semester 4 (spring)

- IE 5545 Decision Analysis (4 credits)
- IE 5551 Production Planning and Inventory Control (4 credits)

Note: Each student selects an individualized set of electives in consultation with the Director of Graduate Studies. The program above is an example and need not be followed exactly.

MS in SE, with focus on Medical Informatics

Semester 1 (fall)

- IE 5111 Systems Engineering I (core course, 2 credits)
- IE 5541 Project Management (core course, 4 credits)

Semester 2 (spring)

- IE 5113 Systems Engineering II (core course, 4 credits)
- PUBH 6414 Biostatistical Methods 1 (3 credits)

Semester 3 (fall)

- HINF 5430 Health Informatics 1 (3 credits)
- PUBH 6562 Information Technology and Health Care (2 credits)
- HINF 5510 Applied Health Care Databases: Database Principles and Data Evaluation (3 credits)

Semester 4 (spring)

- HINF 5431 Health Informatics 2 (3 credits)
- HINF 5531 Health Data Analytics and Data Science (2 credits)
- IE 5553 Simulation (core course, 4 credits)

Note: Each student selects an individualized set of electives in consultation with the Director of Graduate Studies. The program above is an example and need not be followed exactly.

**MS in SE, with
focus on
The Medical Industry**

Semester 1 (fall)

- IE 5111 Systems Engineering I (core course, 2 credits)
- IE 5541 Project Management (core course, 4 credits)

Semester 2 (spring)

- IE 5113 Systems Engineering II (core course, 4 credits)
- IE 5553 Simulation (core course, 4 credits)
- PUBH 6589 Medical Technology Evaluation and Market Research (2 credits)

Semester 3 (fall)

- IE 5441 Financial Decision Making (4 credits)
- PUBH 6562 Information Technology and Health Care (2 credits)
- MILI 6995 Medical Industry Valuation Laboratory (2 credits)

Semester 4 (spring)

- IE 5522 Quality Engineering and Reliability (4 credits)
- MILI 6990 The Healthcare Marketplace (2 credits)

Note: Each student selects an individualized set of electives in consultation with the Director of Graduate Studies. The program above is an example and need not be followed exactly.

MS in SE, with focus on Service Operations

Semester 1 (fall)

- IE 5111 Systems Engineering I (core course, 2 credits)
- IE 5541 Project Management (core course, 4 credits)

Semester 2 (spring)

- IE 5113 Systems Engineering II (core course, 4 credits)
- MBA6220 Operations Management (3 credits)

Semester 3 (fall)

- IE 5441 Financial Decision Making (4 credits)
- STAT 5021 Statistical Analysis (4 credits)
- SCO 6051 Service Management (2 credits)

Semester 4 (spring)

- IE 5522 Quality Engineering and Reliability (4 credits)
- IE 5553 Simulation (core course, 4 credits)

Note: Each student selects an individualized set of electives in consultation with the Director of Graduate Studies. The program above is an example and need not be followed exactly.

MS in SE, with focus on Supply Chain Management

Semester 1 (fall)

- IE 5111 Systems Engineering I (core course, 2 credits)
- IE 5541 Project Management (core course, 4 credits)

Semester 2 (spring)

- IE 5113 Systems Engineering II (core course, 4 credits)
- IE 5553 Simulation (core course, 4 credits)

Semester 3 (fall)

- IE 5441 Financial Decision Making (4 credits)
- STAT 5021 Statistical Analysis (4 credits)
- MBA6220 Operations Management (3 credits)

Semester 4 (spring)

- SCO 6056 Managing Supply Chain Operations (2 credits)
- IE 5551 Production Planning and Inventory Control (core course, 4 credits)

Note: Each student selects an individualized set of electives in consultation with the Director of Graduate Studies. The program above is an example and need not be followed exactly

Students may build custom plans (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)

SCO 6056 Managing Supply Chain Operations (4 cr)

SCO 6059 Quality Management and Lean Six Sigma (4 cr)

Operations Research

IE 5531 Engineering Optimization I (4 cr)

IE 5532 Stochastic Models (4cr)

IE 5545 Decision Analysis (4 cr)

Human Factors

IE 5511 Human Factors (4 cr)

IE 5513 Engineering Safety (4 cr)

Engineering Management

IE 5522 Quality Engineering and Reliability (4 cr)

IE 5441 Financial Decision Making (4 cr)

IE 5545 Decision Analysis (4 cr)

IE 5551 Production Planning and Inventory Control (4cr)

IX. 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 plan form but do not include them in the credit totals at the bottom of the degree plan 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 plan form but do not include them in the credit totals at the bottom of the degree plan 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.

X. 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 plan 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 plan, 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.

XI. DOCTORAL PRELIMINARY EXAMINATION PROCEDURES

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 two 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 requirements.

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 an in-class exam of 5 hours, covering both areas. The written exam is open-book and open-notes. No electronic devices are allowed in the written exam. The oral exams will be typically scheduled within a day or two after the written exam. In the oral exam, the examining committee members will ask additional questions related to the written 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 exam, 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. 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.

XII. 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 are majoring in M.S. I.Sy.E. and want to switch tracks.
- 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

XIII. 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 plan 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.

XIV. 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 XV Computing Facilities.

The department supplies building and room keys by having the division chair or faculty member responsible for the laboratory area, contacting the key person at mekey@umn.edu. Once approved you will receive an email regarding when to pick up your keys.

XV. 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 (ITICC)*, 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 10. Users must also pick up an access card from Jeanne Sitzmann, 1120 M.E.

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.

