INDUSTRIAL AND SYSTEMS ENGINEERING

The Master's program in Industrial & Systems Engineering (ISE) is a 30 credit hour degree program designed for engineers and other professionals who have responsibility for designing, installing, improving and evaluating large integrated systems. Specializations/courses are available in the areas of:

- Human Factors/Ergonomics
- Operations Research & Management Science
- Quality Systems Design
- Advanced Manufacturing & Automation
- Information Systems Management
- Program Management & Product Development

The program may be completed entirely on campus, entirely online, or through a combination of on-campus and online courses.

The ISE Ph.D. program provides educational opportunities to talented students to acquire the advanced knowledge needed to become creative researchers as well as technical leaders and technology innovators in industrial and systems engineering. The program is a full-time, research-based degree designed to address the growing needs of society for scientific and engineering professionals with advanced knowledge, technical skills, and abilities to conduct original and high-quality translational research in industrial and systems engineering. Students are admitted for full-time study and all admission offers are for the Fall term only.

Specific requirements of the program are described below.

The program may be completed entirely on campus, entirely online, or through a combination of on-campus and online courses.

Admission

Undergraduate Degree Requirement

Admission to this degree program requires a bachelor's degree in engineering, physical science, computer science, or applied mathematics.

Students who do not meet BS degree requirements of the program should speak to the program advisor regarding the additional requirements to be met.

Course Prerequisites

- A calculus based course in probability and statistics (IMSE 510, Probability and Statistical Models or equivalent)
- A course in operations research (IMSE 500, Models of Operations Research or equivalent)

The IMSE 510 and IMSE 500 course requirements can be completed after admission into the program. However, only IMSE 500 will count toward the 30-credit degree requirement.

Degree Requirements

The degree MSE in ISE requires a minimum of 30 credit hours.

Minimum Grade Requirement in addition to maintaining a minimum cumulative GPA of 3.0 or higher every semester:

1. Courses in which grades of C- or below are earned cannot be used to fulfill degree requirements.
2. No more than two courses in which grades of B- or below are earned can be used to fulfill degree requirements.

A minimum of a 3.0 cumulative GPA or higher is required at the time of graduation.

Advanced Standing Provision

Up to six graduate credit hours (grade of B or better) may be transferred from another accredited institution. Students may transfer up to one-half (1/2) the minimum number of credit hours required for their master's or professional degree from another University of Michigan program.

Graduate Academic Policies can be found below:

http://catalog.umd.umich.edu/academic-policies-graduate/

Specific Course Requirements

The program of study must satisfy the following distribution and course requirements:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>Design and Analysis of Exp</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Human Factors &amp; Ergonomics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Prod &amp; Oper Engineering I</td>
<td>3</td>
</tr>
<tr>
<td>Concentration</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>All courses can be taken from one concentration area or any combination of the three concentration areas below.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Credit Hours</td>
<td></td>
<td>21</td>
</tr>
</tbody>
</table>

Concentrations

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMSE 543</td>
<td>Industrial Ergonomics</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 545</td>
<td>Vehicle Ergonomics I</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 546</td>
<td>Safety Engineering</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 548</td>
<td>Res.Meth.Human Fctrs/Ergonomic</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 577</td>
<td>Human-Computer Interaction</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 593</td>
<td>Vehicle Package Engineering</td>
<td>3</td>
</tr>
<tr>
<td>AENG 546</td>
<td>Vehicle Ergonomics II</td>
<td>3</td>
</tr>
<tr>
<td>Operations Research &amp; Management Science:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMSE 500</td>
<td>Models of Oper Research</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 505</td>
<td>Optimization</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 514</td>
<td>Multivariate Statistics</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 5205</td>
<td>Eng Risk-Benefit Analysis</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 5215</td>
<td>Program Budget, Cost Est &amp; Con</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 559</td>
<td>System Simulation</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 605</td>
<td>Advanced Optimization</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 606</td>
<td>Advanced Stochastic Processes</td>
<td>3</td>
</tr>
</tbody>
</table>
Integrated Design and Manufacturing Engineering Concentration

Quality Systems Design:

- IMSE 513 Robust Design 3
- IMSE 519 Quan Meth in Quality Engin 3
- IMSE 561 Tot Qual Mgmt and Six Sigma 3
- IMSE 567 Reliability Analysis 3

Advanced Manufacturing & Automation:

- IMSE 502 Computer-Integrated Mfg 3
- IMSE 538 Intelligent Manufacturing 3
- IMSE 5655 Supply Chain Management 3
- IMSE 581 Prod & Oper Engineering II 3

Information Systems Concentration

Information Systems Management:

- IMSE 553 Software Engineering 3
- IMSE 556 Database Systems 3
- IMSE 557 Comp Networks and Comm 3

Enterprise Information Systems:

- IMSE 555 Decision Support/Expert Sys 3
- IMSE 5585 Electronic Commerce 3
- IMSE 564 Meth & Tech in ERP Sys Develop 3
- IMSE 570 Enterprise Information Systems 3
- IMSE 5715 Modeling of Int Info Syst 3
- IMSE 5725 Object Oriented System Design 3
- IMSE 574 IS Based Prod Planning & Cont 3
- IMSE 579 Software Int Mfg & Logis Mgmt 3

Program Management & Product Development

- EMTG 580 Mgt of Prod and Proc Design 3
- IMSE 515 Fundamentals of Program Mgt 3
- IMSE 516 Project Management and Control 3
- IMSE 517 Managing Global Programs 3

At least two graduate-level cognate courses for a minimum of six credit hours each in departments other than IMSE must be elected.

The remaining credit hours may be selected with the approval of the graduate advisor.

With the approval of their graduate advisor, students may substitute a master's thesis for no more than six credit hours of graduate coursework. Students choosing the thesis option are required to elect a minimum of 9 credit hours from the concentration electives, rather than the 12 credit hours stipulated above for the concentration areas. Students must complete 2 of the courses from one of the concentration areas.

Dual Degree, MBA/MSE-Industrial Systems Engineering

The MBA/MSE-Industrial Systems Engineering has been carefully developed to meet the increasing need for professionals who have expertise in both engineering and management. It is open to students who have completed a Bachelor of Science degree in engineering, a physical science, computer science, or applied mathematics.

The program is offered jointly by the College of Business and the College of Engineering and Computer Science. It allows students to receive both the MBA and MSE-ISE simultaneously upon completion of the required 57-66 credit hours.

You may complete the program on campus, on-line, or any combination of the two, and you may enroll on a full- or part-time basis.

Admission is rolling, and you may begin the program in September, January, or May. Students must apply and be admitted to the MBA and the MSE-ISE programs separately. University of Michigan-Dearborn students who have been admitted to the program may take up to 6 graduate business credits during the final semester of their undergraduate program.

Program Goals and Objectives

Master of Business Administration

Goal 1: Students will have an understanding of the core business disciplines and be able to apply this knowledge to global business situations.

Objectives: MBA students will:

1. Demonstrate knowledge of disciplinary concepts, terminology, models, and perspectives.
2. Identify business problems and apply appropriate solutions (problem-finding/problem-solving).
3. Integrate knowledge across disciplinary areas (integrative thinking).
4. Apply knowledge in a global environment.

Goal 2: Students will be effective communicators.

Objectives: MBA students will:

1. Demonstrate an ability to effectively communicate in a manner that is typically required of a business professional.

Goal 3: Students will appreciate the importance of ethical/corporate social responsibility issues.

Objectives: MBA students will:

1. Identify and explain alternative approaches to ethical/corporate social responsibility issues.

Admission Prerequisites

Master of Business Administration

- Mathematics admission prerequisite
- GMAT/GRE admission prerequisite

MSE in Industrial and Systems Engineering

- Completion of a bachelor of science degree in engineering, a physical science, computer science, or applied mathematics
- A course in Probability and Statistics equivalent to IMSE 510
- A course in Operations Research equivalent to IMSE 500

Ph.D. in Industrial and Systems Engineering

About the Program

The ISE Ph.D. program provides educational opportunities to talented students to acquire the advanced knowledge needed to become creative researchers as well as technical leaders and technology innovators in industrial and systems engineering.
This Ph.D. program of the Rackham Graduate School of the University of Michigan-Ann Arbor is located, administered, and offered by UM-Dearborn. The program observes the standards for admissions, registration, degree requirements, awarding of degrees, and other administrative policies and regulations established by the Executive Board of the Rackham Graduate School.

**Program Description:**
The Ph.D. ISE program offers concentrations in integrated design and manufacturing, decision science and operations research, and human factors and ergonomics.

The program requires the core, concentration, and cognate coursework; qualifying and dissertation proposal examinations; a written dissertation; and an oral defense of the dissertation. The Ph.D. ISE degree is offered to exceptional students who have completed, with distinction, a master's degree in engineering or a closely related field.

Degree requirements for the Ph.D. ISE include a minimum of 18 credit hours of coursework (beyond master’s) and a minimum of 24 credit hours of Ph.D. dissertation. The Ph.D. ISE is composed of five major milestones, which all students are required to pass successfully before graduation:

- Filing an approved plan of study
- Completion of the required coursework with the minimum GPA 3.3
- Advancement to candidacy
- Passing the dissertation proposal examination
- Completion of required dissertation research credit hours
- Successful oral defense of an approved written dissertation

The target typical time of degree completion is four (4) years.

**Curriculum**

**Satisfactory Progress Requirements:**
Only letter-graded courses at the 500+ level count toward the degree. Courses completed with a grade lower than B or a 'U' grade are not accepted.

To advance to candidacy, the cumulative coursework GPA (Grade Point Average) must be 3.3 or above on the 4.0-scale.

**Coursework Requirement:**

**Breadth Requirement:**
The breadth requirement is satisfied by a student taking three core courses (9 credit hours) in the program. The minimum grade for breadth requirement courses is B.

**Depth Requirement:**
Students must select at least three courses (9 credit hours) from the same concentration area. The minimum grade for depth requirement courses is B.

**Approved Program Courses**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Core Courses (select three courses, 9 credit hours)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMSE 505</td>
<td>Optimization</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 514</td>
<td>Multivariate Statistics</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 548</td>
<td>Res.Meth.Human Fctrs/Ergonomic</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 581</td>
<td>Prod &amp; Oper Engineering II</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Concentration Areas and Courses (9 credit hours)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area 1. Integrated Design and Manufacturing (Select 3 courses)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMSE 511</td>
<td>Design and Analysis of Exp</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 519</td>
<td>Quan Meth in Quality Engin</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 559</td>
<td>System Simulation</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 561</td>
<td>Tot Qual Mgmt and Six Sigma</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 567</td>
<td>Reliability Analysis</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 538</td>
<td>Intelligent Manufacturing</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 5655</td>
<td>Supply Chain Management</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 580</td>
<td>Prod &amp; Oper Engineering I</td>
<td>3</td>
</tr>
<tr>
<td>EMGT 580</td>
<td>Mgt of Prod and Proc Design</td>
<td>3</td>
</tr>
<tr>
<td>AENG 589</td>
<td>Auto Assembly Systems</td>
<td>3</td>
</tr>
<tr>
<td>IMSE 605</td>
<td>Advanced Optimization</td>
<td>3</td>
</tr>
</tbody>
</table>

Area 2. Operations Research and Decision Science (Select 3 courses)

| IMSE 5205 | Eng Risk-Benefit Analysis                      | 3            |
| IMSE 5215 | Program Budget, Cost Est & Con                | 3            |
| IMSE 5655 | Supply Chain Management                        | 3            |
| IMSE 559  | System Simulation                              | 3            |
| IMSE 581  | Prod & Oper Engineering II                     | 3            |
| IMSE 605  | Advanced Optimization                          | 3            |
| IMSE 606  | Advanced Stochastic Processes                  | 3            |

Area 3. Human Factors and Ergonomics (Select 3 courses)

| IMSE 511  | Design and Analysis of Exp                     | 3            |
| IMSE 543  | Industrial Ergonomics                          | 3            |
| IMSE 545  | Vehicle Ergonomics I                           | 3            |
| IMSE 546  | Safety Engineering                             | 3            |
| IMSE 577  | Human-Computer Interaction                     | 3            |
| IMSE 593  | Vehicle Package Engineering                    | 3            |

**Cognate Requirement:**
At least 4 credit hours of coursework must be outside the industrial and systems engineering area. See the Cognate section below for ways to satisfy this requirement. A list of cognate course is provided in the approved program courses section.

**Cognate Courses**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIS 505</td>
<td>Algorithm Analysis and Design</td>
<td>3</td>
</tr>
<tr>
<td>CIS 536</td>
<td>Text Mining and Information Retrieval</td>
<td>3</td>
</tr>
<tr>
<td>CIS 550</td>
<td>Object-Oriented Programming and Its Applications</td>
<td>3</td>
</tr>
<tr>
<td>CIS 556</td>
<td>Database Systems</td>
<td>3</td>
</tr>
<tr>
<td>CIS 571</td>
<td>Web Services</td>
<td>3</td>
</tr>
</tbody>
</table>
CIS 579  Artificial Intelligence  3
CIS 652  Advanced Information Visualization and Virtualization  3

Electrical and Computer Engineering
ECE 531  Intelligent Vehicle Systems  3
ECE 533  Active Automotive Safety Sys  3
ECE 537  Data Mining  3
ECE 542  Intr to Pwr Mgmt & Reliability  3
ECE 552  Fuzzy Systems  3
ECE 579  Intelligent Systems  3
ECE 5831  Pat Rec & Neural Netwks  3
ECE 644  Advanced Robotics  3
ECE 679  Adv Intelligent Sys  3

Mechanical Engineering
ME 552  Sustainable Energy Systems  3
ME 560  Experimental Methods in Design  3
ME 565  Mechatronics  3
ME 567  Reliability Consid in Design  3
ME 580  Advanced Engineering Materials  3
ME 584  Mechanical Behavior of Polymer  3

Mathematics and Statistics
MATH 520  Stochastic Processes  3
MATH 525  Mathematical Statistics II  3
MATH 562  Mathematical Modeling  3
MATH 583  Discrete Optimization  3
MATH 584  Applied&Algorithmic Graph Thy  3
MATH 592  Introduction to Topology  3
STAT 535  Data Analysis and Modeling  3
STAT 530  Applied Regression Analysis  3

Psychology
PSYC 530  Psychology in the Workplace  3
PSYC 548  Psychological Assessment I  4
PSYC 563  Sensation and Perception  3
PSYC 561  Learning and Memory  3
PSYC 565  Ind&Grp Tech in Cln Hlth Psyc  3

Required Seminar Courses:
ENGR 700 Ph.D. Research Methodology Seminar:
This course provides doctoral students with the fundamental training for conducting high-level scholarly research used in the various fields of engineering. Topics include evaluation of information resources, intellectual property, writing for journals and dissertation, effective work with scientific literature, literature review, plagiarism, publication, bibliographic management, and library resources. Students also complete the Responsible Conduct of Research (RCR) and Scholarship Training workshops. Additionally, students appointed as GSIs are required to attend the approved GSI training workshop.

The course is required for all doctoral students in the first year of enrollment and prior to taking the qualifying exam. Passing is based on participation and attendance and passing the RCR exam. The seminars will carry no credit hours.

Cognate Requirement:
The IMSE department recognizes the value of intellectual breadth in graduate education and the importance of formal graduate study in areas beyond the student's field of specialization. The student can satisfy the Ph.D. ISE program cognate requirement in one of the following ways:

- Completion of at least four hours of approved cognate credits, which must be from outside the IMSE department. The minimum acceptable grade for a cognate course is a B. The list of approved cognate courses can be found in the Approved Program courses section.
- Completion of a University of Michigan master's degree that included a cognate component. This coursework must be completed no more than five (5) years before admission to the Ph.D. ISE program.
- Completion of a relevant master's degree from another university that had coursework that meets the expectation of the program cognate requirement. This coursework must be completed no more than five (5) years before admission to the Ph.D. ISE program. These courses do not apply toward the minimum 18 credit hours in residence at UM-Dearborn required for the degree and do not appear on the university transcript.

Exams, Milestones and Timeline:

- Pre-Candidacy
  - All coursework
  - ENGR 700 seminar
  - RCR requirement
  - Completion of a 4-credit cognate course with a minimum B grade.

- Qualifying Exam
  - Completed related Core area coursework
  - Posting a minimum cumulative GPA of 3.3 out of 4 at the time of applying for the exam

Students must take the Qualifying Exam by the end of the third term in the program.

- Candidacy: Achieving candidacy for the Ph.D. ISE requires:
  - Completion of the coursework and Pre-candidacy requirements
  - Passing of the qualifying examination
  - Selection and Approval of a Dissertation Committee
  - Submission of the candidacy application form
  - Posting a minimum cumulative GPA of 3.3 out of 4 at the time of applying for the candidacy

Candidates must register for the IMSE 990 Dissertation course each fall and winter until completion of all degree requirements. A Ph.D. ISE student should achieve candidacy within two years from the time of initial enrollment in the program.

- Dissertation Proposal Requirements: The dissertation proposal examination requires:
  - Achieving Candidacy
  - Identify a research advisor and agree on an appropriate topic
  - Submit and defend a proposal for the doctoral research content

The examination must be completed within a year of passing the qualifying examination.
· Dissertation and Oral Defense: The dissertation examination requires the following:
  · Passing the dissertation proposal examination
  · Completion of required dissertation research credit hours
  · Conduction an original research
  · Submission of a written dissertation
  · A Pre-Defense meeting
  · An Oral Defense of an approved written dissertation

The dissertation defense may not be scheduled in the same academic term as the dissertation proposal examination.

The Ph.D. ISE program has a limit of 7 years. Students are expected to complete the degree within five years of achieving candidacy, but no more than seven years from the date of the first enrollment in the Ph.D. ISE program.

Qualifying Exam:
The purpose of the qualifying examination is to assist both the department and the student in determining whether a student can be expected to perform at a sufficiently high level in advanced coursework and research to complete the requirements for the degree.

The examinations are given twice a year, once in the fall and once in the winter. The qualifying examination is composed of the following.

  · By the end of the third semester in the program, a student must take one three-hour written qualifying examination covering the material in three core courses taken in the program.
  · Each one-hour portion of the examination covers material from one of three core courses taken in the program: (1) Optimization (coverage of IMSE 505), (2) Applied Probability and Statistics (coverage of IMSE 514), (3) Production (coverage of IMSE 581), and (4) Ergonomics (coverage of IMSE 548).

Forming the Dissertation Committee:
Dissertation Committee
The composition of a dissertation committee adheres to the Rackham guidelines (see the Rackham dissertation handbook).

  · The dissertation committee will consist of four members, including at least three tenure-track members (appointment as Professor, Associate Professor, or Assistant Professor) of the instructional faculty affiliated with a Rackham doctoral program.
  · The student’s dissertation advisor, who must be a member of the graduate faculty of the department, will serve as chair or co-chair.
  · Of the additional members, two must hold at least 50% appointment as tenure or tenure-track faculty. One of them must be co-supervised by two co-chairs. Both co-chairs must hold at least 50 percent appointments as tenured or tenure-track faculty. One of them must be a member of the graduate faculty of the IMSE department. The other can be from the IMSE department or a department other than IMSE.
  · The third committee member (cognate member) must be from outside the department: a faculty member with at least 50% appointment from a Rackham Doctoral program other than Ph.D. in ISE.
  · The composition of the dissertation committee must be approved by the Ph.D. program committee and requires Rackham approval.
  · A committee may have a sole chair or two co-chairs. By special arrangement, retired faculty members who were affiliated with a Rackham doctoral program or research professors may serve as sole chairs. Persons who may serve as co-chair, but not the sole chair, include:
    · tenure or tenure-track members of the University’s instructional faculty who are not affiliated with a Rackham doctoral program;
    · research faculty;
    · instructors and lecturers;
    · similarly qualified University faculty or staff, or person from outside the University; and
    · former University faculty members who have moved to a faculty position at another university.

In the cases when it is justified by the nature of the student’s research and by approval of the program committee, the dissertation work can be co-supervised by two co-chairs. Both co-chairs must hold at least 50 percent appointments as tenured or tenure-track faculty. One of them must be a member of the graduate faculty of the IMSE department. The other can be from the IMSE department or a department other than IMSE.

Dissertation Proposal and Dissertation Research:
Please refer to the Path to Degree (https://umdearborn.edu/cecs/graduate-programs/path-degree/) for the policies, procedures, and forms for the dissertation committee, dissertation proposal, dissertation, and final oral defense.

Dissertation Proposal Examination
The main objective of the dissertation proposal examination is to ensure sufficient strength and feasibility of the proposed research topic, as well as the suitability of the student’s background and skills regarding the topic.

The examination consists of a written dissertation proposal and its open-to-the-public presentation by the student. The examination is conducted by the dissertation committee. As a rule, the dissertation committee continues overseeing the student’s work to the stage of the final dissertation defense.

Dissertation
After passing the dissertation proposal examination, the student may proceed with the dissertation research and the writing of the dissertation. The dissertation should document the original contributions made by the candidate as a result of independent research. This research work should be of archival quality. In advance of graduation, all members of the student’s dissertation committee must approve the dissertation. To obtain this approval a student must submit a written copy of the dissertation to the dissertation committee and defend the research work at a final oral examination open to other faculty, students, and the interested public. Students must be registered for IMSE 990 the full spring/summer term if defending the dissertation after May during the spring/summer term.


Students are expected to complete the degree within two years of passing the dissertation proposal exam, but no more than seven years from the date of the first enrollment in the Ph.D. ISE program. The Ph.D. ISE committee conducts annual reviews to evaluate progress.
toward degree completion. Students defending the dissertation must be registered in the 990 Dissertation Research course.

**Dissertation Research Requirement**

- At least 24 credit hours of doctoral research credit must be completed before graduation.
- Students who have completed the coursework requirements but have not reached the candidacy status should register for IMSE 980 (Pre-Candidacy Dissertation Research). A maximum of 12 credits may be completed in IMSE 980 Pre-Candidacy course.
- Students who have achieved candidacy should register for 6 credits in IMSE 990 (Doctoral Dissertation Research).

Note that the actual completion of the dissertation project is likely to take several years at full-time enrollment and, thus, require more than the minimum number of credit hours.

**Final Oral Defense:**

Upon completion of the dissertation work, the student initiates the last step toward the degree—the dissertation defense process. The process follows the official guidelines and consists of the following main stages:

1. Preparation of a written dissertation formatted in accordance with the guidelines,
2. Pre-Defense meetings with the members of the program committee,
3. Written evaluations of the dissertation by the dissertation committee members presented to the Ph.D. program committee,
4. The Oral Defense of the dissertation consisting of two parts:
   - Public seminar and open question session held by the student
   - Private deliberations by the committee,
5. Final oral examination report and certificate of approval prepared by the dissertation committee and submitted to the Ph.D. program committee.
6. Post-Defense meeting with the CECS Graduate Education Office

**IMSE 500 Models of Oper Research 3 Credit Hours**
The method of mathematical modeling and its application to decision-making problems in organizations. Some widely used models and techniques: linear programming, queuing, inventory, and simulation.

**Restriction(s):**
Can enroll if Class is Graduate

**IMSE 501 Human Factors & Ergonomics 3 Credit Hours**
The analysis and prediction of human performance in industrial and other man-machine systems using work sampling, time-motion analysis, synthetic and standard time study, and learning curves, in the design of such systems. Lecture and laboratory. Cannot receive credit for both IMSE 442, and IMSE 501. This class may be scheduled at the same time as the undergraduate course IMSE 442. Graduate students will be required to do additional research paper and/or project.

**Prerequisite(s):** IMSE 317* or IMSE 510*

**Restriction(s):**
Can enroll if Class is Post-baccalaureate NCFD or Graduate

**IMSE 502 Computer-Integrated Mfg 3 Credit Hours**
This course provides basic knowledge of elements in Computer-Integrated Manufacturing Systems, with particular emphasis on Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), Computer-Aided Process Planning (CAPP), materials handling, and information flow in manufacturing systems. Hands-on experiments and course projects are required. Two lecture hours and three laboratory hours. Credit cannot be given for both IMSE 483 and IMSE 502. This class may be scheduled at the same time as the undergraduate course IMSE 483. Graduate students will be required to do additional research paper and/or project.

**Restriction(s):**
Can enroll if Class is Post-baccalaureate NCFD or Graduate

**IMSE 503 Computer-Aided M/C & Tool Desg 3 Credit Hours**
Study of the fundamentals of machine tool design, cutting tools, metal forming dies, and jig fixtures for practical applications in machining and assembly. Principles of design for manufacture and assembly as applied to tool and machine design. Laboratory exercise and projects are required using computer-aided design software. Two lecture hours and three laboratory hours. Credit cannot be given for both IMSE 484 and IMSE 503. This class may be scheduled at the same time as the undergraduate course IMSE 484. Graduate students will be required to do additional research paper and/or project.

**Prerequisite(s):** IMSE 382 or ME 381

**Restriction(s):**
Can enroll if Class is Post-baccalaureate NCFD or Graduate

**IMSE 504 Metal Forming Processes 3 Credit Hours**
This course focus is on fundamentals of metal forming processes; mechanics of metal forming; formability of manufacture; and economic aspect of the process. Emphasis is placed on analysis of bulk and sheet metal forming processes as applied to practical cases such as automobile manufacturing. Laboratory and course project are required. Credit cannot be given for both IMSE 488 and IMSE 504. This class may be scheduled at the same time as the undergraduate course IMSE 488. Graduate students will be required to do additional research paper and/or project.

**Prerequisite(s):** IMSE 382 or IMSE 381

**Restriction(s):**
Can enroll if Class is Post-baccalaureate NCFD or Graduate
IMSE 505  Optimization  3 Credit Hours
Prerequisite(s): IMSE 300 or IMSE 500

IMSE 508  Modeling of Large-Scale Sys  3 Credit Hours
The modern and classical concepts and tools required for modeling, analysis and synthesis of large-scale dynamic systems. Topics include system dynamics, interpretable structural modeling, cross-impact analysis, information theory, theory of hierarchical systems. Emphasis is on constructing models of real world problems taken from urban, industrial, transportation, and health care systems. Students are asked to select problems of interest and present final project reports.
Prerequisite(s): IMSE 505 and IMSE 506

IMSE 510  Probability & Statistical Mod  3 Credit Hours
Prerequisite(s): IMSE 317

IMSE 511  Design and Analysis of Exp  3 Credit Hours
One factor, two factor, and multifactor experiments. Fixed random and mixed models. Blocked confounding, incomplete blocks, factorial experiments, fractional factorial experiments. Introduction to response surface analysis.
Prerequisite(s): IMSE 510

IMSE 512  Taguchi Method of Quality Eng  3 Credit Hours
Quality engineering methodology developed by Genichi Taguchi. Design and analysis of experiments using orthogonal arrays and linear graphs. Accumulation analysis for categorized data. Signal-to-noise ratio as a measure of quality characteristics. Simulation using orthogonal arrays. Parameter design for reducing variability around the target without cost increase. Tolerance design for reducing variability with minimum cost increase. Evaluation and improvement of measurement.
Prerequisite(s): IMSE 510

IMSE 513  Robust Design  3 Credit Hours
Students will learn models and methods in the context of overall strategies to empirically study the design of products and manufacturing processes to reduce variability and to reduce sensitivity to parameter variation. Topics include: process capability studies and measures, basic DOE concepts, factorial experiments, evaluating sources of variation, evolutionary operation and adaptive statistical process control.
Prerequisite(s): IMSE 510

IMSE 514  Multivariate Statistics  3 Credit Hours
Linear statistical models used in simple and multiple regression, and analysis of variation. Principles and techniques of principle component analysis are studied and applied to business and engineering problems using statistical computer software. (YR)
Prerequisite(s): IMSE 510

IMSE 515  Fundamentals of Program Mgt  3 Credit Hours
An overview of the project/program management framework and knowledge areas including plan development and execution, scope management, time management, cost management, quality management, human resource management, communications management, risk management, and procurement management. Typical Program Phases and Life Cycles observed in Defense, Construction, Automobile, and Software Industries. Program Organizational Structures, Program Management Processes, and International Project Management are covered. Role of software tools for Program Management and Product Development are discussed. Applications of Lean Product Development Techniques are considered. Cutting waste and lead time in program management are covered. Case studies are used extensively throughout the course.
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Level is Rackham or Graduate or Professional Development

IMSE 516  Project Management and Control  3 Credit Hours
Project Planning, Scheduling, and Controlling functions are discussed in detail including work breakdown structure, CPM and PERT methods, resource allocation and leveling techniques, cost control and minimization, trade-off analysis, learning curves overlapping relationships and concurrent engineering, multiple project execution and optimization. Applications of Lean Techniques in program management are discussed as well as the role of IT in accelerating the product development and reducing the program time. The importance of integrating the Supply Chain in the Product Development is also considered. Case studies and project management software are used throughout the course.
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Level is Rackham or Graduate or Professional Development

IMSE 517  Managing Global Programs  3 Credit Hours
This course focuses on some of the central strategic and organizational problems that arise in managing global programs, including cultural conflicts, developing and managing international managers, global and local brands, and organizing to resolve global-local conflicts. The course uses a combination of case studies, problems, lectures and discussion, over a wide variety of companies and countries.
Prerequisite(s): IMSE 515
Restriction(s):
Can enroll if Level is Rackham or Graduate or Professional Development

IMSE 519  Quan Meth in Quality Engin  3 Credit Hours
This course introduces the advanced quantitative and analytical methods used in quality measurement, prediction, control and improvement. The topics include sampling design and plan, control charts, statistical quality control, time series, process capability analysis and quality cost analysis. Quality related topics in robust and tolerance design are also included.
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Level is Rackham or Graduate or or Doctorate

IMSE 520  Managerial Decision Analysis  3 Credit Hours
Normative decision analysis, decisions, structures, and trees. Utility theory, game theory, and statistical decision theory are introduced. Applications of the theories to management studies in capital investment, bidding, purchasing, and risk analysis are discussed.
Prerequisite(s): IMSE 510
IMSE 5205  Eng Risk-Benefit Analysis  3 Credit Hours
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Class is Post-baccalaureate NCFD or Graduate
Can enroll if College is Business

IMSE 521  Mfg Cost Estimation & Control  3 Credit Hours
In this course, concepts of strategic costing in product development and manufacturing are introduced. Engineering economy techniques are used in the study of life cycle cost elements. Equipment acquisition and replacement justification methods under risk and uncertainty are presented.
Restriction(s):
Can enroll if Class is Graduate

IMSE 5215  Program Budget, Cost Est & Con  3 Credit Hours
This course focuses on cost estimation and control for program managers and engineers. The course introduces a systematic approach for applying engineering economy techniques in cost estimating, resource planning, cost planning, cost management and control, and the study of life cycle cost elements. An introduction to decisions under risk and uncertainty as well as an introduction to project crashing are also presented.
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Class is Post-baccalaureate NCFD or Graduate
Can enroll if Level is Rackham or Professional Development or Graduate or Doctorate
Can enroll if College is Engineering and Computer Science or Business

IMSE 525  Fin & Econ Software Appl  1 Credit Hour
This course introduces methodologies and tools for modeling, design and operations planning of manufacturing systems. Topics include introduction to integrated manufacturing systems, manufacturing system and data modeling methodologies, process planning, group technology, manufacturing system layout, scheduling, push and pull production systems. Industrial case studies are presented and discussed.
Restriction(s):
Can enroll if Class is Graduate

IMSE 526  Marketing Software Application  1 Credit Hour
This course applies concepts and techniques of marketing management to business and engineering systems case studies. Specifications for some of these systems will be developed utilizing ERP software such as SAP R/3 application development software suite. (YR).
Prerequisite(s): IMSE 570 and IMSE 571
Corequisite(s): EMGT 510
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate NCFD or Graduate

IMSE 5275  Managerial Acct Software Appl  1 Credit Hour
This course applies concepts and techniques of managerial accounting to business and engineering systems case studies. Specifications for some of these systems will be developed utilizing ERP software such as SAP R/3 application development software suite. (YR).
Prerequisite(s): IMSE 570 and IMSE 571
Corequisite(s): EMGT 540
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate NCFD or Graduate

IMSE 5285  Human Resource Software Appl  1 Credit Hour
This course applies concepts and techniques of human resource management to business and engineering systems case studies. Specifications for some of these systems will be developed utilizing ERP software such as SAP R/3 application development software. (YR).
Prerequisite(s): IMSE 570 and IMSE 571
Corequisite(s): EMGT 545
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate NCFD or Graduate

IMSE 532  Information for Manufacturing  3 Credit Hours
Acquiring and organizing design and manufacturing information (including geometric modeling, group technology, and automated data acquisition). Identifying kinds needed, sources, and recipients. Ensuring information quality; establishing criteria for selecting processing modes and media. Designing, installing, commissioning, and operating information-handling systems. Handling information in production systems.
Prerequisite(s): (ECE 539 or ME 588) and IMSE 530
Restriction(s):
Can enroll if Class is Graduate

IMSE 533  Manufacturing Systems  3 Credit Hours
This course introduces methodologies and tools for modeling, design and operations planning of manufacturing systems. Topics include introduction to integrated manufacturing systems, manufacturing system and data modeling methodologies, process planning, group technology, manufacturing system layout, scheduling, push and pull production systems. Industrial case studies are presented and discussed.
Restriction(s):
Can enroll if Class is Graduate

IMSE 534  Human Performance Engin in Mfg  3 Credit Hours
The human as a systems component in an information processing context emphasizing capabilities and limitations. The roles of sensing, perception, decision making, short term memory, long term memory, motivation, expectations and attention. An overview of Learning Organization concepts emphasizing personal mastery, mental models, and team learning. A strategy for design of the user-system interface. Analysis methods including functional analysis, traditional and object-oriented task analysis, and cognitive walk-through. Team design project and individual exercises. Emphasis on experiential learning.
Prerequisite(s): IMSE 530
Restriction(s):
Can enroll if Class is Graduate
Can enroll if College is Engineering and Computer Science
IMSE 536  Machinery Diagnostics  3 Credit Hours
Prerequisite(s): IMSE 510  
Restriction(s):
Can enroll if Class is Graduate

IMSE 537  Metal Machining Processes  3 Credit Hours
Detailed study of the principles of conventional and non-traditional metal removing processes, machine tools accuracy, cutting fluids, and cutting tools. The course emphasis will be on the mechanics of metal cutting, machining processes, cutting tool materials and tool geometry, selection of cutting conditions, planning for machining and optimization of manufacturing process. Role of numerical control in improving machining process and productivity of manufacturing system.  
Prerequisite(s): IMSE 317  
Restriction(s):
Can enroll if Class is Graduate

IMSE 538  Intelligent Manufacturing  3 Credit Hours
A comprehensive and integrated approach to topics associated with the science of artificial intelligence and their role in today’s manufacturing environments. Design and management issues including information systems in an automated and integrated manufacturing environment.  
Prerequisite(s): IMSE 317

IMSE 543  Industrial Ergonomics  3 Credit Hours
Effective ergonomic interventions in industrial environment enhance productivity, safety and job satisfaction. This course introduces engineers and engineering students how to apply ergonomic principles in designing industrial and manufacturing operations in which people play a significant role, so that human capabilities are maximized, physical fatigue is minimized, and performance is optimized. Case studies and topics emphasize industrial applications.  
Prerequisite(s): IMSE 442

IMSE 544  Industrial Biomechanics  3 Credit Hours
This course introduces the mechanical behavior of the musculoskeletal systems as related to physical work activities. Fundamentals of human body mechanics (Kinetic and Kinematic aspects of locomotion, body link systems, muscle strength and performance), muscle fatigue and musculoskeletal injury mechanism are covered with application to design of physical work activities and equipment. (YR).  
Prerequisite(s): IMSE 442

IMSE 545  Vehicle Ergonomics I  3 Credit Hours
Prerequisite(s): IMSE 442

IMSE 546  Safety Engineering  3 Credit Hours
Safety requirements for production processes, equipment, and plants; organization and administration of safety programs, current safety laws, current occupational safety research.  
Prerequisite(s): IMSE 442

IMSE 548  Res.Meth.Human Fctrs/Ergonomic  3 Credit Hours
Full Course Title: Research Methods in Human Factors and Ergonomics  
This course covers principals and guidelines of Human Factors and Ergonomics (HFE) practices applied to complex human machine systems. The emphasis is on understanding advanced HFE assessment and surveillance methods in describing and quantifying human-machine-environment interaction. Key topics include, human modeling and simulation, information processing and related motor behavior, and ergonomics design and evaluation tools.  
Prerequisite(s): IMSE 442

IMSE 549  Product Design and Evaluation  3 Credit Hours
Design approaches and processes used in developing customer/user-oriented products. Study of widely used product evaluation techniques: methods of observation, communication and experimentation; subjective (e.g., psychological scaling) and objective measurement methods. Review of product design and evaluation case studies. Laboratory projects to evaluate several products.  
Prerequisite(s): IMSE 442

IMSE 550  Data Management  3 Credit Hours
Topics in computer organization; principle data structures (stacks, trees, linked lists) and their use; searching and sorting; algorithm specification, and recursion. Programming assignments will deal with applications of these subjects.  

IMSE 551  Compiler Construction  3 Credit Hours
The design and construction of compilers and programming systems. Lexical scan; parsing techniques; code generation and optimization; storage allocation. Applications of formal language theory in compiler design. Translator writing systems; XPL.  
Prerequisite(s): IMSE 550

IMSE 552  Design/Analysis of Algorithms  3 Credit Hours
Design, evaluation, and communication of algorithms for solving problems using a digital computer. Topics include problem-solving approaches, algorithm notation, determination of algorithm correctness, measures of efficiency, improvement of algorithms. Examples and homework in designing algorithms for data processing, scheduling, combinatorial optimization, and elementary computer graphics, and numerical analysis.  
Prerequisite(s): IMSE 550

IMSE 553  Software Engineering  3 Credit Hours
Program design methodologies; control flow and data flow in programs; program measurement. Software life cycle; large program design, development, testing, and maintenance. Software reliability and fault-tolerance. Evolution dynamics of software.  
Prerequisite(s): IMSE 550

IMSE 554  Management Info Systems  3 Credit Hours
Basic systems concepts, role of a system analyst in an information system, systems investigation, feasibility study, output/input design, hardware/software evaluation and selection, data management, security considerations, systems implementation, information systems documentations, systems projects estimation and control. Students will be asked to develop a complete information system from case studies.  
Prerequisite(s): IMSE 454
IMSE 555  Decision Support/Expert Sys  3 Credit Hours
Decision support process and decision support systems, development
tools, executive support systems, expert systems and their development
processes, expert shells, integration of decision support and expert
systems.
Prerequisite(s): IMSE 350

IMSE 556  Database Systems  3 Credit Hours
Data structures and file processing; GUIDE and CODASYL reports;
comparisons among the database management systems, relational,
hierarchical, and network approaches; system design guidelines; DDL and
Schema/Subschema; DML and Query language.

IMSE 557  Comp Networks and Comm  3 Credit Hours
To study the nature of communicating and distributing
processing techniques, compare networking options, introduce specific
business applications that require data communication and networks,
and examine the role of communication software in the system, and
discuss the related management issues.
Prerequisite(s): IMSE 454

IMSE 5585  Electronic Commerce  3 Credit Hours
This course examines how new information technologies and networks
affect the exchange of goods and services between buyers and sellers
in firms. What are economics of different electronic commerce models
for firms? The course combines critical evaluation of business strategies
with hands-on experience in building supporting electronic commerce
systems utilizing electronic data interchange (EDI) software. (YR).
Prerequisite(s): IMSE 570 and IMSE 571
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate
NCFD or Graduate

IMSE 559  System Simulation  3 Credit Hours
The modeling and simulation of discrete-change, continuous-change
and combined-change stochastic systems. Conducting simulation
studies using contemporary software such as SLAM II or random number
generation, distribution sampling, and output analysis. Comparisons with
analytical queuing models.
Prerequisite(s): IMSE 510

IMSE 561  Tot Qual Mgmt and Six Sigma  3 Credit Hours
This course covers implementing Total Quality Management (TQM),
undertaking Six Sigma Projects, and applying Baldrige National Quality
Award criteria and ISO 9000 principles to improve quality performances
in an organization. Topics include Definitions and Importance of Quality,
Quality Costs, Quality Function Deployment (QFD), Product Specification
and Critical-to-quality Measures (CQM), Statistical Quality Control (SQC),
Robustness Concepts, Quality System Design and Evaluation. Six Sigma
and DMAIC Methodologies, Design for Six Sigma (DFSS) process, IDOV
(Identity requirements, Design alternatives, Optimize the design and
Verify process capability) Methodology, and several other concepts and
tools related to quality are also covered.
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Class is Graduate

IMSE 564  Meth & Tech in ERP Sys Develop  3 Credit Hours
Students will explore different technology tools and methodologies for
building/customizing applications in ERP systems to meet business need
of an Enterprise. Extensive software design and development activities
will be covered using modular/Object Oriented Programming, Data
Modeling, Data Dictionary, Database Access, User Interface, Dialogue
Programming, Interactive Report Design using appropriate tools such as,
ABAP Workbench, SAP HANA Native Application Development, and SAP
Project Implementation phases.
Prerequisite(s): IMSE 570 and (IMSE 556 or CIS 556)
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate
NCFD or Graduate

IMSE 5655  Supply Chain Management  3 Credit Hours
This course will address theories, concepts, models, methodologies
and techniques for managing a supply chain. Topics include supply
chain strategy, drivers and metrics of performance, designing global
and regional supply chain networks using optimization models,
planning demand and supply in a supply chain using forecasting,
aggregate planning, and inventory optimization models, designing the
transportation systems, pricing, and employing IT systems effectively in
supply chains.
Prerequisite(s): IMSE 500 and IMSE 510
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate
NCFD or Graduate

IMSE 567  Reliability Analysis  3 Credit Hours
Statistics of reliability and life testing. Application of stochastic models
for failure based on Poisson and related processes. Use of exponential
and extreme value distribution in reliability. Use of Markov process in the
areas of equipment reliability, maintenance and availability.
Prerequisite(s): IMSE 510

IMSE 569  Sys Simulation in Auto Engin  3 Credit Hours
The modeling and simulation of discrete, continuous and combined
change stochastic systems. Conducting simulation studies using
contemporary software such as ARENA and WITNESS. Topics in
simulation methodology include random number generation, distribution
sampling, input and output analysis. Integration techniques for
continuous simulation, application to design of manufacturing and
automotive systems.
Prerequisite(s): IMSE 510

IMSE 570  Enterprise Information Systems  3 Credit Hours
The purpose of this course is to provide a foundation for the analysis,
design and implementation of enterprise information systems. Topics
include systems and organization theories, and information systems
planning and evaluation. Students will be also introduced to various
systems development life cycle phases of an enterprise information
system. Students will acquire an understanding of the flow of information
( forecasts, financial, accounting and operational data) within an
enterprise and the factors that should be considered in designing an
integrated enterprise information system. This includes all systems
in the business cycle from revenue forecasts, production planning,
inventory management, logistics, manufacturing, accounts payable,
sales, accounts receivable, payroll, general ledger and report generation.
Specifications for some of these systems will be developed utilizing
ERP software such as SAP R/3 application development software suite.
(YR).
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate
NCFD or Graduate
IMSE 5715  Modeling of Int Info Syst  3 Credit Hours
A review of approaches for modeling of integrated information systems. ARIS architecture. Data, control, function, and organization views of an information system. Requirements definition, design specification, and implementation definition of the different views. Process chain diagrams. Management of ERP projects. (YR).
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate NCFD or Graduate

IMSE 5725  Object Oriented System Design  3 Credit Hours
Students will be introduced to fundamental concepts and methods of object oriented design and development. Topics that will be covered include object oriented database concepts, data models, schema design (conceptual schemas and physical schemas), query languages, physical storage of objects and indexes on objects, version management, schema evolution and systems issues such as concurrent control and recovery from failure. For application programming, a programming language such as C++ will be used for database design and query language. (YR).
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate NCFD or Graduate

IMSE 574  IS Based Prod Planning & Cont  3 Credit Hours
Students will be introduced to theories, models, methods and techniques in demand forecasting, inventory management, capacity planning, production scheduling and management components, in production planning and control for an enterprise. Application systems to model information sharing between these components will be developed using ERP software such as the SAP R/3 application development software suite. (YR).
Prerequisite(s): IMSE 510 and IMSE 570 and IMSE 571
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate NCFD or Graduate

IMSE 5755  Bus Proc Int using Entrpr Tech  3 Credit Hours
Full Title: Business Process Integration using Enterprise Technology
This course introduces the concept of integration, optimization and configuration of strategic business processes across the enterprise using ERP software technology. Use cases and specifications for some of these systems are introduced in different functional areas, such as Finance, Human Capital Management, Logistics, and Project Systems utilizing ERP software. (F)
Restriction(s):
Can enroll if Level is Rackham or Graduate

IMSE 577  Human-Computer Interaction  3 Credit Hours
Full Course Title: Human-Computer Interaction for UI and UX Design - This course introduces current theory and design techniques concerning how user interfaces (UI) and user experience (UX) should be designed and assessed to be easy to learn and use. Course includes following general modules introduction of HCI & UX, Interface/Interaction design strategy; Advanced Issues in HCI; and Evaluation methods.
Prerequisite(s): CIS 553
Restriction(s):
Can enroll if Class is Graduate
Can enroll if Level is Rackham or Graduate or Doctorate

IMSE 579  Software Int Mfg & Logis Mgmt  3 Credit Hours
Students will be introduced to theories, models and techniques in manufacturing, logistics components and their interaction within an enterprise. Topics that will be covered include production/shop order analysis and management, capacity planning, and materials planning and inventory management. Application systems to model information sharing between these components will be developed using ERP software such as the SAP R/3 application development suite. (YR).
Prerequisite(s): IMSE 510 and IMSE 570 and (IMSE 571 or IMSE 5715)
Restriction(s):
Can enroll if Class is Post-baccalaureate Cert only or Post-baccalaureate NCFD or Graduate

IMSE 580  Prod & Oper Engineering I  3 Credit Hours
Production and operations management techniques including forecasting, inventory control, MRP, detailed scheduling, aggregate planning, process variability and its effects on throughput and inventory, factory physics principles, and lean methods.
Prerequisite(s): IMSE 510

IMSE 581  Prod & Oper Engineering II  3 Credit Hours
This course addresses the advanced theory and techniques of production and inventory systems. Topics include advanced forecasting methods, production scheduling and lot-sizing, stochastic single-and multi-item inventory systems, and service operations. This course also includes discussions of research articles on production and inventory systems.
Prerequisite(s): IMSE 580 or EMGT 520

IMSE 5825  Industrial Controls  3 Credit Hours
This course introduces the principle aspects of computers and their applications in systems control, principles of automation, with emphasis on manufacturing industries. Discussion on the hardware and software associated with this task and other topics such as integrated systems modeling, sensor technologies, digital and analog signal processing and control, and information communication are also included. Laboratory exercises and projects are required. Credit cannot be given for both IMSE 482 and IMSE 5825. This class may be scheduled at the same time as the undergraduate course IMSE 482. Graduate students will be required to do additional research paper and/or project.
Prerequisite(s): ECE 305
Restriction(s):
Can enroll if Class is Post-baccalaureate NCFD or Graduate

IMSE 583  Concurrent Design &Manufacture  3 Credit Hours
This course will cover topics in manufacturing design and analysis with emphasis on the parallel design of product and processes. Topics include principles of design theory, concurrent engineering, group technology, cost estimating, assembly systems, and design for assembly and manufacture. Design projects using computer tools are required on a team-oriented basis.
Prerequisite(s): IMSE 382

IMSE 584  Logistical Systems  3 Credit Hours
Introduction to concepts of physical distribution and logistics management. Quantitative treatment of topics in materials management, transportation, forecasting, warehouse location. Logistical system design techniques which synthesize the above topics in order to design a fundamental system.
Prerequisite(s): IMSE 580

IMSE 585  Material Handling Systems  3 Credit Hours
Studies of material handling methods and equipment, study of techniques used in the analysis and design of material handling systems, study of storage and warehousing systems.
Prerequisite(s): IMSE 500
IMSE 586  Big Data Aanal & Visuliztn  3 Credit Hours
Topics covered include Big Data’s role in engineering, Data Visualization and Infographics Design Principles, Univariate, Bivariate and Multivariate Data Visualization, Visualization Groups, Clustering Distance Measures, Hierarchical, Partition-Based and Fuzzy Clustering. Predictive Analytics using Principal Component Analysis, Multivariate Linear Regression, Discriminant Analysis, and Logistic Regression. Software Tools and Techniques for Visualization and Data Analytics such as Tableau, SAS VA, Pentaho and R.  (F)
Prerequisite(s): IMSE 510
Corequisite(s): IMSE 510

IMSE 587  Facilities Planning  3 Credit Hours
Analysis, planning and design of physical facilities utilizing operations research, engineering and economic principles. Synthesis of physical plant equipment and man into an integrated system for either service or manufacturing activities. Design of material handling systems. Students are required to select projects of interest and present design project reports. Credit may not be given for both IMSE 474 and IMSE 587. This class may be scheduled at the same time as the undergraduate course IMSE 474. Graduate students will be required to do additional research paper and/or project.
Prerequisite(s): IMSE 500

IMSE 588  Bldg High Perf Learning Org  3 Credit Hours
The purpose of this course is to develop students’ knowledge and skills to explore and experience how the disciplines of systems thinking, personal mastery, mental models, team learning and shared vision impact on organizational learning and influence management practices for building highly performing organizations.

IMSE 590  Grad Study in Sel Topics I  1 to 3 Credit Hours
Individual or group of selected topics in industrial and systems engineering.
Restriction(s):
Can enroll if Class is Graduate

IMSE 591  Grad Study in Sel Topics II  1 to 3 Credit Hours
Continuation of IMSE 590.
Restriction(s):
Can enroll if Class is Graduate

IMSE 593  Vehicle Package Engineering  3 Credit Hours
Vehicle package specifications related to exterior and interior design reference points, dimensions and curb loadings. Benchmarking package studies, ergonomic tools and design practices used in the automobile industry. Driver positioning considerations; seat height, heel points, hip points, steering wheel location, seat pan, and back angles. Pedal design issues, gear shift positioning. Visibility of instrument panel space. Armrest and console design considerations. Principles and considerations in selecting and location types and characteristics of controls and displays on instrument panels, doors, consoles, and headers. Engine compartment packaging issues. Perception of interior spaciousness and visibility of the road over cowl and hood.
Prerequisite(s): IMSE 442
Restriction(s):
Can enroll if Class is Graduate

IMSE 600  Research in IMSE  1 to 3 Credit Hours
Individual or group study or research in a field of interest to the student. Topics may be chosen from any of the areas of industrial and systems engineering. The student will submit a project report and give an oral presentation at the close of the term.
Restriction(s):
Can enroll if Class is Graduate

IMSE 605  Advanced Optimization  3 Credit Hours
This course will cover selected advanced optimization methods for engineering disciplines and information systems. Topics include nonlinear programming, network optimization, dynamic programming and optimal control. Theories related to optimality and convergence, population-based optimization, etc. will be covered. Students will be expected to write computer program code to implement optimization methodologies.
Prerequisite(s): IMSE 500
Restriction(s):
Can enroll if Class is Graduate
Can enroll if Level is Rackham or Graduate or or Doctorate

IMSE 606  Advanced Stochastic Processes  3 Credit Hours
This course introduces the theory and applications of discrete and continuous stochastic processes and models. The topics include Poisson process, renewal theory, discrete-time and continuous-time Markov chains, martingales, random walks, and Brownian motion. Other Markov processes with applications to queuing, simulation, and operations research in manufacturing and service systems will also be covered.
Prerequisite(s): IMSE 510
Restriction(s):
Can enroll if Level is Rackham or Graduate or or Doctorate
Can enroll if College is Engineering and Computer Science

IMSE 610  Adv Top Enterprise Info Sys  3 Credit Hours
This course introduces advanced topics in the development, management and improvement of information systems in the context of supporting large enterprises. It covers emerging issues and solutions in modeling, IT infrastructure and technologies, critical enterprise functions, knowledge engineering, security and governance of enterprise information systems. It focuses on the changing requirements posed by the dynamics of their residing environment and information technology.
Prerequisite(s): IMSE 5715
Restriction(s):
Can enroll if Class is Graduate
Can enroll if Level is Rackham or Graduate or or Doctorate

IMSE 659  Advanced System Simulation  3 Credit Hours
Simulation with animation packages using contemporary software such as SIMAN/CINEMA or SLAM/TESS. Topics in simulation methodology: random number generation and testing, distribution sampling, validation are reviewed. Emphasis on output analysis, design of simulation experiments, variance reduction techniques, expert systems in simulation.
Prerequisite(s): IMSE 459 and IMSE 559

IMSE 682  Seminar in Comp Proc Contl  3 Credit Hours
Advanced treatment of the design of process control systems with emphasis on the modeling of a process of computer control and the design and analysis of a control strategy. Each student is expected to select a project and design and program the control strategy or support software on a mini-computer.
Prerequisite(s): IMSE 582

IMSE 699  Master’s Thesis Project  1 to 6 Credit Hours
Graduate students electing this course, while working under the general supervision of a member of the department faculty, are expected to plan and conduct the work themselves, to submit a thesis for review and approval, and to present an oral defense of the thesis.
Restriction(s):
Can enroll if Class is Graduate
IMSE 980  Ph.D. diss research precand  1 to 9 Credit Hours
Full Title: Ph.D. dissertation research pre-candidate Dissertation research by a pre-candidate student of the Ph.D. in Industrial and Systems Engineering (I&SE) Program conducted under guidance of the faculty advisor. The credits earned in this dissertation research course count towards (fulfil) 24 credit hours of dissertation research requirements of the Ph.D. I&SE program. (F,W,S)
Restriction(s):
Can enroll if Level is Doctorate or
Can enroll if Major is Industrial & Systems Engin

IMSE 990  PHD Dis Research Cand  1 to 9 Credit Hours
Full Title: Ph.D. dissertation research candidate Dissertation research by a candidate student of the Ph.D. in Industrial and Systems Engineering Program conducted under guidance of the faculty advisor. (F,W,S)
Restriction(s):
Can enroll if Level is Doctorate or
Can enroll if Major is Industrial & Systems Engin

* An asterisk denotes that a course may be taken concurrently.

Frequency of Offering
The following abbreviations are used to denote the frequency of offering:
(F) fall term; (W) winter term; (S) summer term; (F, W) fall and winter terms; (YR) once a year; (AY) alternating years; (OC) offered occasionally