# Industrial Engineering, MS

The MS in industrial engineering program supports two major paths: one focusing on courses and one on research and a thesis. The first path is intended primarily for students who wish to advance their technical knowledge and move toward a career in industry. The second path is also a good choice for students interested in industry, but it is targeted more toward developing independent research skills and writing, and it also can support future graduate work.

Both paths expect some diversity of technical skills in three major areas: systems, human factors, and analytics. The systems area emphasizes the design, construction, and analysis of complex systems with interdependent parts that include people and machines. The human factors area emphasizes the interaction of people with systems and includes the study and analysis of people's cognitive and physical limitations. The analytics area emphasizes the application of mathematical formulas, including statistical approaches, as well as algorithmic and computational approaches to deriving knowledge from data. Each area is supported by several faculty members and many faculty members support multiple areas; see Facilities in the Department of Industrial and Systems Engineering section of the catalog to learn more about each research lab and its activities.

## Learning Outcomes

### Without Thesis

Students will:

- demonstrate a broad knowledge of the field of industrial and systems engineering and deep knowledge in their specific area of study;
- identify and analyze problems of value to industry and society;
- apply contemporary methodologies for solving problems valued by industry and society;
- demonstrate project and team management skills and initiative; and
- demonstrate ethical and professional behavior.

### With Thesis

Students will:

- demonstrate a broad knowledge of the field of industrial and systems engineering and deep knowledge in their specific area of study;
- identify and analyze problems of value to industry and society;
- transform knowledge into applications valued by industry and society;
- demonstrate collaborative and communication skills;
- demonstrate project and team management skills; and
- demonstrate ethical and professional behavior.

## Requirements

The Master of Science program in industrial engineering requires a minimum of 30 s.h. of graduate credit. Students must maintain a UI cumulative grade-point average higher than 3.25 to earn the degree.

In addition, students must enroll in ENGR:7270 Engineering Ethics, typically in the first fall semester of enrollment. ISE:5000 Graduate Seminar: Industrial Engineering must be taken in the first two consecutive semesters of enrollment and one semester (fall or spring) in subsequent academic years. More information about graduate seminar requirements can be found in the Graduate Student Handbook on the Department of Industrial and Systems Engineering Graduate Program website. Credit in ISE:5000 and ENGR:7270 may not be applied toward the 30 s.h. of required coursework.

## Breadth Requirement

All students must successfully complete at least one approved graduate-level course in each of three focus areas—analytics, human factors, and systems. Those with a relevant academic background in these areas may be excused from this requirement by the director of graduate studies.

For more detailed information about program requirements and focus area courses, see the Graduate Student Handbook on the Department of Industrial and Systems Engineering website.

### Analytics

| Course # | Title | Hours |
|---|---|---|
| One of these: | | |
| ISE:3610 | Stochastic Modeling | 3 |
| ISE:3660 | Data Analytics With R | 3 |
| ISE:3700 | Operations Research | 3 |
| ISE:4172 | Big Data Analytics | 3 |
| ISE:5730 | Digital Industry | 3 |
| ISE:5740 | Design and Analysis of Computer Experiments | 3 |
| ISE:6300 | Innovation Science and Studies | 3 |
| ISE:6380 | Deep Learning | 3 |
| ISE:6650 | Human Analytics and Behavioral Operations | 3 |
| ISE:6760 | Pattern Recognition for Financial Data | 3 |
| ISE:6780 | Financial Engineering and Optimization | 3 |
| ISE:6790 | Advanced Data Analytics and Informatics | 3 |

### Human Factors

| Course # | Title | Hours |
|---|---|---|
| One of these: | | |
| ISE:3400 | Human Factors | 3 |
| ISE:3450 | Ergonomics | 3 |
| ISE:4175 | Safety Engineering | 3 |
| ISE:5420 | Automated Vehicle Systems | 3 |
| ISE:5460 | User Experience Design | 3 |
| ISE:6211 | Human Factors in Healthcare Systems | 3 |
| ISE:6220 | Cognitive Engineering | 3 |
| ISE:6410 | Research Methods in Human Factors Engineering | 3 |

| Course # | Title | Hours |
|---|---|---|
| ISE:6420 | Human/Computer Interaction | 3 |
| ISE:6450 | Human Factors in Aviation | 3 |
| ISE:6460 | The Design of Virtual Environments | 3 |
| ISE:6480 | Unmanned Aircraft Systems | 3 |

### Systems

| Course # | Title | Hours |
|---|---|---|
| One of these: | | |
| ISE:3300 | Manufacturing Systems | 3 |
| ISE:3350 | Process Engineering | 3 |
| ISE:3500 | Information Systems Design | 3 |
| ISE:3600 | Quality Control | 3 |
| ISE:3750 | Digital Systems Simulation | 3 |
| ISE:4620 | Design of Experiments for Quality Improvement | 3 |
| ISE:4900 | Introduction to Six Sigma | 3 |
| ISE:5310 | Advanced Computational Design and Manufacturing | 3 |
| ISE:5520 | Renewable Energy | 3 |
| ISE:5620 | Design of Experiments | 3 |
| ISE:5650 | Mechatronics Engineering for Smart Device Design | 3 |
| ISE:6350 | Computational Intelligence | 3 |
| ISE:6810 | Advanced Topics on Additive Manufacturing | 3 |

# Master of Science Degree Without Thesis

The MS in industrial engineering without thesis requires at least 21 s.h. in Department of Industrial and Systems Engineering courses (prefix ISE), including the 9 s.h. breadth requirement and at least 12 s.h. of graduate-level courses at the 5000 level or above. Courses offered by other College of Engineering departments or courses from other colleges may be selected with the consent of the academic advisor to fulfill some or all of the remaining 9 s.h.

# Master of Science With Thesis

Nonthesis students may petition for entry into the MS thesis program or the PhD program by requesting a change of status through the department. Typically, students make this request at the invitation of a faculty member who is ready to serve as a student's research advisor. The request is then reviewed by the Graduate Admissions Committee. The committee forwards approved requests to the department chair, who may authorize a change of status petition from the department to the Graduate College.

Students are encouraged to write their thesis as a publishable journal article and submit the article for publication. The thesis option consists of a minimum of 21 s.h. of coursework, including the 9 s.h. breadth requirement and up to 9 s.h. of research. Students pursuing the thesis option are permitted to enroll in ISE:5999 Research: Industrial Engineering MS Thesis. Up to 9 s.h. in the thesis course may count toward the graduate-level course requirement. In addition, students must submit the Final Examination: Advanced Degree form, complete a Report of Thesis Approval, and submit a copy of their thesis to the Graduate College by following the published guidelines and deadlines.

## Admission

Applicants must meet the admission requirements of the Graduate College; for detailed information about Graduate College policies, see the Manual of Rules and Regulations on the Graduate College website.

Admission to the graduate program is competitive and based on an applicant's previous coursework, research, and industrial experience. The general admission standards are intended to maintain the quality of the graduate program and to ensure the sufficient preparation required for timely degree completion. Specific admission standards may be waived by the Graduate Admissions Committee when other evidence of competence is compelling. These standards are minimum standards, and meeting these standards does not ensure admission to the program; admitted students typically exceed these standards.

Applicants are expected to have a minimum cumulative grade-point average of 3.00 on a 4.00 scale and have earned a BSE in industrial engineering degree or in a related science or engineering discipline. Applicants are not required to submit the results of their Graduate Record Examination (GRE) General Test.

Applicants must arrange to have three letters of recommendation sent to the department online through the University of Iowa Admissions website. The letters should be completed by persons who are well acquainted with the applicant and the ability of the applicant to undertake graduate work in industrial or systems engineering.

While the department considers applications at any time, first consideration is given to students who have their application materials, including their application, transcripts, English language test scores (DET, IELTS, or TOEFL), and the required letters of recommendation, completed by the admission priority deadline as found on the Graduate Admissions website. The director of graduate admissions is responsible for overseeing the graduate recruiting activities and the admissions procedures in the department. The director serves as the point of initial contact between prospective graduate students and the department and maintains a record of each qualified applicant in the departmental office. The director, in consultation with the Graduate Admissions Committee and the department chair, screens applicants and ultimately determines which applicants are extended offers of admission.

# Applicants With Degrees Not in Industrial or Systems Engineering

The department encourages students with degrees in other scientific disciplines, such as computer science, mathematics, physics, or other engineering disciplines, to apply for admission. Some students may have already completed MS degrees; however, these students are expected to attain proficiency in specified core areas of industrial and systems engineering equivalent to entering graduate students who hold a BSE degree in industrial engineering. The background of each student admitted to the program with a degree other than in industrial or systems engineering is reviewed by the faculty members. These proficiencies are intended to ensure that each admitted graduate student is able to fully participate in all industrial and systems engineering discipline areas at some level, even while advanced courses in certain areas may not be immediately accessible to all graduate

students. The director of graduate studies specifies in writing any remedial courses required of a student.

# Degree Program Selection

Unless otherwise specified, graduate students in the Department of Industrial and Systems Engineering are enrolled in the MS nonthesis program. If a student and faculty member have jointly agreed a student may pursue the MS with thesis option, the student may be admitted into the thesis track.

## Career Advancement

Industrial and systems engineers have many opportunities for employment and service in industrial, government, research, and public service organizations such as airlines, banks, hospitals, health care groups, and consulting companies. Employment opportunities are among the most varied in the engineering field. Industrial and systems engineers hold positions as advisors to management or may participate directly in management decisions. Representative job titles include industrial engineer, manufacturing engineer, systems analyst, quality specialist, operations research analyst, internal consultant, human factors specialist, supervisor, and manager.

## Academic Plans

# Sample Plan of Study

Sample plans represent one way to complete a program of study. Actual course selection and sequence will vary and should be discussed with an academic advisor. For additional sample plans, see MyUI.

## Industrial Engineering, MS

| Course | Title | Hours |
|---|---|---|
| **Academic Career** | | |
| **Any Semester** | | |
| 30 s.h. must be graduate level coursework; graduate transfer credits allowed upon approval. More information is included in the General Catalog and on department website. [a, b] | | |
| Graduate College program GPA of at least 3.25 is required. [c] | | |
| | **Hours** | **0** |
| **First Year** | | |
| **Fall** | | |
| ENGR:7270 | Engineering Ethics [d] | 1 |
| ISE:5000 | Graduate Seminar: Industrial Engineering [e] | 1 |
| Analytics focus area course [f] | | 3 |
| Human factors focus area course [f] | | 3 |
| Elective course [g] | | 3 |
| Elective course [g] | | 3 |
| | **Hours** | **14** |
| **Spring** | | |
| ISE:5000 | Graduate Seminar: Industrial Engineering [e] | 1 |
| Systems focus area course [f] | | 3 |
| Elective course [g] | | 3 |
| Elective course [g] | | 3 |
| Elective course [g] | | 3 |
| | **Hours** | **13** |
| **Second Year** | | |
| **Fall** | | |
| ISE:5000 | Graduate Seminar: Industrial Engineering [e] | 1 |
| Elective course [g] | | 3 |
| Elective course [g] | | 3 |
| | **Hours** | **7** |
| | **Total Hours** | **34** |

a  Must include at least 12 s.h. of graduate-level courses at the 5000 level or above. All students must also select one graduate-level ISE course from each of three focus areas: analytics, human factors, and systems.

b  Students must complete specific requirements in the University of Iowa Graduate College after program admission. Refer to the Graduate College website and the Manual of Rules and Regulations for more information.

c  Graduate College program GPA is comprised of all courses that are approved degree requirements. If a student takes more than the minimum required number of semester hours to complete the degree, but all courses taken are eligible to count toward the degree, those courses will be included in the Graduate College program GPA.

d  Students must enroll in ENGR:7270, typically in the first semester of enrollment; does not count towards total semester hours for the degree.

e  ISE:5000 must be taken in the first two consecutive semesters of enrollment, and one semester (fall or spring) in subsequent academic years; does not count towards total semester hours for the degree.

f  See General Catalog for list of approved courses.

g  Work with faculty advisor to determine appropriate graduate elective coursework and sequence.