Industrial Engineering, BSE

The major in industrial engineering requires a strong foundation of courses in engineering science, mathematics, design, manufacturing, social science, and humanities. Advanced work includes specialty courses in human factors and ergonomics, management, information systems, manufacturing, quality control, and operations research. Design is an integral part of the undergraduate program; all students complete a comprehensive design experience.

The Department of Industrial and Systems Engineering offers a host of options for each engineering student. From the undergraduate engineering degree, a dual Undergraduate to Graduate (U2G) degree, focus areas, and extracurricular activities, there are many options available to explore and develop professional skills. The industrial and systems engineering undergraduate program emphasizes a broad education in engineering fundamentals and the opportunity for in-depth learning in a focus area.

Focus Areas and Specialized Opportunities

As part of the mission to help students be engineers and something more, the Department of Industrial and Systems Engineering offers a variety of focus area options so that students can pursue specialized interests. Industrial engineering focus areas include big data analytics, computer and information systems, design and manufacturing, entrepreneurship, human factors and ergonomics, management, and an option to tailor a focus area to an individual student's interests.

Big Data Analytics

Big data analytics is the process of examining big data in an effort to uncover hidden patterns, unknown correlations, and other useful information—95% of the data in the world today has been created in the last two years alone. This data comes from everywhere: sensors used to gather climate information, posts to social media sites, digital pictures and videos, purchase transaction records, and cell phone GPS signals to name a few.

Computer and Information Systems

Industrial engineers have a natural role to play in this field by using quantitative system analysis, manufacturing system knowledge, and human factors skills to help design and refine computer systems that are becoming ever more complex. The field offers substantial opportunities for technical skill development, travel, and interaction with a diverse range of professionals.

Design and Manufacturing

Many graduates find careers in manufacturing industries that include the use of computer-aided design and manufacturing, virtual and physical prototyping, 3D design, design and simulation of manufacturing processes, and manufacturing systems. They find employment in diverse industries, including the supplier manufacturing industry (e.g., John Deere, Caterpillar, Rockwell Collins, Raytheon, Boeing), health care (e.g., Johnson & Johnson, Zimmer), software, and the information industry (e.g., Pro/Engineer, CATIA, SolidWorks, AutoCAD).

Entrepreneurship

Entrepreneurship allows engineering students to explore venture capital, marketability of products, and technology transfer. They gain exposure to understanding sound business practice, acquire team-building skills in both small and large companies, understand the entrepreneurial approach to acquiring and managing resources, learn how to create a business plan, and obtain valuable contacts and networking opportunities with businesses and industries.

Human Factors and Ergonomics

The human factors and ergonomics focus area represents an increasingly important engineering specialty. The dramatic increase in netcentric computer technology makes system performance increasingly dependent on the match between system characteristics and human capabilities. Graduates find employment in diverse industries that include health care (e.g., GE, Medtronics, Guidant), original equipment manufacturer (OEM) and supplier manufacturing industry (e.g., Rockwell Collins, Boeing, John Deere, Caterpillar), computer systems (e.g., Microsoft, Intel, IBM), the government (e.g., NHTSA, NTSB, NASA, the Department of Defense), and consulting (e.g., Accenture, Battelle). Human factors considers cognitive characteristics, and ergonomics considers physical characteristics. This focus area provides advanced education in psychology, systems, statistics, and biomechanics.

Management

Industrial engineers are often assigned managerial tasks, project management, and financial assessments as they relate to project budgets, cost calculations, and optimization criteria. This focus area prepares students for a career in business management.

Tailored

Students work with an advisor to tailor a program that is specific to their individual needs. For more information about guidelines for tailored focus areas, see EFAs and Specialized Opportunities on the Department of Industrial and Systems Engineering website.

Student Organizations

Student organizations can have an enormous impact on an undergraduate student's career. The College of Engineering is home to a number of student organizations and clubs. Popular organizations for industrial and systems engineering students include the Institute of Industrial and Systems Engineers (IISE) and the Human Factors and Ergonomics Society (HFES).

Undergraduate Resources

Undergraduate resources are available to students to pursue research, access professional services available in the college and across the university, and participate in or view sports and arts events on campus and around town.

Scholarships

A variety of engineering scholarships and funding opportunities are available to industrial and systems engineering students.

Accreditation

The undergraduate program in industrial engineering is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

Educational Objectives

The following educational objectives of the program are defined in conjunction with the accreditation process.

Within a few years of graduation, industrial engineering graduates will:

- continue learning;
- lead and inspire others; and
- engage in the community and society.

Requirements

The Bachelor of Science in Engineering (BSE) with a major in industrial engineering requires a minimum of 129 s.h. of credit, including two 0 s.h. seminars. At the time of graduation, students must have a cumulative grade-point average of at least 2.00 in all college work used to complete degree requirements and in all UI coursework in order to be awarded the BSE.

All BSE students are required to take the same collegiate curriculum. For information about these collegiate requirements, see the Bachelor of Science in Engineering, BSE in the catalog. Students completing the major in industrial engineering fulfill the collegiate statistics requirement by completing STAT:2020 Probability and Statistics for the Engineering and Physical Sciences. Students within the department also are required to take PSY:1001 Elementary Psychology to fulfill part of the BSE collegiate curriculum General Education Component approved course subjects requirement.

The major in industrial engineering requires the following coursework.

Requirements	Hours
Collegiate Curriculum	50
Major Requirements (includes two 0 s.h. seminars)	58
Focus Area	21-26

Major Requirements

Major requirements include a set of common courses (40 s.h.), at least 11 s.h. in engineering fundamentals elective courses, a systems elective (3 s.h.), two departmental seminars (0 s.h.), and one capstone design course (4 s.h.).

Common Courses

Course #	Title	Hours
All of these:		
ISE:2360	Design for Manufacturing	3
ISE:2500	Engineering Economy	3
ISE:3300	Manufacturing Systems	3
ISE:3350	Process Engineering	3
ISE:3400	Human Factors	3
ISE:3450	Ergonomics	3
ISE:3500	Information Systems Design	3
ISE:3600	Quality Control	3
ISE:3610	Stochastic Modeling	3
ISE:3660	Data Analytics with R	3
ISE:3700	Operations Research	3
ISE:3750	Digital Systems Simulation	3
PHYS:1612	Introductory Physics II (with lab)	4

Engineering Fundamentals

Students who are required to complete ENGR:2730 Computers in Engineering as part of their focus area must select a different course to fulfill the engineering fundamentals requirement.

Course #	Title	Hours
At least 11 s.h. from these:		
ENGR:2110	Statics	2
ENGR:2120	Electrical Circuits	3
ENGR:2130	Thermodynamics	3
ENGR:2710	Dynamics	3
ENGR:2720	Materials Science	3
ENGR:2730	Computers in Engineering	3
ENGR:2750	Mechanics of Deformable Bodies	3
ENGR:2995	Introduction to Artificial Intelligence and Machine Learning in Engineering	3

Systems Elective

Students who complete ENGR:2730 Computers in Engineering or ISE:4900 Introduction to Six Sigma as part of their focus area must select a different course to fulfill their systems elective or work with their academic advisor for an appropriate substitution.

Course #	Title	Hours
One of these:		
ISE:4172	Big Data Analytics	3
ISE:4175	Safety Engineering	3
ISE:4900	Introduction to Six Sigma	3
ENGR:2730	Computers in Engineering	3
A course with prefix ISE numbered 5000 or above		3

Departmental Seminars

Course #	Title	Hours
Both of these:		
ISE:2000	Industrial Engineering Sophomore Seminar	0
ISE:3000	Professional Seminar: Industrial Engineering (taken in the third year)	0

Capstone Design Course

Course #	Title	Hours
This course:		
ISE:4600	Industrial Engineering Design Project	4

Focus Area

Students must select focus area courses according to guidelines established by the Department of Industrial and Systems Engineering. Focus areas include big data analytics [p. 3], computer and information systems [p. 3], design and manufacturing [p. 3], entrepreneurship

[p. 4], human factors and ergonomics [p. 4], management [p. 5], and an option to tailor a focus area to an individual student's interests. For more information about focus area options and guidelines for tailored focus areas, see EFAs and Specialized Opportunities on the Department of Industrial and Systems Engineering website.

Focus areas in the industrial engineering major include content area courses and electives; carefully selected elective courses may contribute to earning a minor and/or certificate.

Big Data Analytics

Students in the big data analytics focus area complete four required courses (12 s.h.), two focus area electives (6–7 s.h.), and one math or science elective (3–4 s.h.).

Required Big Data Analytics Courses

Course #	Title	Hours
One of these:		
BAIS:3500	Data Mining	3
ECE:5450/IGPI:5450	Machine Learning	3
All of these:		
ENGR:2730	Computers in Engineering	3
STAT:4540/ BAIS:4540/ DATA:4540/ IGPI:4540	Statistical Learning	3
STAT:4580/ DATA:4580/ IGPI:4580	Data Visualization and Data Technologies	3

Big Data Analytics Electives

Course #	Title	Hours
Two of these:		
ISE:4172	Big Data Analytics	3
CS:2210	Discrete Structures	3
CS:2230	Computer Science II: Data Structures	4
CS:5110/IGPI:5110	Introduction to Informatics	3
ECE:3330/IGPI:3330	Introduction to Software Design	3
STAT:4740/ CS:4740/IGPI:4740/ MATH:4740	Large Data Analysis	3

Math or Science Elective–Big Data Analytics

Course #	Title	Hours
One of these:		
BIOL:1411	Foundations of Biology	4
CHEM:1120	Principles of Chemistry II	4
MATH:3550	Engineering Mathematics V: Vector Calculus	3
MATH:3800/ CS:3700	Introduction to Numerical Methods	3
PHYS:2704	Physics IV	3-4
STAT:3210	Experimental Design and Analysis	3

Computer and Information Systems

Students in the computer and information systems focus area complete five required courses (16 s.h.) and two focus area electives (6–7 s.h.).

Required Computer and Information Systems Courses

Course #	Title	Hours
All of these:		
CS:2210	Discrete Structures	3
CS:2230	Computer Science II: Data Structures	4
ECE:3330/IGPI:3330	Introduction to Software Design	3
ENGR:2730	Computers in Engineering	3
MATH:3800/ CS:3700	Introduction to Numerical Methods	3

Computer and Information Systems Electives

Course #	Title	Hours
Two of these:		
CS:2630	Computer Organization	4
CS:3330	Algorithms	3
CS:3820	Programming Language Concepts	3
CS:4400	Database Systems	3
CS:5800/ECE:5800	Fundamentals of Software Engineering	3

Design and Manufacturing

Students in the design and manufacturing focus area complete two required courses (6 s.h.), three focus area electives (9–12 s.h.), one math or science elective (3–4 s.h.), and one advanced engineering elective (3–4 s.h.).

Required Design and Manufacturing Courses

Course #	Title	Hours
Both of these:		
ARTS:1020	Elements of 3D Design	3
TDSN:2240/ CEE:2240	Digital Drafting with AutoCAD	3

Design and Manufacturing Electives

Course #	Title	Hours
Three of these:		
ISE:4116/ME:4116	Manufacturing Processes Simulations and Automation	3
ISE:4900	Introduction to Six Sigma	3
ISE:5310	Advanced Computational Design and Manufacturing	3
ISE:5620	Design of Experiments	3
ISE:5650	Mechatronics Engineering for Smart Device Design	3
BME:2500	Biomaterials and Biomechanics	4
BME:2710	Engineering Drawing, Design, and Solid Modeling	3

BME:5101	Biomaterials and Implant Design	3
ME:4112/CEE:4512	Engineering Design Optimization	3
ME:5167/CEE:5137	Composite Materials	3
MTLS:4910	Mixed Media and Professional Practices	3-4
TDSN:2250	Digital Prototyping	3
TDSN:3200	Product Design	4
TDSN:3285	Fabrication and Design: Hand-Built Bicycle	4

Math or Science Elective–Design and Manufacturing

Course #	Title	Hours
One of these:		
BIOL:1411	Foundations of Biology	4
CHEM:1120	Principles of Chemistry II	4
MATH:3550	Engineering Mathematics V: Vector Calculus	3
MATH:3800/ CS:3700	Introduction to Numerical Methods	3
PHYS:2704	Physics IV	3-4

Advanced Engineering Elective–Design and Manufacturing

Students select one course numbered 3000 or above from any department in the College of Engineering (prefix BME, CBE, CEE, ECE, ISE, or ME).

Entrepreneurship

Students in the entrepreneurship focus area complete three required courses (9 s.h.), two technological entrepreneurship courses (6 s.h.), one advanced elective (3 s.h.), and one math or science elective (3–4 s.h.).

Required Entrepreneurship Courses

Course #	Title	Hours
All of these:		
ISE:4900	Introduction to Six Sigma	3
ENTR:2000	Entrepreneurship and Innovation	3
ENTR:3100	Entrepreneurial Finance	3

Technological Entrepreneurship Certificate Courses

Students select two courses that count toward the Certificate in Technological Entrepreneurship for a total of 6 s.h.

Advanced Elective

Course #	Title	Hours
One of these:		
A course numbered 3000 or above with prefix BME, CBE, CEE, ECE, ISE, or ME		3
A course numbered 3000 or above with prefix ACCT, BAIS, BUS, ECON, ENTR, FIN, MGMT, or MKTG		3

Math or Science Elective–Entrepreneurship

Course #	Title	Hours
One of these:		
BIOL:1411	Foundations of Biology	4
CHEM:1120	Principles of Chemistry II	4
MATH:3550	Engineering Mathematics V: Vector Calculus	3
MATH:3800/ CS:3700	Introduction to Numerical Methods	3
PHYS:2704	Physics IV	3-4
STAT:3210	Experimental Design and Analysis	3

Human Factors and Ergonomics

Students in the human factors and ergonomics focus area complete three required courses (10 s.h.), one math or science elective (3 s.h.), one engineering elective (3–4 s.h.), and two general electives (6–7 s.h.).

Required Human Factors and Ergonomics Courses

Course #	Title	Hours
All of these:		
PSY:2601	Introduction to Cognitive Psychology	3
PSY:2701	Introduction to Behavioral Neuroscience	4
PSY:2811	Research Methods and Data Analysis in Psychology I	3

Math or Science Elective–Human Factors and Ergonomics

Course #	Title	Hours
One of these:		
STAT:3200	Applied Linear Regression	3
STAT:3210	Experimental Design and Analysis	3
STAT:4143/ PSQF:4143	Introduction to Statistical Methods	3

Engineering Elective

Course #	Title	Hours
One of these:		
ISE:4175	Safety Engineering	3
ISE:5420	Automated Vehicle Systems	3
ISE:5460	User Experience Design	3
ISE:6220	Cognitive Engineering	3
ISE:6410	Research Methods in Human Factors Engineering	3
ISE:6450	Human Factors in Aviation	3
BME:2500	Biomaterials and Biomechanics	4
BME:5640	Ergonomics of Occupational Injuries	3

General Electives

Course #	Title	Hours
Two of these:		
PSY:3040	Psychology of Learning	3
PSY:3620	Human Memory	3

PSY:4020	Laboratory in Psychology	4
OEH:4310	Occupational Ergonomics: Principles	3

Management

Students in the management focus area complete five required courses (15 s.h.), one math or science elective (3–4 s.h.), and one advanced engineering elective (3 s.h.).

Required Management Courses

Course #	Title	Hours
All of these:		
ACCT:2100	Introduction to Financial Accounting	3
ACCT:2200	Managerial Accounting Analytics and Data Visualization	3
MGMT:2000	Introduction to Law	3
MGMT:2100	Introduction to Management	3
MKTG:3000	Introduction to Marketing Strategy	3

Math or Science Elective–Management

Course #	Title	Hours
One of these:		
BIOL:1411	Foundations of Biology	4
CHEM:1120	Principles of Chemistry II	4
MATH:3550	Engineering Mathematics V: Vector Calculus	3
MATH:3800/ CS:3700	Introduction to Numerical Methods	3
PHYS:2704	Physics IV	3-4
STAT:3210	Experimental Design and Analysis	3

Advanced Engineering Elective–Management

Students select one course numbered 3000 or above from any department in the College of Engineering (prefix BME, CBE, CEE, ECE, ISE, or ME).

Tailored

Students work with their advisor to tailor a program that is specific to their individual needs.

Combined Programs

BSE/MS in Industrial Engineering

The College of Engineering offers a combined Bachelor of Science in Engineering/Master of Science program for industrial engineering undergraduate students who intend to earn an MS in industrial engineering.

Undergraduate students at the University of Iowa who have completed more than 80 s.h. and have a grade-point average higher than 3.25 may apply for admission to the Undergraduate to Graduate (U2G) program designed to accelerate the attainment of an MS in industrial engineering degree. Students typically complete their MS within one year of their BSE degree.

Students meet with their academic advisor, complete a plan, and submit an application for the MS program of study to the Graduate College. Graduate Record Examination (GRE) General Test scores are not required for University of Iowa students. Students continue to follow the industrial and systems engineering curriculum as planned with their advisor.

Students may take up to 12 s.h. of graduate coursework in the last year of undergraduate studies to be counted toward both degrees, attend the program's graduate seminar, and optionally work with a faculty member on a master's thesis project while they are still undergraduates.

Interested students should discuss the Undergraduate to Graduate (U2G) program with their advisor during their third year of study. Applications should be submitted to the department before the start of their fourth year.

Career Advancement

Industrial and systems engineers have many opportunities for employment and service in industrial, government, research, and public service organizations. 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. Industrial and systems engineers are employed by manufacturing and energy firms, wind turbine manufacturers, government agencies, and service organizations such as airlines, banks, hospitals, health care groups, and consulting companies.

People are often surprised to learn the impact and breadth of the industrial engineering profession, which is one of the three largest areas of engineering employment, according to the Bureau of Labor Statistics. Yet, only 5% of all engineers are trained specifically for this specialty, according to the American Society for Engineering Educators (ASEE). It is one of the more gender-diverse engineering degrees: 34.1% of industrial engineering bachelor's degrees are awarded to women, compared to 24% of all engineering bachelor's degrees, according to the ASEE.

Engineering Career Services develops and promotes experiential education and professional opportunities for students in the College of Engineering. Professional staff coordinate the college's co-op and internship program, engage in employer outreach, and provide opportunities for students to network with employers, including engineering career fairs and other programming related to career development.

Engineering Career Services offers individual advising and class presentations on résumé and cover letter preparation, job and internship search strategies, interviewing skills, job offer evaluation, and much more. Engineering Career Services partners with the Pomerantz Career Center to facilitate on-campus interviewing, postgraduation outcome collection, and the university's online recruiting system, Handshake.

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, BSE

Course	Title	Hours
First Year		
Fall		
RHET:1030	Rhetoric [a]	4
MATH:1550	Engineering Mathematics I: Single Variable Calculus [b, c]	4
CHEM:1110	Principles of Chemistry I [a, d]	4
ENGR:1100	Introduction to Engineering Problem Solving [e]	3
ENGR:1000	Engineering Success for First-Year Students [e]	1
CSI:1600	Success at Iowa	0
	Hours	**16**
Spring		
PSY:1001	Elementary Psychology [a]	3
MATH:1560	Engineering Mathematics II: Multivariable Calculus [b]	4
MATH:2550	Engineering Mathematics III: Matrix Algebra [a]	2
PHYS:1611	Introductory Physics I [b]	4
ENGR:1300	Introduction to Engineering Computing [b]	3
	Hours	**16**
Second Year		
Any Semester		
Students must choose a focus area. See General Catalog or consult an advisor for more information.		
	Hours	**0**
Fall		
GE: Diversity, Equity, and Inclusion [f]		3
MATH:2560	Engineering Mathematics IV: Differential Equations [a]	3
PHYS:1612	Introductory Physics II [a]	4
Major: engineering fundamentals elective [g]		2 - 3
Major: engineering fundamentals elective [g]		3
Major: engineering fundamentals elective [g]		3
ISE:2000	Industrial Engineering Sophomore Seminar [e]	0
	Hours	**18-19**
Spring		
STAT:2020	Probability and Statistics for the Engineering and Physical Sciences [a]	3
Major: engineering fundamentals elective [g]		3
ISE:2500	Engineering Economy [h]	3
ISE:3500	Information Systems Design [h]	3
Focus Area: required course [i]		3
	Hours	**15**
Third Year		
Fall		
GE: Engineering Be Creative [j]		3
ISE:2360	Design for Manufacturing [e]	3
ISE:3400	Human Factors [e]	3
ISE:3610	Stochastic Modeling [e]	3
ISE:3700	Operations Research [e]	3
	Hours	**15**
Spring		
GE: Approved Course Subjects [k]		3
ISE:3300	Manufacturing Systems [h]	3
ISE:3450	Ergonomics [h]	3
ISE:3660	Data Analytics with R [h]	3
ISE:3750	Digital Systems Simulation [h]	3
Focus Area: required or elective course [i]		3
ISE:3000	Professional Seminar: Industrial Engineering [h]	0
	Hours	**18**
Fourth Year		
Fall		
GE: Approved Course Subjects [k]		3
ISE:3350	Process Engineering [e]	3
ISE:3600	Quality Control [e]	3
Focus Area: required course [i]		3
Focus Area: required or elective course [i]		3
	Hours	**15**
Spring		
ISE:4600	Industrial Engineering Design Project [b]	4
Major: systems elective [l]		3
Focus Area: required or elective course [i]		3
Focus Area: required or elective course [i]		3
Focus Area: elective course [i]		3
Degree Application: apply on MyUI before deadline (typically in February for spring, September for fall) [m]		
	Hours	**16**
	Total Hours	**129-130**

a Typically this course is offered in fall, spring, and summer sessions. Check MyUI for course availability since offerings are subject to change.

b Typically this course is offered in fall and spring semesters. Check MyUI for course availability since offerings are subject to change.

c Enrollment in math courses requires completion of a placement exam.

d Enrollment in chemistry courses requires completion of a placement exam.

e Typically this course is offered in fall semesters only. Check MyUI for course availability since offerings are subject to change.

f Students select a course from one of two GE CLAS Core areas: Diversity and Inclusion or Values and Culture.

g Students complete at least 11 s.h. in engineering fundamentals courses, selected from the following: ENGR:2110, ENGR:2120, ENGR:2130, ENGR:2710, ENGR:2720, ENGR:2730, ENGR:2750, and ENGR:2995. Students who are required to complete ENGR:2730 as part of their focus area must select a different course to fulfill the engineering fundamentals requirement. See General Catalog or consult an advisor for more information.

h Typically this course is offered in spring semesters only. Check MyUI for course availability since offerings are subject to change.

i Students select one of several standard focus areas or tailor a focus area to individual interests. Focus areas require at least 21 s.h. and consist of content area courses and

electives. Carefully selected elective courses may contribute to earning a minor and/or certificate. See General Catalog or consult an advisor for more information.

j See General Catalog for list of approved courses. Students who intend to enroll in a Be Creative course with prerequisites must request a waiver by completing the Request Prerequisite Special Permission form on MyUI.

k See General Catalog for list of approved course subjects.

l Students complete one systems elective (3 s.h.), selected from the following: ISE:4172, ISE:4175, ISE:4900, ENGR:2730, or a course with prefix ISE numbered 5000 or above. Students who are required to complete ENGR:2730 or ISE:4900 as part of their focus area must select a different course to fulfill the systems elective requirement. See General Catalog or consult an advisor for more information.

m Please see Academic Calendar, Office of the Registrar website for current degree application deadlines. Students should apply for a degree for the session in which all requirements will be met. For any questions on appropriate timing, contact your academic advisor or Graduation Services.