

# Mechanical Engineering, BSE

The major in mechanical engineering lays a foundation in the basic disciplines of mathematics, physics, and chemistry and in the engineering sciences of statics, dynamics, thermodynamics, mechanics of deformable bodies, mechanics of fluids and transfer processes, materials science, and electrical sciences. An understanding of these sciences enables mechanical engineers to design parts of systems and understand whole systems, plan the production and use of energy, plan and operate industrial manufacturing facilities, and design automatic control systems for machines and other mechanical systems.

Mechanical engineering students develop an awareness of social and humanistic issues relating to business, environment, government, history, language, religion, and international relations. They also acquire an appreciation of professional and ethical responsibilities.

Programs designed to lead to professional licensure are subject to federal regulations regarding informational disclosures. Please see Professional Licensure Disclosures by Program for further information.

## Educational Objectives

Within a few years of graduation, graduates of the mechanical engineering program will:

- have successful careers in engineering and beyond and will have assumed professional roles of increasing responsibility and impact;
- have acquired new knowledge and expertise through professional development opportunities or advanced education; and
- be engaged in workplace, professional, or civic communities.

Graduates from the Department of Mechanical Engineering BSE program will be prepared to contribute effectively as engineers in a diverse and multidisciplinary work environment. They will have the ability to:

- identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics;
- apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare as well as global, cultural, social, environmental, and economic factors;
- communicate effectively with a range of audiences;
- recognize ethical and professional responsibilities in engineering situations and make informed judgments that consider the impact of engineering solutions in global, economic, environmental, and societal contexts;
- function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives;
- develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions; and
- acquire and apply new knowledge as needed, using appropriate learning strategies.

## Requirements

The Bachelor of Science in Engineering (BSE) with a major in mechanical engineering requires a minimum of 129 s.h. of credit, including two 0 s.h. department 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. 6 s.h. of a student's major courses fulfill the basic science or college-level math collegiate requirement. Students completing the major in mechanical engineering also fulfill the collegiate statistics requirement by completing STAT:2020 Probability and Statistics for the Engineering and Physical Sciences.

The BSE with a major in mechanical engineering requires the following coursework.

Requirements	Hours
Collegiate Curriculum	49
Basic Science and College-Level Math, from Major Requirements or Focus Area	6
Major Requirements (includes two 0 s.h. seminars)	53
Focus Area	21

## Major Requirements

Major requirements include a set of common courses (56 s.h.), two departmental seminars (0 s.h.), and one capstone design course (3 s.h.).

Course #	Title	Hours
All of these:		
ME:2200	Introduction to Mechanical Engineering Design	2
ME:2300	Manufacturing Processes	3
ME:3045	Heat Transfer	3
ME:3052	Mechanical Systems	4
ME:3351	Engineering Instrumentation	2
ME:3600	Control of Mechanical Engineering Systems	3
ME:4048	Energy Systems Design	4
ME:4055	Mechanical Systems Design	3
ME:4080	Experimental Engineering	4
ENGR:2110	Statics	2
ENGR:2120	Electrical Circuits	3
ENGR:2130	Thermodynamics	3
ENGR:2510	Fluid Mechanics	4
ENGR:2710	Dynamics	3
ENGR:2720	Materials Science	3
ENGR:2750	Mechanics of Deformable Bodies	3
MATH:3550	Engineering Vector Calculus	3
PHYS:1612	Introductory Physics II (with lab)	4

## Departmental Seminars

Course #	Title	Hours
Both of these:		
ME:2020	Mechanical Engineering Program Seminar	0
ME:3091	Professional Seminar: Mechanical Engineering	0

## Capstone Design Course

Course #	Title	Hours
This course:		
ME:4086	Mechanical Engineering Design Project	3

## Focus Area

Students must select focus area courses according to guidelines established by the Department of Mechanical Engineering. The mechanical engineering program offers a variety of focus area options, including standard focus areas developed and maintained by the program and flexible focus areas tailored to individual student interests. The focus area is a set of 21 s.h. of elective courses taken during the second through fourth years that provide mechanical engineering undergraduate students with a unique opportunity to acquire advanced education in an area of their choice.

Standard focus areas are offered in energy and environment [p. 2], manufacturing [p. 2], mechanical engineering design [p. 3], and robotics and autonomous systems [p. 4]. For guidelines regarding tailored focus areas, see ME Focus Areas on the Department of Mechanical Engineering website.

Focus areas in mechanical engineering consist of required courses, focus area electives, and additional electives; carefully selected elective courses may contribute to earning a minor and/or certificate.

## Energy and Environment

Students in the energy and environment focus area complete one required course (3 s.h.), at least two focus area electives (6 s.h.), and up to four additional electives to total 21 s.h.

### Required Energy and Environment Course

Course #	Title	Hours
At least one of these:		
ME:5145	Intermediate Heat Transfer	3
ME:5160/CEE:5369	Intermediate Mechanics of Fluids	3

### Energy and Environment Electives

Course #	Title	Hours
At least two of these:		
ME:4111/CEE:4511	Scientific Computing and Machine Learning	3
ME:4160	Engines and Power Plants	3
ME:5145	Intermediate Heat Transfer (if not taken as a required course)	3
ME:5149	Propulsion Engineering	3

ME:5160/CEE:5369	Intermediate Mechanics of Fluids (if not taken as a required course)	3
CEE:4107/CBE:4410	Sustainable Systems	3

## Additional Electives, Energy and Environment

The remainder of the 21 s.h. must be fulfilled by electives. In addition to the following courses, students may also select courses not already taken from the lists of required energy and environment courses and approved energy and environment electives. See "Flexible Electives" in this section of the catalog for more information.

Course #	Title	Hours
ME:4024	Product Design and Realization	3
ME:4125	Biomimetic Fluid Dynamics	3
ME:4175	Computational Naval Hydrodynamics	3
ME:4186	Enhanced Design Experience	3
ME:5143	Computational Fluid and Thermal Engineering	3
ME:5210/CBE:5110	Intermediate Thermodynamics	3
CBE:3405	Green Chemical and Energy Technologies	3
CBE:5415/IGPI:5415	Satellite Image Processing and Remote Sensing of Atmosphere	3
CBE:5417/CEE:5417/IGPI:5417	Physical Meteorology and Atmospheric Radiative Transfer	3
CEE:3371	Principles of Hydraulics and Hydrology	3
CEE:4102	Groundwater	3
CEE:4159/	Air Pollution Control	3
CBE:4459/IGPI:4159	Technology	3
CEE:5380	Fluid Flows in Environmental Systems	3
ECE:5620	Electric Power Systems and Renewable Energy	3
ISE:2500	Engineering Economy	3
May include one of these:		
SEES:1080	Introduction to Environmental Science	3-4
SEES:1290	Energy and the Environment	3

## Manufacturing

Students in the manufacturing focus area complete two required courses (6 s.h.), at least two focus area electives (6 s.h.), and up to three additional electives (9 s.h.) to total 21 s.h.

### Required Manufacturing Courses

Course #	Title	Hours
This course:		
ME:4111/CEE:4511	Scientific Computing and Machine Learning	3
And at least one of these:		
ME:4116/ISE:4116	Manufacturing Processes Simulations and Automation	3

ME:4140	Modern Robotics and Automation	3
ME:5146	Modeling of Materials Processing	3

### Manufacturing Electives

Course #	Title	Hours
At least two of these:		
ME:4024	Product Design and Realization	3
ME:4116/ISE:4116	Manufacturing Processes Simulations and Automation (if not taken as a required course)	3
ME:4140	Modern Robotics and Automation (if not taken as a required course)	3
ME:4145	Industrial Internet of Things (IIoT)	3
ME:4200	Modern Engineering Materials for Mechanical Design	3
ME:5146	Modeling of Materials Processing (if not taken as a required course)	3
ME:5167/CEE:5137	Composite Materials	3
ME:5170	Data-Driven Analysis in Engineering Mechanics	3

### Additional Electives, Manufacturing

The remainder of the 21 s.h. must be fulfilled by electives. In addition to the following courses, students may also select courses not already taken from the lists of required manufacturing courses and approved manufacturing electives. See "Flexible Electives" in this section of the catalog for more information.

Course #	Title	Hours
ME:4110/CEE:4515	Computer-Aided Engineering	3
ME:4112/CEE:4512	Engineering Design Optimization	3
ME:4117	Finite Element Analysis	3
ME:4150	Artificial Intelligence in Engineering	3
ME:4153/CEE:4532	Fundamentals of Vibrations	3
ME:4186	Enhanced Design Experience	3
ME:5114	Nonlinear Control in Robotic Systems	3
ME:5143	Computational Fluid and Thermal Engineering	3
ME:5145	Intermediate Heat Transfer	3
ME:5159/CEE:5549	Fracture Mechanics	3
ME:5300	Uncertainty Quantification and Design Optimization	3
BME:5620	Introduction to Applied Biomedical Finite Element Modeling	3
ECE:5550	Internet of Things	3
ISE:3300	Manufacturing Systems	3
ISE:3600/CEE:3142/ STAT:3620	Quality Control	3
ISE:3700	Operations Research	3

ISE:4620	Design of Experiments for Quality Improvement	3
ISE:4900	Introduction to Six Sigma	3

### Mechanical Engineering Design

Students in the mechanical engineering design focus area complete two required courses (6 s.h.), at least two focus area electives (6 s.h.), and up to three additional electives (9 s.h.) to total 21 s.h.

### Required Design Courses

Course #	Title	Hours
Both of these:		
ME:4111/CEE:4511	Scientific Computing and Machine Learning	3
ME:4186	Enhanced Design Experience	3

Students in the mechanical engineering design focus area are required to apply for a yearlong design experience comprised of ME:4086 Mechanical Engineering Design Project (see "Capstone Design Course") in the fall and ME:4186 Enhanced Design Experience in the spring (see Policy on Participation in PEDE or VIPT Programs). Students who are not accepted or who are unable to take the yearlong set of courses are required to replace ME:4186 with a course from the section titled "Design Electives" or "Additional Electives-Mechanical Engineering Design."

### Design Electives

Course #	Title	Hours
At least two of these:		
ME:4024	Product Design and Realization	3
ME:4110/CEE:4515	Computer-Aided Engineering	3
ME:4112/CEE:4512	Engineering Design Optimization	3
ME:4117	Finite Element Analysis	3
ME:5143	Computational Fluid and Thermal Engineering	3
ME:5170	Data-Driven Analysis in Engineering Mechanics	3
ME:5300	Uncertainty Quantification and Design Optimization	3

### Additional Electives, Mechanical Engineering Design

The remainder of the 21 s.h. must be fulfilled by electives. In addition to the following courses, students may also select courses not already taken from the list of approved design electives. See "Flexible Electives" in this section of the catalog for more information.

Course #	Title	Hours
ME:4116/ISE:4116	Manufacturing Processes Simulations and Automation	3
ME:4120	Advanced Linear Control Systems	3
ME:4125	Biomimetic Fluid Dynamics	3
ME:4140	Modern Robotics and Automation	3
ME:4145	Industrial Internet of Things (IIoT)	3

ME:4150	Artificial Intelligence in Engineering	3
ME:4153/CEE:4532	Fundamentals of Vibrations	3
ME:4175	Computational Naval Hydrodynamics	3
ME:4200	Modern Engineering Materials for Mechanical Design	3
ME:5114	Nonlinear Control in Robotic Systems	3
ME:5120	Vehicle System Dynamics	3
ME:5145	Intermediate Heat Transfer	3
ME:5149	Propulsion Engineering	3
ME:5150/CEE:5540	Intermediate Mechanics of Deformable Bodies	3
ME:5154	Intermediate Kinematics and Dynamics	3
ME:5159/CEE:5549	Fracture Mechanics	3
ME:5160/CEE:5369	Intermediate Mechanics of Fluids	3
ME:5167/CEE:5137	Composite Materials	3
ME:5179/CEE:5179	Continuum Mechanics	3

## Robotics and Autonomous Systems

Students in the robotics and autonomous systems focus area complete two required courses (6 s.h.), at least two focus area electives (6 s.h.), and up to three additional electives (9 s.h.) to total 21 s.h.

### Required Robotics and Autonomous Systems Courses

Course #	Title	Hours
Both of these:		
ME:4111/CEE:4511	Scientific Computing and Machine Learning	3
ME:4120	Advanced Linear Control Systems	3

### Robotics and Autonomous Systems Electives

Course #	Title	Hours
At least two of these:		
ME:4116/ISE:4116	Manufacturing Processes Simulations and Automation	3
ME:4140	Modern Robotics and Automation	3
ME:4145	Industrial Internet of Things (IIoT)	3
ME:4150	Artificial Intelligence in Engineering	3
ME:4175	Computational Naval Hydrodynamics	3
ME:4176	Experimental Naval Hydrodynamics	3
ME:5114	Nonlinear Control in Robotic Systems	3
ME:5120	Vehicle System Dynamics	3
ME:5170	Data-Driven Analysis in Engineering Mechanics	3
ME:6115	Cooperative Autonomous Systems	3

## Additional Electives, Robotics and Autonomous Systems

The remainder of the 21 s.h. must be fulfilled by electives. In addition to the following courses, students may also select courses not already taken from the list of approved robotics and autonomous systems electives. See "Flexible Electives" in this section of the catalog for more information.

Course #	Title	Hours
ME:4024	Product Design and Realization	3
ME:4110/CEE:4515	Computer-Aided Engineering	3
ME:4125	Biomimetic Fluid Dynamics	3
ME:4153/CEE:4532	Fundamentals of Vibrations	3
ME:4186	Enhanced Design Experience	3
ME:5150/CEE:5540	Intermediate Mechanics of Deformable Bodies	3
ME:5154	Intermediate Kinematics and Dynamics	3
ME:5300	Uncertainty Quantification and Design Optimization	3
ECE:5550	Internet of Things	3
ENGR:2730	Computers in Engineering	3

## Flexible Electives

Students in all mechanical engineering focus areas may apply up to 3 s.h. of flexible elective courses to the additional elective requirement. Flexible elective courses include the following.

- A College of Engineering course that is required for another BSE major, excluding department seminars.
- A mechanical engineering course (prefix ME) numbered 4100 or above.
- A chemistry course (prefix CHEM) numbered above 1110, a mathematics course (prefix MATH) numbered above 3350, or a physics course (prefix PHYS) numbered above 1612. Students who have completed ME:4111 Scientific Computing and Machine Learning cannot use MATH:3800 Introduction to Numerical Methods as a flexible elective.
- An independent study (ME:4098) in a mechanical engineering subject area.

## Combined Programs

### BSE/MS in Mechanical Engineering

A Bachelor of Science/Master of Science combined degree program is available for qualified University of Iowa undergraduate students. This allows students to complete an MS in two or three semesters after completion of their BSE degree. Those in the combined degree program receive a BSE when all requirements have been completed, and then become MS students in the Department of Mechanical Engineering (ME).

The Undergraduate to Graduate (U2G) combined degree program is primarily intended for students interested in pursuing the MS without thesis. However, the MS thesis option can be pursued in instances where students have been conducting research under the supervision of an ME faculty member since at least the summer following their junior year,

and an ME faculty member is willing to advise them and serve as committee chair for their final exam.

Interested students should discuss the combined degree program with their advisor during their third year. Applications should be submitted during the second semester of their third year and before the start of their fourth year (two-semester blended model); see the U2G Program on the Department of Mechanical Engineering website. However, single-semester admits are allowed and must adhere to the application deadlines and other program requirements.

Accepted students are expected to have a minimum University of Iowa cumulative grade-point average (GPA) of at least 3.25 and maintain this GPA throughout their time in the program. Undergraduate students whose UI cumulative GPA falls below this minimum are removed from the combined program.

Students may contact any ME faculty member to inquire about participation in the U2G combined degree program, research opportunities, and financial support.

## Program Benefits

Students may apply up to 12 s.h. of graduate-level coursework toward both their BSE and MS degrees. However, credit may not be applied to courses taken prior to admission to the combined degree program. Mechanical engineering courses eligible for graduate credit have a prefix of ME and be numbered 4100 or above, except for ME:4186 Enhanced Design Experience. The courses selected must fulfill MS coursework requirements and apply to BSE electives.

Students who select the thesis option can begin work on their MS thesis research with a faculty advisor during their fourth year of undergraduate studies.

Graduate Record Examination (GRE) General Test scores are not required for admission to the combined degree program. Students are assessed undergraduate tuition and fees until their BSE has been conferred; then, students are assessed graduate tuition and fees, and they may be eligible for graduate assistantships.

## BSE/MS in Civil and Environmental Engineering

The combined BSE in mechanical engineering/MS in civil and environmental engineering enables undergraduate students majoring in mechanical engineering to begin work toward the MS in civil and environmental engineering while completing the bachelor's degree. Students admitted to the program may count 9 s.h. of coursework toward both the BSE and MS degree requirements. They may also count an additional 3 s.h. toward the MS degree requirements before they have been awarded the BSE. See the MS in civil and environmental engineering in the catalog.

## Career Advancement

Engineering is a well-respected profession that is used as a foundation for a variety of careers in industry, medicine, law, government, and consulting. Engineering majors consistently claim several of the top ten spots on the list of top-paid majors for bachelor's degree graduates, according to the National Association of Colleges and Employers (NACE). On average, 93-98% of graduates are employed in their field of study or pursuing advanced education within seven months of graduation.

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 an engineering career fair each semester 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, postgraduate 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.

### Mechanical Engineering, BSE

Course	Title	Hours
<b>First Year</b>		
<b>Fall</b>		
RHET:1030	Rhetoric: Writing and Communication <sup>a</sup>	4
CHEM:1110	Principles of Chemistry I <sup>a, b</sup>	4
MATH:1550	Engineering Calculus I <sup>c, d</sup>	4
ENGR:1100	Introduction to Engineering Problem Solving <sup>e</sup>	3
CSI:1600	Success at Iowa	0
<b>Hours</b>		<b>15</b>
<b>Spring</b>		
GE: Approved Course Subjects <sup>f</sup>		3
MATH:1560	Engineering Calculus II <sup>c</sup>	4
MATH:2550	Engineering Matrix Algebra <sup>c</sup>	2
PHYS:1611	Introductory Physics I <sup>c</sup>	4
ENGR:1300	Introduction to Engineering Computing <sup>c</sup>	3
<b>Hours</b>		<b>16</b>
<b>Second Year</b>		
<b>Fall</b>		
GE: Approved Course Subjects <sup>f</sup>		4
MATH:2560	Engineering Differential Equations <sup>c</sup>	3
PHYS:1612	Introductory Physics II <sup>a</sup>	4
ENGR:2110	Statics <sup>a</sup>	2
ENGR:2120 or ME:2200	Electrical Circuits <sup>g</sup> or Introduction to Mechanical Engineering Design	2 - 3
ENGR:2130	Thermodynamics <sup>a</sup>	3
ME:2020	Mechanical Engineering Program Seminar <sup>e</sup>	0

Focus Area Form: Students should fill out a focus area selection form by the end of their Fall semester. Focus area forms can be updated/changed at anytime. Please see the Mechanical Engineering - Undergraduate Focus Areas webpage for the link.

		<b>Hours</b>	<b>18-19</b>
<b>Spring</b>			
ENGR:2710	Dynamics <sup>a</sup>		3
ENGR:2720	Materials Science <sup>a</sup>		3
ENGR:2750	Mechanics of Deformable Bodies <sup>a</sup>		3
ME:2200 or ENGR:2120	Introduction to Mechanical Engineering Design <sup>g</sup> or Electrical Circuits	2 - 3	3
ME:2300 or STAT:2020	Manufacturing Processes <sup>c</sup> or Probability and Statistics for the Engineering and Physical Sciences		3
Focus Area: required course <sup>h</sup>			3
		<b>Hours</b>	<b>17-18</b>
<b>Third Year</b>			
<b>Fall</b>			
MATH:3550	Engineering Vector Calculus <sup>c</sup>		3
STAT:2020 or ME:2300	Probability and Statistics for the Engineering and Physical Sciences <sup>c</sup> or Manufacturing Processes		3
ENGR:2510	Fluid Mechanics <sup>c</sup>		4
ME:3351	Engineering Instrumentation <sup>e</sup>		2
ME:3600	Control of Mechanical Engineering Systems <sup>e</sup>		3
ME:3091	Professional Seminar: Mechanical Engineering <sup>e</sup>		0
		<b>Hours</b>	<b>15</b>
<b>Spring</b>			
GE: Engineering Be Creative <sup>i</sup>			3
ME:3045	Heat Transfer <sup>j</sup>		3
ME:3052	Mechanical Systems <sup>j</sup>		4
Focus Area: required or elective course <sup>h</sup>			3
Focus Area: elective course <sup>h</sup>			3
		<b>Hours</b>	<b>16</b>
<b>Fourth Year</b>			
<b>Fall</b>			
GE: Cultural Perspectives, Values, and Society <sup>k</sup>			3
ME:4048	Energy Systems Design <sup>e</sup>		4
ME:4055	Mechanical Systems Design <sup>e</sup>		3
Focus Area: elective course or ME:4080 Experimental Engineering <sup>c, h</sup>			3
Focus Area: elective course or ME:4086 Mechanical Engineering Design Project <sup>c, h</sup>			3
		<b>Hours</b>	<b>16</b>
<b>Spring</b>			
GE: Approved Course Subjects <sup>f</sup>			3
ME:4080	Experimental Engineering <sup>c, h</sup>		4
ME:4086	Mechanical Engineering Design Project <sup>c, h</sup>		3
Focus Area: elective course <sup>h</sup>			3
Focus Area: elective course <sup>h</sup>			3

Degree Application: apply on MyUI before deadline (typically in February for spring, September for fall) <sup>l</sup>

<b>Hours</b>	<b>16</b>
<b>Total Hours</b>	<b>129-131</b>

- a Typically this course is offered in fall, spring, and summer sessions. Check MyUI for course availability since offerings are subject to change.
- b Enrollment in chemistry courses requires completion of a placement exam.
- c Typically this course is offered in fall and spring semesters. Check MyUI for course availability since offerings are subject to change.
- d Enrollment in math 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 See General Catalog for list of approved course subjects.
- g ENGR:2120 is typically taught fall, spring, and summer. ME:2200 is typically taught in the fall and spring. Check MyUI for course availability since offerings are subject to change.
- h Students select one of the preapproved standard focus areas or create a tailored focus area. Focus areas require at least 21 s.h. of coursework and consist of required course and electives. See General Catalog or consult an advisor for more information.
- i 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.
- j Typically this course is offered in spring semesters only. Check MyUI for course availability since offerings are subject to change.
- k Students select a course from one of two GE CLAS Core areas: Understanding Cultural Perspectives or Values and Society.
- l Please see Academic Calendar, on 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 Degree Services.