

MECHANICAL ENGINEERING

For the undergraduate curriculum in mechanical engineering leading to the degree bachelor of science. The Mechanical Engineering program is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org/>.

Mechanical engineers apply the principles of motion, energy, and force to create mechanical solutions to technological problems, thereby realizing devices and systems that make life better. About one-fifth of all engineers practicing today are mechanical engineers. Their skills are used in research, development, design, testing, production, technical sales, technical management, as well as medicine, law, and business. Mechanical engineers are characterized by personal creativity, breadth of knowledge, and versatility. For these reasons they are found to function and thrive as valuable members and leaders of multidisciplinary teams. Mechanical engineers are employed in a wide range of industries; examples include agricultural/heavy equipment, biomedical, consulting, energy and power, manufacturing, product design and transportation.

Student Learning Outcomes:

Graduates of the Mechanical Engineering curriculum should have, at the time of graduation:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to 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
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Program Educational Objectives:

The mechanical engineering curriculum is organized to provide students with a broad foundation in mathematics, science, engineering, social science and humanities. Areas emphasized in the curriculum are design

and optimization, dynamic systems and control, materials processing and mechanics, and thermo-fluid sciences. Elective courses provide additional emphasis in terms of the student's unique educational goals, whether they include immediate entry into industry or further professional or graduate study.

The mechanical engineering curriculum at Iowa State University is dedicated to preparing students for productive careers in the state, nation, and the world and has the following objectives:

1. Graduates will have utilized a foundation in engineering and science to improve lives and livelihoods through a successful career in mechanical engineering or other fields.
2. Graduates will have become effective collaborators and innovators, leading or participating in efforts to address social, technical and business challenges.
3. Graduates will have engaged in life-long learning and professional development through self-study, continuing education or graduate and professional studies in engineering, business, law or medicine.

A major focus throughout the mechanical engineering curriculum is a series of experiences that emphasize engineering design, culminating in a capstone design experience in the senior year. Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints. Development of skills needed to be independent, creative thinkers, effective communicators, and contributing team members is integrated throughout the curriculum. Students also develop an understanding of the societal context in which they will practice engineering, including environmental, legal, aesthetic, and human aspects.

Students are encouraged to participate in the cooperative education program or to obtain engineering internships, both domestically and abroad. Study abroad is encouraged, and the department has exchange programs with several universities around the world. These experiences help students to round out their education and to better prepare for careers in the increasingly global practice of engineering.

Curriculum in Mechanical Engineering

Administered by the Department of Mechanical Engineering. Leading to the degree bachelor of science.

Total credits required: 129 cr.

Any transfer credit courses applied to the degree program require a grade of C or better (but will not be calculated into the ISU cumulative GPA, Basic Program GPA or Core GPA). See also Basic Program and Special Programs.

International Perspectives: 3 cr.

U.S. Diversity: 3 cr.

Communication Proficiency/Library requirement:

ENGL 150 Critical Thinking and Communication (Must have a 3
C or better in this course)

ENGL 250	Written, Oral, Visual, and Electronic Composition (Must have a C or better in this course)	3
LIB 160	Introduction to College Level Research	1
Choose one of the following communication courses (minimum grade of C)		3
ENGL 302	Business Communication	
ENGL 309	Proposal and Report Writing	
ENGL 314	Technical Communication	
SP CM 212	Fundamentals of Public Speaking	

General Education Electives: 15 cr.

No more than three 100-level courses for this set of courses can be applied to the Bachelor of Science Degree in Mechanical Engineering.

Choose one course from the following:		3
ECON 101	Principles of Microeconomics or ECON 102 Principles of Macroeconomics	
Social Science ²		3
Humanities		6
Humanities or Social Science ²		3
Total Credits		15

Basic Program: 24 cr.

A minimum GPA of 2.00 is required for this set of courses (please note that transfer course grades will not be calculated into the Basic Program GPA). See Requirement for Entry into Professional Program in College of Engineering Overview section.

CHEM 167	General Chemistry for Engineering Students or CHEM 177 General Chemistry I	4
ENGL 150	Critical Thinking and Communication (Must have a C or better in this course)	3
ENGR 101	Engineering Orientation	R
M E 160	Mechanical Engineering Problem Solving with Computer Applications ³	3
LIB 160	Introduction to College Level Research	1
MATH 165	Calculus I	4
MATH 166	Calculus II	4
PHYS 231	Introduction to Classical Physics I	4
PHYS 231L	Introduction to Classical Physics I Laboratory	1
Total Credits		24

Mechanical Engineering Foundations: 25 cr.

A minimum GPA of 2.00 for the complete group of Foundations courses is required before students are permitted to enroll in the following Mechanical Engineering Core courses (please note that transfer course

grades will not be calculated into the ME Foundations GPA): ME 324, ME 325, ME 332, ME 335, ME 370 and ME 421.

MATH 265	Calculus III	4
4 credits from the following:		4
MATH 267	Elementary Differential Equations and Laplace Transforms	
MATH 266 & MATH 268	Elementary Differential Equations and Laplace Transforms	
PHYS 232	Introduction to Classical Physics II	4
PHYS 232L	Introduction to Classical Physics II Laboratory	1
E M 324	Mechanics of Materials	3
MAT E 273	Principles of Materials Science and Engineering	3
M E 231	Engineering Thermodynamics I	3
C E 274	Engineering Statics	3

Total Credits **25**

Mechanical Engineering Core: 38 cr.

A minimum GPA of 2.00 is required for this set of courses, including any transfer courses (please note that transfer course grades will not be calculated into the Core GPA):

M E 345	Engineering Dynamics	3
E E 442	Introduction to Circuits and Instruments	2
E E 448	Introduction to AC Circuits and Motors	2
M E 270	Introduction to Mechanical Engineering Design	3
M E 324	Manufacturing Engineering	3
M E 324L	Manufacturing Engineering Laboratory	1
M E 325	Mechanical Component Design	3
M E 332	Engineering Thermodynamics II	3
M E 335	Fluid Flow	4
M E 370	Engineering Measurements	3
M E 421	System Dynamics and Control	4
M E 436	Heat Transfer	4
One Senior Capstone Design course from the following		3
M E 415	Mechanical Systems Design	
M E 442	Heating and Air Conditioning Design	
M E 466	Multidisciplinary Engineering Design	

Total Credits **38**

Other Remaining Courses: 27 cr.

Complete 15 cr. Technical Electives ²		15
M E 170	Engineering Graphics and Introductory Design	3
M E 202	Mechanical Engineering - Professional Planning	R
ENGL 250	Written, Oral, Visual, and Electronic Composition (Must have a C or better in this course)	3

STAT 305	Engineering Statistics	3
Complete one of the following communication courses with a minimum grade of C.		3
ENGL 302	Business Communication	
ENGL 309	Proposal and Report Writing	
ENGL 314	Technical Communication	
SP CM 212	Fundamentals of Public Speaking	
Total Credits		27

Co-op/Internships (Optional)

- These university requirements will add to the minimum credits of the program unless the university-approved courses are also approved by the department to meet other course requirements within the degree program.
U.S. diversity and international perspectives courses may not be taken Pass/Not Pass.
- Choose from department approved list of technical electives (<http://www.me.iastate.edu/students/degrees-and-programs/bs-degree/degree-requirements/tech-electives/>) and general education electives (<http://www.me.iastate.edu/students/degrees-and-programs/bs-degree/degree-requirements/general-education/>). Note: electives used to meet graduation requirements may not be taken Pass-Not Pass (P-NP).
- See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

Transfer Credit Requirements

The Mechanical Engineering Department requires a grade of a C or better for any transfer credit course that is applied to the degree program.

The degree program must include a minimum of 15 credits taken from courses offered through the Mechanical Engineering Department at Iowa State University. Of these 15 credits, 3 must be from one of the senior capstone design courses. The remaining 12 credits may be from the core curriculum program (if a student is deficient in these courses) or from 400-level M E technical electives. No more than 3 credits of independent study shall be applied to meet the 12 credit requirement.

See also: A 4-year plan of study grid showing course template by semester. (<http://catalog.iastate.edu/previouscatalogs/2022-2023/collegeofengineering/mechanicalengineering/#fouryearplantext>)

Mechanical Engineering, B.S.

First Year

Fall	Credits Spring	Credits
CHEM 167	4 ENGL 150	3
M E 160	3 M E 170	3
MATH 165	4 MATH 166	4

ENGR 101	R LIB 160	1
General Education Elective	3 PHYS 231	4
	PHYS 231L	1
		14
		16

Second Year

Fall	Credits Spring	Credits
C E 274	3 E M 324	3
MAT E 273	3 MATH 267	4
MATH 265	4 M E 231	3
PHYS 232	4 M E 270	3
PHYS 232L	1 General Education Elective	3
ENGL 250	3 M E 202	R
		18
		16

Third Year

Fall	Credits Spring	Credits
E E 442	2 M E 325	3
E E 448	2 M E 335	4
M E 345	3 M E 370	3
M E 332	3 M E 324	3
STAT 305	3 Communication Requirement	3
M E 324L	1	
General Education Elective	3	
		17
		16

Fourth Year

Fall	Credits Spring	Credits
Gen Ed Elective (Intl Perspective)	3 Gen Ed Elective (US Diversity)	3
M E 421	4 Technical Elective	3
M E 436	4 Technical Elective	3
Technical Elective	3 Technical Elective	3
Technical Elective	3 Capstone Design	3
		17
		15

Energy Systems Minor

The Energy Systems minor is administered by the mechanical engineering department and is open to all undergraduates in the College of Engineering. The minor may be earned by completing 15 credits from the following courses. The complete list of approved elective courses can be found below. The minor must include at least 9 credits that are not used to meet any other department, college, or university requirement.

<http://www.me.iastate.edu/energy-systems-minor/>

Required courses

ECON 380	Energy, Environmental and Resource Economics	3
E E 351	Analysis of Energy Systems	3
or M E 433	Alternative Energy	
Electives: Choose from a list of approved courses		9

Total Credits **15**

Approved Elective Courses

A B E 325	Biorenewable Systems	3
A B E 342	Agricultural Tractor Power	3
A B E 363	Agri-Industrial Applications of Electric Power and Electronics	4
A B E 380	Principles of Biological Systems Engineering	3
A B E 413	Fluid Power Engineering	3
A B E 472	Controlled Environments for Animals and Plants	3
A B E 480	Engineering Analysis of Biological Systems	3
A B E 572	Controlled Environments for Animals and Plants	3
A B E 580	Engineering Analysis of Biological Systems	3
AER E 381	Introduction to Wind Energy	3
AER E 481	Advanced Wind Energy: Technology and Design	3
AER E 570	Wind Engineering	3
CH E 356	Transport Phenomena I	3
CH E 357	Transport Phenomena II	3
CH E 358	Separations	3
CH E 381	Chemical Engineering Thermodynamics	3
CH E 382	Chemical Reaction Engineering	3
CH E 415	Biochemical Engineering	3
CH E 515	Biochemical Engineering	3
CH E 554	Integrated Transport Phenomena	4
CH E 583	Advanced Thermodynamics	3
CH E 587	Advanced Chemical Reactor Design	3
CON E 352	Mechanical Systems in Buildings	3
CON E 353	Electrical Systems in Buildings	3
CON E 354	Building Energy Performance	3
E E 303	Energy Systems and Power Electronics	3
E E 448	Introduction to AC Circuits and Motors	2
E E 452	Electrical Machines and Power Electronic Drives	3
E E 455	Introduction to Energy Distribution Systems	3
E E 456	Power System Analysis I	3
E E 457	Power System Analysis II	3
E E 458	Economic Systems for Electric Power Planning	3
E E 459	Electromechanical Wind Energy Conversion and Grid Integration	3

E E 552	Energy System Planning	3
E E 553	Steady State Analysis	3
E E 554	Power System Dynamics	3
E E 555	Advanced Energy Distribution Systems	3
E E 556	Power Electronic Systems	3
E E 559	Electromechanical Wind Energy Conversion and Grid Integration	3
E M 570	Wind Engineering	3
ENGR 340	Introduction to Wind Energy: System Design & Delivery	3
ENSCI 480	Engineering Analysis of Biological Systems	3
I E 543	Wind Energy Manufacturing	3
M E 332	Engineering Thermodynamics II	3
M E 335	Fluid Flow	4
M E 413	Fluid Power Engineering	3
M E 436	Heat Transfer	4
M E 437	Introduction to Combustion Engineering	3
M E 441	Fundamentals of Heating, Ventilating, and Air Conditioning	3
M E 442	Heating and Air Conditioning Design	3
M E 444	Elements and Performance of Power Plants	3
M E 448	Fluid Dynamics of Turbomachinery	3
M E 449	Internal Combustion Engines	3
M E 501	Fundamentals of Biorenewable Resources	3
M E 530	Advanced Thermodynamics	3
M E 532	Compressible Fluid Flow	3
M E 535	Thermochemical Processing of Biomass	3
M E 536	Advanced Heat Transfer	3
M E 538	Advanced Fluid Flow	3
M E 542	Advanced Combustion	3
M E 545	Thermal Systems Design	3
M S E 520	Thermodynamics and Kinetics in Multicomponent Materials	3
MAT E 311	Thermodynamics in Materials Engineering	3
POL S 515	Biorenewables Law and Policy	3
WESEP 501	Wind Energy Resources	3
WESEP 502	Wind Energy Systems	3

Concurrent mechanical engineering bs/ms degree

The Department of Mechanical Engineering (ME) provides BS/MS concurrent degrees that allow well-qualified students to be admitted to

the graduate program while still working on their undergraduate degrees during their senior year. Concurrent degrees allow well-qualified students to begin their graduate studies before completing their undergraduate degree to complete their graduate degree on an accelerated timeline. Students in concurrent status must be making good progress toward a bachelor's degree. The minimum requirements for admission to concurrent-student status are the same as those required for admission to the Graduate College. Other aspects of concurrent status include:

- Official enrollment and fee payment will be as a graduate student.
- The graduate credential will be awarded at the same time or after the undergraduate degree is conferred.
- Students may be appointed to graduate research assistantships.
- With the approval of a student's Program of Study (POS) Committee, up to 6 ISU credits taken while in concurrent status may be applied to a bachelor's degree and a graduate degree.

Details on the Masters degree requirements and graduate admission in mechanical engineering may be found at: <https://www.me.iastate.edu/graduate-admissions/>

Details on the graduate college policies on concurrent degrees may be found at: <https://www.grad-college.iastate.edu/handbook/chapter.php?id=4#4.3>

Graduate Study

The department offers programs for the degrees Master of Engineering (M. Eng.), Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) with a major in mechanical engineering. The M.Eng. degree is a coursework-only degree designed to improve professional expertise in mechanical engineering. The M.S. and Ph.D. degrees are designed to improve the student's capability to conduct research as well as their professional expertise. Although co-major and formal minor programs are not offered in mechanical engineering, courses may be used for minor work by students taking major work in other departments.

Well-qualified juniors and seniors in mechanical engineering who are interested in graduate study may apply for concurrent enrollment in the Graduate College to simultaneously pursue both the Bachelor of Science and Master of Science, the Bachelor of Science and Master of Business Administration. Under concurrent enrollment, students are eligible for assistantships and simultaneously take undergraduate and graduate courses. Details are available in the Graduate Programs Office and on the department's website (<http://www.me.iastate.edu/>).

The graduate program offers advanced study in a variety of thrust areas, including biological and nanoscale sciences, clean energy technologies,

complex fluid systems, design and manufacturing innovation, and simulation and visualization.

The department offers students the opportunity to broaden their education by participating in minor programs in established departments, interdepartmental programs, or other experiences as approved by their program of study committees.

The requirements for advanced degrees are established by the student's program of study committee within established guidelines of the Graduate College. Graduate students who have not completed an undergraduate program of study substantially equivalent to that required of undergraduate students in the department can expect that additional supporting coursework will be required.

Program requirements can be found on the department webpage (<http://www.me.iastate.edu/>) and in the Mechanical Engineering Graduate Student Handbook.