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, https://www.abet.org (https://www.abet.org/), under the commission's General Criteria and Program Criteria for Mechanical and Similarly Named Engineering Programs.

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 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 leaders, collaborators, and innovators solving social, technical, business, and global 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, medicine, or other fields.

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, me foundations gpa, or Core GPA). See also Basic Program and Special Programs.
International Perspectives: 3 cr. [1]
U.S. Cultures and Communities: 3 cr. [1]
Communication Proficiency/Library requirement:

ENGL 1500	Critical Thinking and Communication (Must have a C or better in this course)	3
ENGL 2500	Written, Oral, Visual, and Electronic Composition (Must have a C or better in this course)	3
LIB 1600	Introduction to College Level Research	1
Choose one of the following communication courses (minimum grade of C)		3
ENGL 3020	Business Communication	
ENGL 3090	Proposal and Report Writing	
ENGL 3140	Technical Communication	
SPCM 2120	Fundamentals of Public Speaking	

General Education Electives: 15 cr.

No more than three 1000-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 1010	Principles of Microeconomics	
or ECON 102	Principles of Macroeconomics	
Social Science [2]		3
Humanities [2]		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 1670	General Chemistry for Engineering Students	4
or CHEM 1770	General Chemistry I	
ENGL 1500	Critical Thinking and Communication (Must have a C or better in this course)	3
ENGR 1010	Engineering Orientation	R
ME 1600	Mechanical Engineering Problem Solving with Computer Applications [3]	3
LIB 1600	Introduction to College Level Research	1
MATH 1650	Calculus I	4
MATH 1660	Calculus II	4
PHYS 2310	Introduction to Classical Physics I	4
PHYS 2310L	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 3240, ME 3250, ME 3320, ME 3350, ME 3700 and ME 4210.

MATH 2650	Calculus III	4
4 credits from the following:		4
MATH 2670	Elementary Differential Equations and Laplace Transforms	
MATH 2660 & MATH 2680	Elementary Differential Equations and Laplace Transforms	
PHYS 2320	Introduction to Classical Physics II	4
PHYS 2320L	Introduction to Classical Physics II Laboratory	1
EM 3240	Mechanics of Materials	3
MATE 2730	Principles of Materials Science and Engineering	3
ME 2310	Engineering Thermodynamics I	3
CE 2740	Engineering Statics	3
Total Credits		**25**

Mechanical Engineering Core: 38 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 Core GPA):

ME 3450	Engineering Dynamics	3
EE 4420	Introduction to Circuits and Instruments	2
EE 4480	Introduction to AC Circuits and Motors	2
ME 2700	Introduction to Mechanical Engineering Design	3
ME 3240	Manufacturing Engineering	3
ME 3240L	Manufacturing Engineering Laboratory	1
ME 3250	Mechanical Component Design	3
ME 3320	Engineering Thermodynamics II	3
ME 3350	Fluid Flow	4
ME 3700	Engineering Measurements	3
ME 4210	System Dynamics and Control	4
ME 4360	Heat Transfer	4
One Senior Capstone Design course from the following		3
ME 4150	Mechanical Systems Design	
ME 4420	Heating and Air Conditioning Design	
Total Credits		**38**

Other Remaining Courses: 27 cr.

Complete 15 cr. Technical Electives [2]		15
ME 1700	Engineering Graphics and Introductory Design	3
ME 2020	Mechanical Engineering - Professional Planning	R
ENGL 2500	Written, Oral, Visual, and Electronic Composition (Must have a C or better in this course)	3
STAT 3050	Engineering Statistics	3
Complete one of the following communication courses with a minimum grade of C.		3
ENGL 3020	Business Communication	
ENGL 3090	Proposal and Report Writing	
ENGL 3140	Technical Communication	
SPCM 2120	Fundamentals of Public Speaking	
Total Credits		**27**

Co-op/Internships (Optional)

1. 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. Cultures and Communities and International Perspectives courses may not be taken Pass/Not Pass.
2. Choose from department approved list of technical electives (https://www.me.iastate.edu/undergraduate-program/advising/degree-planning/) and general education electives (https://www.me.iastate.edu/undergraduate-program/advising/degree-planning/). Note: electives used to meet graduation requirements may not be taken Pass-Not Pass (P-NP).
3. 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 4000-level ME 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.

Mechanical Engineering, B.S.

First Year

Fall	Credits	Spring	Credits
CHEM 1670	4	ENGL 1500	3
ME 1600	3	ME 1700	3
MATH 1650	4	MATH 1660	4
ENGR 1010	R	LIB 1600	1
General Education Elective	3	PHYS 2310	4
		PHYS 2310L	1
	14		**16**

Second Year

Fall	Credits	Spring	Credits
CE 2740	3	EM 3240	3
MATE 2730	3	MATH 2670	4
MATH 2650	4	ME 2310	3
PHYS 2320	4	ME 2700	3
PHYS 2320L	1	General Education Elective	3
ENGL 2500	3	ME 2020	R
	18		**16**

Third Year

Fall	Credits	Spring	Credits
EE 4420	2	ME 3250	3
EE 4480	2	ME 3350	4
ME 3450	3	ME 3700	3
ME 3320	3	ME 3240	3
STAT 3050	3	Communication Requirement	3
ME 3240L	1		
General Education Elective	3		
	17		**16**

Fourth Year

Fall	Credits	Spring	Credits
Gen Ed Elective (Intl Perspective)	3	Gen Ed Elective (U.S. Cultures and Communities)	3
ME 4210	4	Technical Elective	3
ME 4360	4	Technical Elective	3
Technical Elective	3	Technical Elective	3
Technical Elective	3	Capstone Design	3
	17		**15**

Click below to find more information about the minors

- Energy Systems Minor
- Cyber-Physical Systems Minor

Energy Systems Minor

Energy systems are pervasive in our society. A list of energy-related subjects and applications in the engineering curriculum would be nearly endless, but here are some examples:

- Mechanical engineers have a core area in thermo-fluids where courses in thermodynamics, fluid mechanics, and heat transfer form a base for energy systems.
- Electrical engineers address power transmission and distribution as well as electric motors and power systems.
- Civil engineers develop structures for wind turbines and hydroelectric dams.
- Construction engineers need to understand how building systems impact energy utilization.
- Chemical engineers develop alternative fuels and clean burning technologies.
- Material engineers develop new materials for batteries and fuel cells.
- Aerospace engineers develop wind turbines.
- Industrial engineers address manufacturing efficiency and energy reduction.
- Agricultural engineers develop biorenewable energy sources.

Energy systems are also a significant focus of the grand challenges of engineering (http://www.engineeringchallenges.org/), and this minor will help our students address these issues in their engineering careers.

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 3 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 3800	Energy, Environmental and Resource Economics	3
EE 3510	Analysis of Energy Systems	3
or ME 4330	Alternative Energy	
Electives: Choose from a list of approved courses		9
Total Credits		**15**

Approved Elective Courses

ABE 3250	Biorenewable Systems	3
ABE 3420	Agricultural Tractor Power	3
ABE 3630	Agri-Industrial Applications of Electric Power and Electronics	4
ABE 3800	Principles of Biological Systems Engineering	3
ME 4130	Fluid Power Engineering	3
ABE 4720	Controlled Environments for Animals and Plants	3
ABE 4800	Engineering Analysis of Biological Systems	3
ABE 5720	Controlled Environments for Animals and Plants	3
ABE 5800	Engineering Analysis of Biological Systems	3
AERE 3810	Introduction to Wind Energy	3
AERE 5700	Wind Engineering	3
CHE 3560	Transport Phenomena I	3
CHE 3570	Transport Phenomena II	3
CHE 3580	Separations	3
CHE 3810	Chemical Engineering Thermodynamics	3
CHE 3820	Chemical Reaction Engineering	3
CHE 4150	Biochemical Engineering	3
CHE 5150	Biochemical Engineering	3
CHE 5540	Integrated Transport Phenomena	4
CHE 5830	Advanced Thermodynamics	3
CHE 5870	Advanced Chemical Reactor Design	3
CONE 3520	Mechanical Systems in Buildings	3
CONE 3530	Electrical Systems in Buildings	3
CONE 3540	Building Energy Performance	3
EE 3030	Energy Systems and Power Electronics	3
EE 4480	Introduction to AC Circuits and Motors	2
EE 4520	Electrical Machines and Power Electronic Drives	3
EE 4550	Introduction to Energy Distribution Systems	3
EE 4560	Power System Analysis I	3
EE 4570	Power System Analysis II	3
EE 4580	Economic Systems for Electric Power Planning	3
EE 4590	Electromechanical Wind Energy Conversion and Grid Integration	3
EE 5520	Energy System Planning	3
EE 5530	Steady State Analysis	3
EE 5540	Power System Dynamics	3
EE 5550	Advanced Energy Distribution Systems	3
EE 5560	Power Electronic Systems	3
EE 5590	Electromechanical Wind Energy Conversion and Grid Integration	3
EM 5700	Wind Engineering	3

ME 3320	Engineering Thermodynamics II	3
ENSCI 3240	Energy and the Environment	3
ENSCI 4800	Engineering Analysis of Biological Systems	3
ME 3350	Fluid Flow	4
ME 4130	Fluid Power Engineering	3
ME 4360	Heat Transfer	4
ME 4370	Introduction to Combustion Engineering	3
ME 4410	Fundamentals of Heating, Ventilating, and Air Conditioning	3
ME 4420	Heating and Air Conditioning Design	3
ME 4440	Elements and Performance of Power Plants	3
ME 4480	Fluid Dynamics of Turbomachinery	3
ME 4490	Internal Combustion Engines	3
ME 5010	Fundamentals of Biorenewable Resources	3
ME 5300	Advanced Thermodynamics	3
ME 5320	Compressible Fluid Flow	3
ME 5350	Thermochemical Processing of Biomass	3
ME 5360	Advanced Heat Transfer	3
ME 5380	Advanced Fluid Flow	3
ME 5420	Advanced Combustion	3
ME 5450	Thermal Systems Design	3
MSE 5200	Thermodynamics and Kinetics in Multicomponent Materials	3
MATE 3110	Thermodynamics in Materials Engineering	3
WESEP 5010	Wind Energy Resources	3
WESEP 5020	Wind Energy Systems	3

Cyber-Physical Systems Minor

With the fourth industrial revolution upon us, physical systems are being designed to have a cyber component, that enables remote access, monitoring and control. In these systems, ubiquitous sensing, and advanced data management capability are taking us from automation to autonomy via a deep interconnection between the cyber and physical entities. Cyber-physical systems (CPS) are becoming abundant in many application sectors including manufacturing, energy, health care, transportation and agriculture. Safety-, time- and life-critical systems are relying on CPS concepts to become more efficient, robust, resilient, flexible and scalable. As CPS applications become more pervasive, the engineering education system needs to produce a next generation CPS workforce who can design, produce, and maintain these systems.

The minor requires 15 credits, including at least 6 credits in courses numbered 3000 or above taken at Iowa State University. The minor must include 3 credits that are not used to meet any other department, college, or university requirement.

Required courses:		
ME 2800	Design and Analysis of Cyber-Physical Systems	3
AERE 3640	Cyber-Physical Systems Application	3
CPRE 2870	Cyber-Physical System Fundamentals	3
Elective courses:		6
ME 3700	Engineering Measurements	
ME 4110	Automatic Controls	
ME 4180	Mechanical Considerations in Robotics	
ME 4210	System Dynamics and Control	
ME 4560	Machine Vision	
ME 4750	Modeling and Simulation	
EE 3240	Signals and Systems II	
EE 3330	Electronic Systems Design	
EE 4250	Machine learning: A Signal Processing Perspective	
EE 4760	Control System Simulation	
CPRE 2300	Cyber Security Fundamentals	
CPRE 3880	Embedded Systems II: Mobile Platforms	
CPRE 4140	Introduction to Software Systems for Big Data Analytics	
CPRE 4190	Software Tools for Large Scale Data Analysis	
CPRE 4210	Software Analysis and Verification for Safety and Security	
CPRE 4580	Real Time Systems	
CPRE 4880	Embedded Systems Design	
ABE 4030	Physical Modeling and Control of Dynamic Systems	
ABE 4040	Instrumentation for Agricultural and Biosystems Engineering	
ABE 4100	Electronic Systems Integration for Agricultural Machinery	
IE 4130	Stochastic Modeling, Analysis and Simulation	
IE 4320	Industrial Automation	
IE 4870	Big Data Analytics and Optimization	
AERE 4070	Applied Formal Methods	
AERE 4330	Spacecraft Dynamics and Control	
AERE 4630	Introduction to Multidisciplinary Design Optimization	
AERE 4640	Spacecraft Systems	
CE 4490	Structural Health Monitoring	
CE 4530	Highway Design	
CE 5530	Traffic Engineering	

CE 5560	Transportation Data Analysis	
Total Credits		**15**

Concurrent Mechanical Engineering BS/MS Degree

The Department of Mechanical Engineering (ME) provides B.S./M.S. 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 master's degree requirements and graduate admission in mechanical engineering may be found at: https://www.me.iastate.edu/graduate-admissions/. (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. (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.