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 C or better in this course)
ENGL 250  Written, Oral, Visual, and Electronic Composition 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 4  

or CHEM 177  General Chemistry I  

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  

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  Elementary Differential Equations & MATH 268  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  Mechanical 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  

**Total Credits 27**
Complete one of the following communication courses with a minimum grade of C.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>ENGL 302</td>
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<td>ENGL 309</td>
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<tr>
<td>ENGL 314</td>
<td>3</td>
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<tr>
<td>SP CM 212</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits**: 27

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**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. diversity and international perspectives courses may not be taken Pass/Not Pass.

2. 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).

3. See Basic Program for Professional Engineering Curricula for accepted substitutions for curriculum designated courses in the Basic Program.

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**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.

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**Mechanical Engineering, B.S.**

### First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHEM 167</td>
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<td>ENGL 150</td>
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<tr>
<td>M E 160</td>
<td>3</td>
<td>M E 170</td>
<td>3</td>
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<tr>
<td>MATH 165</td>
<td>4</td>
<td>MATH 166</td>
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<tr>
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### Second Year

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<td>C E 274</td>
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<td>E M 324</td>
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<tr>
<td>MAT E 273</td>
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<td>M E 231</td>
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<td>PHYS 232L</td>
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<tr>
<td>ENGL 250</td>
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<td>M E 202</td>
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### Third Year

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<tr>
<td>E E 448</td>
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<td>M E 335</td>
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<td>M E 345</td>
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<td>M E 370</td>
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<td>M E 332</td>
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### Fourth Year

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<thead>
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<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gen Ed Elective (Intl Perspective)</td>
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<td>Gen Ed Elective (US Diversity)</td>
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<tr>
<td>M E 421</td>
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<td>Technical Elective</td>
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<td>Technical Elective</td>
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<td>Technical Elective</td>
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<td>Technical Elective</td>
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<td>Technical Elective</td>
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<td>Capstone Design</td>
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</table>

### 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.

See also: http://www.me.iastate.edu/energy-systems-minor/

Required courses

<table>
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<tr>
<th>Course</th>
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<tbody>
<tr>
<td>ECON 380</td>
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**Total Credits**: 15

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**General Education Elective**

<table>
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<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>PHYS 231</td>
<td>4</td>
<td>PHYS 231L</td>
<td>1</td>
</tr>
</tbody>
</table>
Electives: Choose from a list of approved courses

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.