MECHANICAL ENGINEERING, B.S. (ENGINEERING)

Begin Campus: Any Penn State Campus
End Campus: University Park

Program Description
Mechanical Engineering is one of the broadest engineering disciplines and is central in many new technological developments. Mechanical engineers create things that help improve the health, happiness and safety of our everyday lives such as biomedical devices, aircraft and cars, and ways to store renewable energies. Mechanical engineering is divided into two broad areas: mechanical systems and thermal systems. Mechanical systems include the design of mechanisms and the analysis of the strength and wear of materials. Thermal systems include methods of energy conversions, heat transfer and fluid flow.

What is Mechanical Engineering?
Mechanical engineering is the largest and broadest engineering discipline. It uses a combination of physics, chemistry, mathematics, and materials science to study mechanical, fluid, and thermal systems. Mechanical engineers are problem solvers: They use their foundational knowledge to apply scientific and engineering methods to the design, construction, and testing of products and components to ensure that they are safe, reliable, and cost effective. Mechanical engineering differs from mechanical engineering technology in that it emphasizes the math and science behind the theoretical development of engineering analysis and design process principles rather than the application of these principles. Mechanical engineers design everything from athletic equipment, medical devices, theme park rides, and personal computers to engines and power plants.

You Might Like This Program If...
You think outside the box to develop solutions to everyday problems. Mechanical engineers contribute to our health, happiness and safety, and often change the way we think about the world.

Entrance to Major
This program currently has administrative enrollment controls. Administrative Enrollment Controls are initiated when limitations of space, faculty, or other resources in a major prevent accommodating all students who request them. Students must follow the administrative enrollment controls that are in effect for the semester that they enter the university.

First-Year Students Entering Summer 2019, Fall 2019, Spring 2020
In order to be eligible for entrance to this major, students must satisfy the following requirements:

- 40-59 graded Penn State credits (excludes transfer and AP credits)
- completed with a grade of C or better: CHEM 110, MATH 140, MATH 141, MATH 250 or MATH 251, PHYS 211, PHYS 212
- earned a minimum of 3.10 cumulative GPA

Students Who Entered Prior to Summer 2019
Students who entered the University during Summer 2018, Fall 2018, and Spring 2019 should view the administrative enrollment controls in the archived 2018-19 Undergraduate Bulletin (http://bulletins.psu.edu/archive/2018-19/undergraduate/general-information/administrative-information/#administrativeenrollmentcontrolstext). Students who entered the University prior to the summer 2018 semester should view the administrative enrollment controls for the semester that they entered the university (http://advising.psu.edu/entrance-major-requirements) on the Academic Advising Portal.

Degree Requirements
For the Bachelor of Science degree in Mechanical Engineering, a minimum of 131 credits is required:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>General Education</td>
<td>45</td>
</tr>
<tr>
<td>Requirements for the Major</td>
<td>113-114</td>
</tr>
</tbody>
</table>

27 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 9 credits of GN courses; 6 credits of GQ courses; 3 credits of GS courses; 9 credits of GWS courses.

General Education
Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (http://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program) section of the Bulletin and consult your academic adviser.

The keystone symbol appears next to the title of any course that is designated as a General Education course. Program requirements may also satisfy General Education requirements and vary for each program.

Foundations (grade of C or better is required.)
- Quantification (GQ): 6 credits
- Writing and Speaking (GWS): 9 credits

Knowledge Domains
- Arts (GA): 6 credits
- Health and Wellness (GHW): 3 credits
- Humanities (GH): 6 credits
- Social and Behavioral Sciences (GS): 6 credits
- Natural Sciences (GN): 9 credits

Integrative Studies (may also complete a Knowledge Domain requirement)
- Inter-Domain or Approved Linked Courses: 6 credits

University Degree Requirements
First Year Engagement
All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3
credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

**Cultures Requirement**
6 credits are required and may satisfy other requirements
- United States Cultures: 3 credits
- International Cultures: 3 credits

**Writing Across the Curriculum**
3 credits required from the college of graduation and likely prescribed as part of major requirements.

**Total Minimum Credits**
A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

**Quality of Work**
Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

**Limitations on Source and Time for Credit Acquisition**
The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80). For more information, check the Suggested Academic Plan for your intended program.

**Requirements for the Major**
To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44). For more information, check the Suggested Academic Plan for your intended program.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CMPSC 200</td>
<td>Programming for Engineers with MATLAB</td>
<td>3</td>
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<tr>
<td>EDSGN 100</td>
<td>Introduction to Engineering Design</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 202C</td>
<td>Effective Writing: Technical Writing</td>
<td>3</td>
</tr>
<tr>
<td>IE 312</td>
<td>Product Design and Manufacturing Processes</td>
<td>3</td>
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<tr>
<td>MATH 220</td>
<td>Matrices</td>
<td>2-3</td>
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<tr>
<td>MATH 231</td>
<td>Calculus of Several Variables</td>
<td>2</td>
</tr>
<tr>
<td>MATSE 259</td>
<td>Properties and Processing of Engineering Materials</td>
<td>3</td>
</tr>
<tr>
<td>ME 390</td>
<td>Academic and Career Development for Mechanical Engineers</td>
<td>0.5</td>
</tr>
<tr>
<td>ME 490</td>
<td>Professional Development for Mechanical Engineers</td>
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</table>

**Prescribed Courses: Require a grade of C or better**
- CHEM 110  Chemical Principles I  3
- EMCH 211  Statics  3
- EMCH 212  Dynamics  3
- EMCH 213  Strength of Materials  3
- MATH 140  Calculus With Analytic Geometry I  4
- MATH 141  Calculus with Analytic Geometry II  4
- MATH 251  Ordinary and Partial Differential Equations  4
- ME 300  Engineering Thermodynamics I  3
- ME 320  Fluid Flow  3
- ME 330  Computational Tools  3
- ME 340  Mechanical Engineering Design Methodology  3
- ME 348  Circuit Analysis, Instrumentation, and Statistics  4
- ME 360  Mechanical Design  3
- ME 370  Vibration of Mechanical Systems  3
- ME 410  Heat Transfer  3
- ME 450  Modeling of Dynamic Systems  3
- ME 454  Mechatronics  3
- PHYS 211  General Physics: Mechanics  4
- PHYS 212  General Physics: Electricity and Magnetism  4

**Additional Courses**
Select 1 credit of First-Year Seminar  1
- BIOL 141  Introduction to Human Physiology  3
- or CHEM 112  Chemical Principles II  3
- or CHEM 111  Experimental Chemistry I  3
- & PHYS 214  and General Physics: Wave Motion and Quantum Physics  3
- CAS 100  Effective Speech  3
- or CAS 100A  Effective Speech  3
- or CAS 100B  Effective Speech  3
- ENGL 15  Rhetoric and Composition  3
- or ENGL 30  Honors Freshman Composition  3

Select 3 credits of the following:
- ECON 14  Principles of Economics  3
- ECON 102  Introductory Microeconomic Analysis and Policy  3
- ECON 104  Introductory Macroeconomic Analysis and Policy  3

Select 3 credits of the following:
- ME 440  
- ME 441  
- ME 442  and  
- ME 443  

Select 2 credits of the following:
- EMCH 316  Experimental Determination of Mechanical Response of Materials  2
- ME 315  Heat Transfer Laboratory  2
- ME 325  Fluids Laboratory  2
- ME 355  Dynamic Systems Laboratory  2
- ME 375  Vibrations Laboratory  2

**Supporting Courses and Related Areas**
Select 3 credits in a 400-level ME Technical Elective course from department list  3
Select 6 credits in Engineering Technical Elective courses from department list  6
Integrated B.S. and M.S. in Mechanical Engineering

A limited number of undergraduate students in the B.S.M.E. program will be considered for admission to the integrated undergraduate/graduate program leading to the B.S.M.E. and the M.S.M.E. degrees. Students with a junior standing in the B.S.M.E. degree program may be admitted to the integrated B.S.M.E./M.S.M.E. program, following a positive review of an application specific to this program by the faculty committee on graduate admissions. Students must have attained a GPA of at least 3.0. Students admitted to the integrated program must maintain a GPA in all classes used toward the M.S.M.E. degree of at least 3.0.

Program Educational Objectives

The overall educational objective of the Mechanical Engineering program is to help prepare our graduates to succeed and provide leadership in a range of career paths. To that end we endeavor to maintain and continuously improve a curriculum that prepares our graduates to:

1. Apply foundational knowledge, critical thinking, problem solving, and creativity in engineering practice or in other fields.
2. Grow as leaders while maintaining the highest societal responsibility and ethical standards in the global workplace.
3. Develop innovative solutions through effective communication, collaboration, inclusivity, and teamwork.
4. Seek advancement in their knowledge and careers through continuing technical and/or professional studies.

Program Outcomes (Student Outcomes)

The program must have documented student outcomes that support the program educational objectives. Attainment of these outcomes prepares graduates to enter the professional practice of engineering. Student outcomes are outcomes (1) through (7), plus any additional outcomes that may be articulated by the program.

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

Academic Advising

The objectives of the university's academic advising program are to help advisees identify and achieve their academic goals, to promote their intellectual discovery, and to encourage students to take advantage of both in-and out-of class educational opportunities in order that they become self-directed learners and decision makers.

Both advisers and advisees share responsibility for making the advising relationship succeed. By encouraging their advisees to become engaged in their education, to meet their educational goals, and to develop the habit of learning, advisers assume a significant educational role. The advisee's unit of enrollment will provide each advisee with a primary academic adviser, the information needed to plan the chosen program of study, and referrals to other specialized resources.

READ SENATE POLICY 32-00: ADVISING POLICY (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/32-00-advising-policy)

University Park

Eric Marsh
Glenn Professor of Mechanical Engineering
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University Park, PA 16802
814-865-5242
erm7@psu.edu

Suggested Academic Plan

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2019-20 academic year. To access previous years' suggested academic plans, please visit the archive (http://bulletins.psu.edu/undergraduate/archive) to view the appropriate Undergraduate Bulletin edition (Note: the archive only contain suggested academic plans beginning with the 2018-19 edition of the Undergraduate Bulletin).

Mechanical Engineering - Ending at University Park Campus (Last Names Starting with A-K)

The course series listed below provides only one of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an Academic Requirements or What if report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

If you are starting at a campus other than the one this plan is ending at, please refer here:

http://advising. engr. psu. edu/ degree-requirements/ academic-plans-by-major.aspx
### First Year

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<td>Science Elective (see below)</td>
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<td>ENGL 15††</td>
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<td>EDSGN 100</td>
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<td>CMPSC 200</td>
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<td>MATSE 259</td>
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<td>ENGL 202C††</td>
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<tr>
<td>ME 330*</td>
<td>3</td>
<td>ME 340*</td>
<td>3</td>
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<tr>
<td>ME 370†</td>
<td>3</td>
<td>ME 360*</td>
<td>3</td>
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<tr>
<td>ME 348†</td>
<td>4</td>
<td>ME 320*</td>
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<td>ME 390</td>
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### Fourth Year

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<tr>
<td>Engineering Technical Elective (ETE)</td>
<td>3</td>
<td>ME 440</td>
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<tr>
<td>ME 410*</td>
<td>3</td>
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<td>ME 450*</td>
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</table>

* Course requires a grade of C or better for the major
† Course requires a grade of C or better for General Education
‡ Course satisfies General Education and degree requirement

### University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, GS, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL/CAS 137 in the fall semester and ENGL/CAS 138 in the spring semester. These courses carry the GWS designation and replace both ENGL 30 and CAS 100. Each course is 3 credits.

### College Note:

- Science elective choices: CHEM 112, BIOL 141, or CHEM 111 and PHYS 214 (3 credits total)
- An Engineering Technical Elective (https://www.me.psu.edu/students/undergraduate/curriculum-electives.aspx) is any three credit, 400-level engineering course NOT required for the major.
- To graduate, two of the following lab courses must be taken: ME 315, ME 325, ME 355, ME 375, and EMCH 316.
- A Mechanical Engineering Technical Elective (METE) is any three credit, 400#level ME course that is not required for the major. ME 494 or ME 496 may not be used.
- Three credits of co-op may also be used for the GTE and completion of three co-op rotations, internships, or a combination of both.
- Students must take 3 credits of United State Cultures (US) and 3 credits of International Cultures (IL) and 6 credits integrative studies (Inter-Domain or Linked) in conjunction with AHS courses.

### Mechanical Engineering-Ending at University Park Campus (Last Names Starting with L-Z)

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Total Credits 131

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† Course requires a grade of C or better for General Education

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### Third Year

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### Fourth Year

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</tr>
<tr>
<td>General Education Course (GHW)†</td>
<td>1.5</td>
<td></td>
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</tbody>
</table>

16 15

Total Credits 131

* Course requires a grade of C or better for the major
† Course satisfies General Education and degree requirement

### University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, GS, and Integrative Studies are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of ‘C’ or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL/CAS 137 in the fall semester and ENGL/CAS 138 in the spring semester. These courses carry the GWS designation and replace both ENGL 30 and CAS 100. Each course is 3 credits.

### College Note:

- Science elective choices: CHEM 112, BIOL 141, or CHEM 111 and PHYS 214 (3 credits total)
- An Engineering Technical Elective (https://www.me.psu.edu/students/undergraduate/curriculum-electives.aspx) is any three credit, 400-level engineering course NOT required for the major.
- To graduate, two of the following lab courses must be taken: ME 315, ME 325, ME 355, ME 375, and EMCH 316.
- A Mechanical Engineering Technical Elective (METE) is any three# credit, 400#level ME course that is not required for the major. ME 494 or ME 496 may not be used.
- Three credits of co-op may also be used for the GTE after completion of three co-op rotations, internships, or a combination of both.
- Students must take 3 credits of United State Cultures (US) and 3 credits of International Cultures (IL) and 3 credits integrative studies (Inter-Domain or Linked) in conjunction with AHS courses.

### Career Paths

Penn State’s mechanical engineering curriculum offers many opportunities to gain hands-on experience in the profession. From experiential laboratory components to a series of design courses, our program prepares you for entering industry or going on to graduate school. The design component of the curriculum culminates in an industry-sponsored senior design project, in which you’ll work in a team to solve a real-world issue.

### Careers

Mechanical engineering graduates go on to work in a diverse range of industries for large multinational companies and small local firms. Mechanical engineers are well prepared to work as managers due to their broad backgrounds and creative problem-solving skills. Our graduates regularly accept positions at Fortune 500 companies, such as Ingersoll Rand, Boeing, Toshiba-Westinghouse, General Electric, Lockheed Martin,
Northrop Grumman, Dow Chemical, ExxonMobil, Procter & Gamble, United Technologies Corporation, and Johnson & Johnson.

MORE INFORMATION ABOUT POTENTIAL CAREER OPTIONS FOR GRADUATES OF THE MECHANICAL ENGINEERING PROGRAM (http://mne.psu.edu/students/undergraduate/what-is-an-engineer.aspx#MechanicalEngineer)

Opportunities for Graduate Studies
If you want to work with renowned faculty, scientists, and engineers, the Department of Mechanical and Nuclear Engineering is a great place for you. We are one of the nation’s largest engineering departments with more than 50 full-time faculty, numerous research staff, visiting faculty, scientists, and more than 300 graduate students. Research funding comes from industry and government sources, including the Department of Energy, the National Science Foundation, the Army, the Air Force, and NASA. Our graduates are known for their ability to find high-level positions in national research centers and laboratories as well as postdoctoral and tenure-track positions in top-tier research universities.

MORE INFORMATION ABOUT OPPORTUNITIES FOR GRADUATE STUDIES (http://mne.psu.edu/students/graduate/prospective.aspx)

Professional Resources
• American Society of Mechanical Engineers (ASME) (http://sites.psu.edu/asmeuniversitypark)

Accreditation
The baccalaureate program in Mechanical Engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org).

MORE INFORMATION ABOUT ABET ACCREDITATION (http://www.abet.org)

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