

# MECHANICAL ENGINEERING, B.S. (BEHREND)

**Begin Campus:** Any Penn State Campus

**End Campus:** Erie

## Program Description

Built upon a broad foundation in physics, chemistry, and mathematics, this major has the objective of educating graduates to be problem solvers. Graduates of this program will have had opportunities to learn about applying scientific principles, engineering analysis, and engineering design to solve unstructured problems that are typical of those found in mechanical engineering. The major helps prepare graduates for a lifelong productive career, whether they choose professional practice, graduate school, or some other career path. Graduates will have had opportunities to learn how to work with others toward a common goal, to clearly express their ideas in written and verbal form, and to be independent and capable of adapting to the continuously changing technology of the work environment.

After completing the fundamental science core, students may pursue their interest in mechanical engineering by studying fluid and solid mechanics, engineering materials and their properties, thermodynamics and heat transfer, computer-aided design, kinematics and dynamics of machine elements, machine design, finite elements, control systems, electricity, and electronic instrumentation and machinery. The students will be required to analyze and solve a significant mechanical engineering design problem during their senior year.

## 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 are a curious, creative problem solver.
- You are interested in engineering, math, chemistry, and physics.
- You are looking for a broad discipline with career flexibility.
- You enjoy working on team-based projects.

## 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: MATH 140, MATH 141, CHEM 110, and PHYS 211
- earned a minimum of 2.40 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/academic-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:**

Requirement	Credits
General Education	45
Requirements for the Major	107-108

**21 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; 3 credits of GWS courses.**

Per Senate Policy 83.80.5, the college dean or campus chancellor and program faculty may require up to 24 credits of coursework in the major to be taken at the location or in the college or program where the degree is earned.

## 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 (<http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#83-80>)). For more information, check the Suggested Academic Plan for your intended program.

## Requirements for the Major

Each student must earn at least a grade of C in each 300- and 400-level course in the major field.

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>).

rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44).

Code	Title	Credits
<b>Prescribed Courses</b>		
CMPSC 200	Programming for Engineers with MATLAB	3
EDSGN 100S	Introduction to Engineering Design	3
EE 211	Electrical Circuits and Power Distribution	3
ENGL 202C	Effective Writing: Technical Writing	3
MATH 230	Calculus and Vector Analysis	4
PHYS 212	General Physics: Electricity and Magnetism	4
<i>Prescribed Courses: Require a grade of C or better</i>		
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 220	Matrices	2-3
MATH 251	Ordinary and Partial Differential Equations	4
MATSE 259	Properties and Processing of Engineering Materials	3
ME 300	Engineering Thermodynamics I	3
ME 320	Fluid Flow	3
ME 345W	Instrumentation, Measurements, and Statistics	4
ME 349	Intermediate Mechanics of Materials	3
ME 357	System Dynamics	3
ME 365	Materials Testing Laboratory	1
ME 367	Machine Design	3
ME 380	Machine Dynamics	3
ME 410	Heat Transfer	3
ME 448	Engineering Design Concepts	3
ME 449	Mechanical Design Projects	3
ME 468	Engineering for Manufacturing	3
PHYS 211	General Physics: Mechanics	4
<b>Additional Courses</b>		
ECON 102 or ECON 104	Introductory Microeconomic Analysis and Policy Introductory Macroeconomic Analysis and Policy	3
Select one of the following:		3
CHEM 111 & PHYS 214	Experimental Chemistry I and General Physics: Wave Motion and Quantum Physics	
CHEM 112	Chemical Principles II	
BIOL 141	Introductory Physiology	
<b>Supporting Courses and Related Areas</b>		
<i>Supporting Courses and Related Areas: Require a grade of C or better</i>		
Select 13 credits of program elective courses from school-approved list <sup>1</sup>		13

<sup>1</sup> These credits must be selected to fulfill the thematic requirements of the major.

## 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>)

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## 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*).

### Erie Campus

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.

First Year		
Fall	Credits Spring	Credits
CHEM 110 <sup>*#†</sup>	3 CMPSC 200 <sup>†</sup>	3
CHEM 111 <sup>†6</sup>	1 ECON 102 or 104 <sup>†</sup>	3
EDSGN 100S <sup>†3,5</sup>	3 MATH 141 <sup>*†#†</sup>	4
ENGL 15 or 30 <sup>†</sup>	3 MATH 220 <sup>*†</sup>	2
MATH 140 <sup>*†#†</sup>	4 PHYS 211 <sup>*#†</sup>	4
General Education Course	3	
	17	16

Second Year		
Fall	Credits Spring	Credits
EMCH 211 <sup>*</sup>	3 EE 211	3
MATH 230	4 EMCH 212 <sup>*</sup>	3
MATH 251 <sup>*</sup>	4 EMCH 213 <sup>*</sup>	3
PHYS 212 <sup>†</sup>	4 ME 300 <sup>*</sup>	3
General Education Course (GHW)	1.5 PHYS 214 <sup>†6</sup>	2
	General Education Course	3
	16.5	17

Third Year		
Fall	Credits Spring	Credits
ENGL 202C <sup>††</sup>	3 CAS 100 <sup>††</sup>	3
ME 320 <sup>*</sup>	3 ME 357 <sup>*</sup>	3
ME 345W <sup>*4</sup>	4 ME 365 <sup>*7</sup>	1
ME 349 <sup>*</sup>	3 ME 367 <sup>*</sup>	3
ME 380 <sup>*7</sup>	3 ME 410 <sup>*</sup>	3
	MATSE 259 <sup>*7</sup>	3
	16	16

Fourth Year		
Fall	Credits Spring	Credits
ME 448 <sup>*1</sup>	3 ME 449 <sup>*2</sup>	3
ME 468 <sup>*</sup>	3 Program Elective (School Approved List) <sup>*</sup>	3
Lab Elective (300, 400-Level) <sup>*</sup>	1 Program Elective (School Approved List) <sup>*</sup>	3
Program Elective (School Approved List) <sup>*</sup>	3 General Education Course	3
Program Elective (School Approved List) <sup>*</sup>	3 General Education Course	3
General Education Course	3 General Education Course (GHW)	1.5
	16	16.5

Total Credits 131

- \* Course requires a grade of C or better for the major
- ‡ Course requires a grade of C or better for General Education
- # Course is an Entrance to Major requirement
- † 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, 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.

- 1 The following course is only offered in the **FALL** semester: ME 448
- 2 The following courses are only offered in the **SPRING** semester: ME 449
- 3 Course will satisfy First-Year Seminar requirement.
- 4 Course will satisfy Writing Across the Curriculum requirement.
- 5 Students starting at a location other than Penn State Behrend must take EDSGN 100 plus a seminar course.
- 6 Interested students may substitute BIOL 141 or CHEM 112 for both CHEM 111 and PHYS 214.
- 7 ME 380 or the combination of MATSE 259 and ME 365 can be taken in either semester of the Third Year.

**School-Approved Electives for Mechanical Engineering: This elective list is subject to change.**

Mechanical Engineering students at Behrend are required to take four 3-credit courses and one 1-credit lab (13 total credits) of technical electives. The courses must be selected from one of the following two thematic areas:

**Technical**

Take one Lab Course:

ME 308	Fluid Flow and Heat Transfer Laboratory (fall and spring)
ME 465	Introduction to Manufacturing Laboratory (fall and spring)
ME 492	Dynamic and Vibration Lab (spring)
ME 424	Additive Manufacturing Lab (fall and spring)

Take two courses from Group 1:

ME 370	Vibration of Mechanical Systems (fall and spring)
ME 401	Refrigeration and Air Conditioning (spring)
ME 408	Energy Systems (spring)
ME 427	Aerodynamics for Mechanical Engineers (fall)
ME 428	Applied Computational Fluid Dynamics (spring)
ME 467	Applied Finite Element Analysis (fall and spring)
ME 469	Metallic Manufacturing Processes (spring)

ME 491	Bioengineering Applications of Mechanical Engineering (fall)
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Take one course from Group 2:

Any course in Group 1	
IE 405 (spring only)	Deterministic Models in Operations Research
MATH 412	Fourier Series and PDE's (fall only, odd years)
MATH 449 (spring only, odd years)	Applied Ordinary Differential Equations
MATH 455	Introduction to Numerical Analysis (fall only)
MATH 456 (even years)	Introduction to Numerical Analysis (spring only, even years)
MATH 482 (spring only, even years)	Mathematic Methods of Operations Research
PHYS 400 (fall only, even years)	Intermediate Electricity and Magnetism
PHYS 419	Theoretical Mechanics (spring only, even years)
PHYS 458	Intermediate Optics (spring only, odd years)
STAT 414	Introduction to Probability Theory (fall only, odd years)

Take one course from Group 3:

Any course in Group 1 or 2	
IE 302	Engineering Economy (spring preferred)
ME 494	Research Project*
ME 495	Internship*
ME 496	Independent Study*
ME 497	Special Topics*
MET 457	Lean Manufacturing
MGMT 409 (spring)	Project Management for Engineers (fall and spring)
PSYCH 444 (PSYCH 100)	Engineering Psychology (fall, NOTE: requires PSYCH 100)
QC 450 (spring)	Quality Control and Quality Improvement

\*Selection of ME 494-ME 497 courses require written approval of the program coordinator.

**Engineering Management**

Take one Lab Course:

ME 308	Fluid Flow and Heat Transfer Laboratory (fall and spring)
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ME 465	Introduction to Manufacturing Laboratory (fall and spring)
ME 497A	Dynamic Systems and Vibrations Lab (fall and spring)
ME 497B	Rapid Prototyping Lab (fall and spring)

Take the following two courses:

MGMT 409	Project Management for Engineers (fall and spring)
IE 302	Engineering Economy (spring preferred)

Take two additional courses from the following list:

IE 405	Deterministic Models in Operations Research (spring only)
MATH 482	Mathematic Methods of Operations Research (spring only, even years)
ME 370	Vibrations of Mechanical Systems (fall and spring)
ME 401	Refrigeration and Air Conditioning (spring)
ME 408	Energy Systems (spring)
ME 427	Aerodynamics for Mechanical Engineers (fall)
ME 428	Applied Computational Fluid Dynamics (spring)
ME 467	Applied Finite Element Analysis (fall and spring)
ME 469	Metallic Manufacturing Processes (spring)
ME 491	Bioengineering Applications of Mechanical Engineering (fall)

Students in the Engineering Management thematic who also complete either the Operations and Supply Chain Management minor or the Technical Sales minor may substitute 400-level SCM courses for the 6 additional credits of 400-level IE, MATH or ME courses.

#### Advising Notes:

- Only students who have gone through the entrance-to-major process and have been accepted into this major may register for junior and senior-level ME courses.

## Career Paths

Because every industry values a mechanical engineer's problem-solving capabilities, you'll enjoy tremendous career flexibility in disciplines as varied as research, manufacturing, product and systems design and testing, health care, energy, the military, transportation, and consumer products. A mechanical engineering education also is excellent preparation for technical management, business, law, or technical sales.

## Careers

Typical entry-level careers for mechanical engineering graduates are applications engineer, design engineer and mechanical design engineer, test engineer, equipment installation engineering, facilities technician, stress analysis engineer, product development engineer, and project engineer.

## Opportunities for Graduate Studies

Graduate programs in mechanical engineering delve more deeply into areas of specialization such as automotive engineering, robotics, advanced manufacturing, thermal science, computational fluid mechanics, combustion modeling, or biomechanical engineering.

## Professional Resources

- American Society of Mechanical Engineers (<https://www.asme.org>)
- Society of Women Engineers (<http://societyofwomenengineers.swe.org>)
- National Society of Black Engineers (<http://www.nsbe.org/home.aspx>)

## Accreditation

The B.S. in Mechanical Engineering offered by Penn State Behrend is accredited by the Engineering Accreditation Commission of ABET, [abet.org](http://abet.org). ABET is a nonprofit, non-governmental accrediting agency for programs in applied and natural science, computing, engineering and engineering technology and recognized as an accreditor by the Council for Higher Education Accreditation. ABET accreditation is voluntary and provides assurance that a college or university program meets the quality standards of the profession for which that program prepares graduates. The School of Engineering at Penn State Behrend consistently places in the Top 50 in U.S. News & World Report's rankings of the nation's undergraduate engineering programs.

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

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