

MECHANICAL ENGINEERING, BACHELOR OF SCIENCE

The BS in the **Mechanical Engineering** degree program is accredited by the Engineering Accreditation Commission of ABET, under the General Criteria and the Program Criteria for Engineering Mechanics and Similarly Named Engineering programs.

The mission of the B.S. in mechanical engineering degree program is to provide a rigorous educational experience that prepares a select group of students for leadership positions in the profession and a lifetime of learning. The faculty is committed to maintaining a modern and flexible curriculum which, building on a foundation of basic sciences and mathematics, develops a solid education in the fundamentals and modern applications of mechanical engineering. The aim of the Mechanical Engineering program is to build competence in the design and development of thermal, fluid, and mechanical systems, and to develop the professional skills necessary to excel as an engineer.

The program provides a basic background in thermal and mechanical systems. Laboratory instruction, as well as the senior design project, gives the student hands-on experience. Each student's program of study is planned in consultation with their advisor. Students have the opportunity to complete courses and develop depth in areas of focus within mechanical engineering chosen from fluid mechanics and thermal processes, mechanics of solids, heat transfer and energy, mechanical design, robotics, and biomechanics. The student's advisor can provide guidance on these focus areas.

The information below describes the academic requirements for students entering JHU as degree-seeking students in Fall 2024. Students who entered JHU as degree-seeking students prior to Fall 2024 should view the appropriate archived catalogue (<https://e-catalogue.jhu.edu/archive/>).

Students must meet the University requirements and the Whiting School of Engineering requirements (see Requirements for a Bachelor's Degree (<https://e-catalogue.jhu.edu/ksas-wse/undergraduate-policies/academic-policies/requirements-bachelors-degree/>) in this catalogue), as well as the departmental major requirements, to complete a bachelor's degree.

Students will earn at least 125 credits while completing the Bachelor of Science degree in Mechanical Engineering.

The Mechanical Engineering department recognizes students with exemplary academic records by awarding Departmental Honors to students with a cumulative Grade Point Average of 3.50.

UNIVERSITY AND WSE SCHOOL REQUIREMENTS

These requirements are described in this section of the catalogue (<https://e-catalogue.jhu.edu/ksas-wse/undergraduate-policies/academic-policies/requirements-bachelors-degree/>).

First-Year Seminar (FYS)

All students entering Hopkins from high school are required to complete a First-Year Seminar with a Satisfactory (S) grade in their first year of study. First-Year Seminars are offered only with the Satisfactory/Unsatisfactory grading system; they are not offered for letter grades.

Code	Title	Credits
	One FYS course ¹	3
Total Credits		3

¹ Mechanical Engineering encourages students to take a 3-credit discussion-based FYS course.

Writing Intensive for BS in Mechanical Engineering

A grade of C- or higher is required. No Satisfactory/Unsatisfactory grades will be accepted. Courses must be at least 3 credits each and courses applied here may also be used towards satisfying the Distribution requirement.

Code	Title	Credits
	Two Writing Intensive (W) courses	6
Total Credits		6

¹ EN.530.404 MechE Senior Design Project II is a required Senior Design course that can be used to count as one of the Writing Intensive courses.

Distribution for BS in Mechanical Engineering

A maximum of 10 credits of D grades may be accepted; all other credits for this requirement must be C- or above grades. No Satisfactory/Unsatisfactory grades will be accepted. Courses must be at least 3 credits each and may overlap with the Writing Intensive requirement. Elementary language courses, which do not carry an area designator, can be used to satisfy the Distribution requirement for engineering students.

Mechanical Engineering majors may count no more than one course taught in the Whiting School (numbered EN.xxx.xxx) with Humanities or Social Sciences area designation toward this requirement.

Code	Title	Credits
	Six Humanities (H) or Social Science (S) courses that are comprised of the following:	18
	Four H or S courses at any level	
	Two H or S courses at 300-level or higher ¹	
Total Credits		18

¹ Intermediate language courses that are at the 200 level can satisfy the upper-level requirement, even though they are not 300-level or higher.

MAJOR REQUIREMENTS

A grade of C- or higher is required. No Satisfactory/Unsatisfactory (S/U) grade will be accepted.

MATHEMATICS

Code	Title	Credits
AS.110.108	Calculus I (Physical Sciences & Engineering)	4
AS.110.109	Calculus II (For Physical Sciences and Engineering)	4
AS.110.202	Calculus III	4
	or AS.110.211 Honors Multivariable Calculus	
EN.553.291	Linear Algebra and Differential Equations	4

or AS.110.201	Linear Algebra	
& AS.110.302	and Differential Equations and Applications	
EN.553.311	Intermediate Probability and Statistics ¹	4
Total Credits		19-20

¹ EN.553.311 Intermediate Probability and Statistics is preferred. Other Probability and Statistics courses of at least 3 credits will be considered with advisor pre-approval.

BASIC SCIENCES

Code	Title	Credits
AS.030.101	Introductory Chemistry I	3
AS.171.102	General Physics: Physical Science Major II	4
or AS.171.108	General Physics for Physical Science Majors (AL)	
AS.173.112	General Physics Laboratory II ¹	1
EN.530.123	Introduction to Mechanics I ²	3
EN.530.124	Introduction to Mechanics II ²	2
Total Credits		13

¹ Students who obtain credits for AS.171.102 General Physics: Physical Science Major II by exam credit are required to take the lab, AS.173.112 General Physics Laboratory II.

² Students who obtain credits for AS.171.101 General Physics: Physical Science Major I by exam credit are not required to take EN.530.123 Introduction to Mechanics I. However, they must take EN.530.124 Introduction to Mechanics II.

INTRODUCTORY ENGINEERING AND COMPUTING

Code	Title	Credits
EN.500.114	Gateway Computing: Matlab ^{1,2}	3
EN.530.107	MechE Undergraduate Seminar I	0.5
EN.530.108	MechE Undergraduate Seminar II	0.5
EN.530.111	Intro to MechE Design and CAD ³	2
EN.530.115	MechE Freshman Lab I ³	1
EN.530.116	MechE Freshman Lab II	1
Total Credits		8

¹ EN.500.114 Gateway Computing: Matlab is the strongly preferred computing option. Students may choose to take EN.500.112 Gateway Computing: JAVA or EN.500.113 Gateway Computing: Python instead, which is acceptable. However, all students will be expected to know MATLAB for their future MechE courses. Students who do not take Gateway Computing: Matlab should consider taking the one-credit online course EN.500.134 Bootcamp: MATLAB.

² Students who scored a 5 on the AP Computer Science exam have two options: 1. take EN.500.113 Gateway Computing: Python or EN.500.114 Gateway Computing: Matlab and forfeit the exam credit, or 2. take EN.601.220 Intermediate Programming or EN.601.226 Data Structures or another programming course of at least three credits pre-approved by the student's advisor. If Option 2 is chosen, then the AP Computer Science credit will count towards the computing requirement and EN.601.220 or EN.661.226 or other pre-approved 3-credit programming course will count as one of the student's Technical Electives.

³ If EN.530.111 and EN.530.115 are not taken, students must take one of the introductory engineering courses: EN.500.101 What Is

Engineering?, EN.520.137 First Year ECE Design, or EN.570.108 Introduction to Environmental Engineering and Design.

CORE ENGINEERING COURSES

Code	Title	Credits
EN.530.202	Mechanical Engineering Dynamics	3
EN.530.212	MechE Dynamics Laboratory	1
EN.530.215	Mechanics-Based Design	3
EN.530.216	Mechanics Based Design Laboratory	1
EN.530.231	Mechanical Engineering Thermodynamics	3
EN.530.232	Mechanical Engineering Thermodynamics Laboratory	1
EN.530.327	Introduction to Fluid Mechanics	3
EN.530.329	Introduction to Fluid Mechanics Laboratory	1
EN.530.334	Heat Transfer	3
EN.530.335	Heat Transfer Laboratory	1
EN.530.343	Design and Analysis of Dynamical Systems	3
EN.530.344	Design and Analysis of Dynamical Systems Laboratory	1
EN.530.352	Materials Selection	4
EN.560.201	Statics & Mechanics of Materials	3
EN.560.211	Statics and Mechanics of Materials Laboratory	1
Electronics Courses		4-5
EN.520.230	Mastering Electronics	
& EN.520.231	and Mastering Electronics Laboratory	
or EN.530.243	Electronics & Instrumentation	
& EN.530.243	and Electronics and Instrumentation Laboratory	
Manufacturing Course		3
EN.530.254	Manufacturing Engineering	
Management and Leadership Course(s)		3-6
EN.660.463	Engineering Management & Leadership	
or EN.660.105	Foundations of American Enterprise	
& EN.660.343	and Process Innovation and Quality Management	
Total Credits		42-46

CAPSTONE DESIGN

Code	Title	Credits
EN.530.403	MechE Senior Design Project I	4
EN.530.404	MechE Senior Design Project II	4
Total Credits		8

MECHANICAL ENGINEERING ELECTIVES

Code	Title	Credits
Two Mechanical Engineering courses at 300-level (EN.530.3xx) or higher or any of the following Mechanical Engineering-related courses: ¹		6
AS.270.366	Spacecraft Instrumentation Project	
EN.520.495	Microfabrication Laboratory	
EN.560.449	Energy Systems	
EN.580.451	Immunoengineering Laboratory	
EN.580.452	Cell and Tissue Engineering Lab	
EN.660.345	Multidisciplinary Engineering Design 1	

EN.660.346	Multidisciplinary Engineering Design 2	
<i>Total Credits</i>		6

- ¹ A maximum of six credits of letter-graded Customized Academic Learning (CAL) may be applied towards the Mechanical Engineering Elective and Technical Electives.
- A maximum of three credits of undergraduate research (EN.530.501 Undergraduate Research, EN.530.511 Group Undergraduate Research, EN.530.597 Research - Summer, or equivalent course numbers from other departments)
 - A maximum of three credits of independent study (EN.530.526 Undergrad Independent Study, EN.530.527 Independent Study, EN.530.599 Independent Study, or equivalent course numbers from other departments)
 - Students may not count six credits of undergraduate research or six credits of independent study toward the electives.

TECHNICAL ELECTIVES

Code	Title	Credits
Three courses that have Engineering, Quantitative, or Natural Science area designations at 300-level or higher ^{1,2}		9
<i>Total Credits</i>		9

- ¹ One course can be EN.601.220 Intermediate Programming, EN.601.226 Data Structures, or another programming course of at least three credits pre-approved by the student's advisor.
- ² A maximum of six credits of letter-graded Customized Academic Learning (CAL) may be applied towards the Mechanical Engineering Elective and Technical Electives.
- A maximum of three credits of undergraduate research (EN.530.501 Undergraduate Research, EN.530.511 Group Undergraduate Research, EN.530.597 Research - Summer, or equivalent course numbers from other departments)
 - A maximum of three credits of independent study (EN.530.526 Undergrad Independent Study, EN.530.527 Independent Study, EN.530.599 Independent Study, or equivalent course numbers from other departments)
 - Students may not count six credits of undergraduate research or six credits of independent study toward the electives.

TRACKS

A grade of C- or higher is required. No Satisfactory/Unsatisfactory (S/U) grade will be accepted.

Aerospace Track

A student may specialize in aerospace engineering once a solid background in the fundamentals of mechanical engineering has been developed through the basic Mechanical Engineering courses. This track requires knowledge and background in several fields including advanced dynamics, flight mechanics, propulsion, aerospace materials and structures, signal processing, control systems, astrophysics, and space systems.

Required Courses

At least five courses are required. These required courses can be counted toward the Mechanical Engineering Elective and Technical

Elective requirements. A sixth course is highly recommended, though not required.

Code	Title	Credits
Complete five courses from the following:		15
AS.171.321	Introduction to Space, Science, and Technology	
AS.270.318	Remote Sensing of the Environment	
EN.530.418	Aerospace Structures	
	or EN.530.61 Aerospace Structures	
EN.530.424	Dynamics of Robots and Spacecraft	
	or EN.530.62 Dynamics of Robots and Spacecraft (Graduate)	
EN.530.425	Mechanics of Flight	
EN.530.427	Intermediate Fluid Mechanics	
	or EN.530.62 Intermediate Fluid Mechanics (graduate)	
EN.530.432	Jet & Rocket Propulsion	
EN.530.438	Aerospace Materials	
	or EN.530.63 Aerospace Materials	
EN.530.470	Space Vehicle Dynamics & Control	
EN.530.483	Applied Computational Modeling in Aerodynamics and Heat Transfer	
<i>Total Credits</i>		15

Biomechanics Track

A student may specialize in biomechanics once a solid background in the fundamentals of mechanical engineering has been developed through the core Mechanical Engineering or Engineering Mechanics courses. The essence of mechanics is the interplay between forces and motion. In biology, mechanics is important at the macroscopic, cellular, and subcellular levels.

At the macroscopic length scale, biomechanics of both soft and hard tissues plays an important role in computer-integrated surgical systems and technologies (e.g., medical robotics). At the cellular level, issues such as cell motility and chemotaxis can be modeled as mechanical phenomena. At the subcellular level, conformational transitions in biological macromolecules can be modeled using molecular dynamics simulation, which is nothing more than computational Newtonian mechanics; statistical mechanics or using coarse-grained techniques that rely on principles from the mechanics of materials. In addition, much of structural biology can be viewed from the perspective of Kinematics (e.g., finding spatial relationships in data from the Protein Data Bank).

Required Courses

At least four courses are required. These required courses can be counted toward the Mechanical Engineering Elective and Technical Elective requirements.

Code	Title	Credits
Complete at least two courses from the following:		6
EN.510.426	Biomolecular Materials I - Soluble Proteins and Amphiphiles	
EN.530.410	Biomechanics of the Cell	
EN.530.441	Introduction to Biophotonics	
EN.530.445	Introduction to Biomechanics	
EN.530.448	Biosolid Mechanics	
EN.530.469	Locomotion Mechanics: Recent Advances	
	or EN.530.66 Locomotion Mechanics: Recent Advances	
EN.530.672	Biosensing & BioMEMS	

Complete additional two courses from the following or from the list above: 6-8

EN.520.495	Microfabrication Laboratory	
EN.530.436	Bioinspired Science and Technology	
EN.530.443	Fundamentals, Design Principles and Applications of Microfluidic Systems	
EN.530.468	Locomotion Mechanics: Fundamentals	
EN.530.474	Effective and Economic Design for Biomedical Instrumentation	
	or EN.530.67 Effective and Economic Design for Biomedical Instrumentation	
EN.530.480	Image Processing and Data Visualization	
EN.580.452	Cell and Tissue Engineering Lab	
EN.580.456	Neural and Rehabilitation Engineering	
EN.580.457	Introduction to Rehabilitation Engineering: Design Lab	

Total Credits 12-14

Sample Program of Study

First Year

First Semester	Credits	Second Semester	Credits
AS.030.101	3	AS.110.109	4
AS.110.108	4	EN.500.114	3
EN.530.107	.5	EN.530.108	.5
EN.530.111	2	EN.530.116	1
EN.530.115	1	EN.530.124	2
EN.530.123	3	Writing Intensive (also counted as Humanities/Social Sciences)	3
First-Year Seminar	3	Humanities/Social Sciences	3
16.5		16.5	

Second Year

First Semester	Credits	Second Semester	Credits
AS.110.202	4	EN.530.202	3
AS.171.102	4	EN.530.212	1
AS.173.112	1	EN.530.215	3
EN.530.231	3	EN.530.216	1
EN.530.232	1	EN.530.241	3
EN.560.201	3	EN.530.243	1
EN.560.211	1	EN.553.291	4
17		16	

Third Year

First Semester	Credits	Second Semester	Credits
EN.530.254	3	EN.530.334	3
EN.530.327	3	EN.530.335	1
EN.530.329	1	EN.530.343	3
EN.530.352	4	EN.530.344	1
EN.553.311	4	Mechanical Engineering Elective	3
		Technical Elective	3
		Humanities/Social Sciences	3
15		17	

Fourth Year

First Semester	Credits	Second Semester	Credits
EN.530.403	4	EN.530.404 (also counted as Writing Intensive)	4
EN.660.463	3	Technical Elective	3
Mechanical Engineering Elective	3	Humanities/Social Sciences	3
Technical Elective	3	Humanities/Social Sciences	3
Humanities/Social Sciences	3		
16		13	

Total Credits 127

¹ Mechanical Engineering encourages students to take a 3-credit discussion-based FYS course.

Accreditation Statement

The BS in Mechanical Engineering degree program is accredited by the Engineering Accreditation Commission of ABET (<https://www.abet.org>), under the General Criteria and the Program Criteria for Mechanical and Similarly Named Engineering programs.

Program Educational Objectives

Our primary objective is to educate an exceptional group of engineers who, after graduation, will be

- successful and on track to become leaders among their peers in industry, government laboratories and
- other organizations, and advanced students in the best graduate programs.

Student Outcomes

Students graduating with a B.S. in Mechanical Engineering will have demonstrated:

1. An ability to identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply both analysis and synthesis in the engineering design process, resulting in designs that meet desired needs.
3. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
4. An ability to communicate effectively with a range of audiences.
5. 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.
6. An ability to recognize the ongoing need for additional knowledge and locate, evaluate, integrate, and apply this knowledge appropriately.
7. An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty.

Enrollments and Graduates

Enrollment*

Term	Total	First-Year	Sophomore	Junior	Senior
Fall 2014	250	65	68	55	62
Fall 2015	247	43	74	69	61
Fall 2016	219	38	40	74	67

Fall 2017	197	39	40	38	80
Fall 2018	173	50	39	44	40
Fall 2019	182	34	52	46	50
Fall 2020	191	49	40	48	54
Fall 2021	193	47	51	37	58
Fall 2022	204	55	61	44	44
Fall 2023	224	68	56	52	48

B.S. Degrees Awarded**

Academic Year	Total
2013-2014	54
2014-2015	55
2015-2016	54
2016-2017	65
2017-2018	75
2018-2019	33
2019-2020	40
2020-2021	45
2021-2022	51
2022-2023	40

* Based on Fall census each year

** Includes, August, December, and May conferrals each academic year