ENGINEERING MECHANICS, BACHELOR OF SCIENCE

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

The mission of the B.S. in engineering mechanics 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 mechanical engineering sciences. The aim of the Engineering Mechanics program is to build competence in the analysis, design, and modeling of fluid and solid systems, and to develop the professional skills necessary to excel as an engineer.

The curriculum is intended to enable graduates to explore fundamental questions in many fields of engineering. Emphasis is placed on the basic sciences (mathematics, physics, and chemistry) and on the analysis, modeling, and design aspects of solid and fluid engineering systems. Although specific core courses are required, the student is encouraged and guided by their advisor to select an individual program of study, within ABET guidelines, according to the student's particular goals. This program of study may range from a general study of mechanics or engineering science to more specialized programs in a variety of areas, such as robotics, fluid dynamics, environmental engineering, mechanics of solids, experimental mechanics, dynamical systems, mechanics of materials, or biomechanics.

This flexibility makes the program ideal for double-majors and for those wishing to tailor a strong foundation for graduate work in a wide range of disciplines. All engineering science and technical elective courses must be at the 300-level or higher. Exceptions can be considered in consultation with the student's advisor, but will be uncommon.

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 Engineering Mechanics.

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 in the fall.

Writing Intensive for BS in Engineering Mechanics

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 courses [1]		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 Engineering Mechanics

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.

Engineering Mechanics 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 on all core Engineering Mechanics courses. 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	4-8
or AS.110.201 & AS.110.302	Linear Algebra and Differential Equations and Applications	
EN.553.311	Intermediate Probability and Statistics	4
Mathematics Elective		4
Total Credits		*23-24*

[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
Basic Science Elective		4
Total Credits		*17*

[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 to learn 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. If option 2 is chosen, then the AP Computer Science credit will count towards the computing requirement and EN.601.220 or EN.601.226 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.

*** Correction 10/30/2024: EN.601.226 was inadvertently mislabled 661.626 at publication.

ENGINEERING MECHANICS CORE 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
or EN.530.405	Mechanics of Advanced Engineering Structures	
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.560.201	Statics & Mechanics of Materials	3
EN.560.211	Statics and Mechanics of Materials Laboratory	1
Total Credits		*20*

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*

ENGINEERING SCIENCE ELECTIVES

Code	Title	Credits
One Dynamics course		
One Fluid Mechanics course		
One Materials course		
One Solid Mechanics course		
Total Credits		*12-14*

Dynamics Courses

Code	Title	Credits
EN.530.343	Design and Analysis of Dynamical Systems	3
EN.530.420	Robot Sensors/Actuators	4
EN.530.421	Mechatronics	3
EN.530.424	Dynamics of Robots and Spacecraft	3

EN.530.470	Space Vehicle Dynamics & Control	3
EN.553.391	Dynamical Systems	4

Fluid Mechanics Courses

Code	Title	Credits
EN.530.425	Mechanics of Flight	3
EN.530.427	Intermediate Fluid Mechanics	3
or EN.530.627	Intermediate Fluid Mechanics (graduate)	
EN.530.432	Jet & Rocket Propulsion	3
EN.530.464	Energy Systems Analysis	3
or EN.530.664	Energy Systems Analysis (graduate)	
EN.530.483	Applied Computational Modeling in Aerodynamics and Heat Transfer	3
or EN.530.683	Applied Computational Modeling in Aerodynamics and Heat Transfer	

Materials Courses

Code	Title	Credits
EN.510.311	Structure Of Materials	3
EN.510.313	Mechanical Properties of Materials	3
EN.510.314	Electronic Properties of Materials	3
EN.510.315	Physical Chemistry of Materials II	3
EN.530.352	Materials Selection	4
EN.530.405	Mechanics of Advanced Engineering Structures	3
EN.530.414	Computer-Aided Design	3
EN.530.418	Aerospace Structures	3
or EN.530.619	Aerospace Structures	
EN.530.438	Aerospace Materials	3
or EN.530.638	Aerospace Materials	
EN.530.455	Additive Manufacturing	3
or EN.530.655	Additive Manufacturing (Graduate)	
EN.530.605	Mechanics of Solids and Materials	3
EN.530.606	Mechanics of Solids and Materials II	3
EN.560.330	Foundation Design	3
EN.560.730	Finite Element Methods	3

Solid Mechanics Courses

Code	Title	Credits
EN.530.405	Mechanics of Advanced Engineering Structures	3
EN.530.414	Computer-Aided Design	3
EN.530.418	Aerospace Structures	3
or EN.530.619	Aerospace Structures	
EN.530.430	Applied Finite Element Analysis	3
EN.530.438	Aerospace Materials	3
or EN.530.638	Aerospace Materials	
EN.530.448	Biosolid Mechanics	3
EN.530.605	Mechanics of Solids and Materials	3
EN.530.606	Mechanics of Solids and Materials II	3
EN.530.655	Additive Manufacturing (Graduate)	3
EN.560.330	Foundation Design	3

TECHNICAL ELECTIVES

Code	Title	Credits
Courses that have Engineering, Quantitative, or Natural Science area designations at 300-level or higher [1]		
Total Credits		*18*

1 Students should consult their advisor about the technical elective courses.

2 A maximum of six credits of letter-graded Customized Academic Learning (CAL) may be applied towards the 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 elective.

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 Engineering Mechanics 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.

Students pursuing the Aerospace Engineering Track must take at least five of the following courses, which can be counted toward the Engineering Science Elective and Technical Elective requirements in the general Engineering Mechanics program. A sixth course is highly recommended, though not required.

Required Courses

At least five courses are required. These required courses can be counted toward the Engineering Science 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.530.619	Aerospace Structures	
EN.530.424	Dynamics of Robots and Spacecraft	
or EN.530.624	Dynamics of Robots and Spacecraft (Graduate)	
EN.530.425	Mechanics of Flight	
EN.530.427	Intermediate Fluid Mechanics	
or EN.530.627	Intermediate Fluid Mechanics (graduate)	
EN.530.432	Jet & Rocket Propulsion	

EN.530.438	Aerospace Materials	
or EN.530.638	Aerospace Materials	
EN.530.470	Space Vehicle Dynamics & Control	
EN.530.483	Applied Computational Modeling in Aerodynamics and Heat Transfer	
Total Credits		*15*

Biomechanics Track

Engineering Mechanics is a highly flexible program offered by the Department of Mechanical Engineering, which is ideal for students who want to specialize in any area of mechanics, including biomechanics. 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, 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 (nothing more than computational Newtonian mechanics), statistical mechanics, or 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 six courses are required. Courses should be concentrated either at the cellular/subcellular length scale or in macroscopic biomechanics. These courses can be counted toward the Engineering Science Elective and Technical Elective requirements.

Code	Title	Credits
Complete at least six courses from the following:		18-20
AS.020.305	Biochemistry	
AS.020.363	Developmental Biology	
EN.520.495	Microfabrication Laboratory	
EN.530.410	Biomechanics of the Cell	
EN.530.429	Musculoskeletal Biomechanics	
EN.530.436	Bioinspired Science and Technology	
EN.530.441	Introduction to Biophotonics	
EN.530.445	Introduction to Biomechanics	
EN.530.448	Biosolid Mechanics	
EN.530.468	Locomotion Mechanics: Fundamentals	
or EN.530.668	Locomotion Mechanics: Fundamentals	
EN.530.469	Locomotion Mechanics: Recent Advances	
or EN.530.669	Locomotion Mechanics: Recent Advances	
EN.530.474	Effective and Economic Design for Biomedical Instrumentation	
or EN.530.674	Effective and Economic Design for Biomedical Instrumentation	
EN.530.493	Fabrication of Biomaterials, Engineered Tissues and Food	
EN.530.672	Biosensing & BioMEMS	
EN.540.409	Dynamic Modeling and Control	
EN.540.440	Micro/Nanotechnology: The Science and Engineering of Small Structures	
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		*18-20*

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 count as Humanities/Social Sciences)	3
First-Year Seminar[1]	3	Basic Science Elective	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.553.291	4
EN.560.201	3	Humanities/Social Science	3
EN.560.211	1		
	17		**15**

Third Year

First Semester	Credits	Second Semester	Credits
EN.530.327	3	Engineering Science elective	3
EN.530.329	1	Engineering Science elective	3
EN.553.311	4	Technical Elective	3
Engineering Science elective	3	Mathematics Elective	4
Technical Elective	3	Humanities/Social Sciences	3
Humanities/Social Sciences	3		
	17		**16**

Fourth Year

First Semester	Credits	Second Semester	Credits
EN.530.403	4	EN.530.404 (also count as Writing Intensive)	4
Engineering Science elective	3	Technical Elective	3
Technical Elective	3	Technical Elective	3
Humanities/Social Sciences	3	Technical Elective	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 Engineering Mechanics degree program is accredited by the Engineering Accreditation Commission of ABET (https://www.abet.org), under the General Criteria and the Program Criteria for Engineering Mechanics and Similarly Named Engineering programs.

Program Educational Objectives

The educational objectives for the B.S. in engineering mechanics degree are designed to educate a select group of science-oriented engineers who, after graduation, will be successful and on track to become leaders among their peers

- in the best graduate programs in engineering, science, medical schools, or law schools, and
- in industry, government laboratories, and other organizations.

Student Outcomes

Students graduating with a B.S. in Engineering Mechanics 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	15	5	2	6	2
Fall 2015	14	1	6	3	4
Fall 2016	12	1	2	4	5
Fall 2017	11	1	2	2	6
Fall 2018	8	3	1	2	2
Fall 2019	9	2	3	1	3
Fall 2020	8	3	-	4	1
Fall 2021	11	3	3	-	5
Fall 2022	11	3	3	4	1
Fall 2023	8	1	2	3	2

B.S. Degrees Awarded**

Academic Year	Total
2014-2015	1
2015-2016	3
2016-2017	5
2017-2018	3
2018-2019	2
2019-2020	3
2020-2021	1
2021-2022	4
2022-2023	1

* Based on Fall census each year

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