MECHANICAL ENGINEERING, BACHELOR OF SCIENCE

B.S. Mechanical Engineering

The BS in the **Mechanical Engineering** degree program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org (https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.abet.org%2F&data=05%7C01%7Cme-academic%40jhu.edu%7Ca42e4cf34fd34c670ef808db66b2b673%7C9fa4f438b1e6473b803f86f8aedf0dec%7C0%7C0%7C638216689974317674%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=r7t7aMe68f1%2FIo0U6FsGLJTJB2JPJbK%2B2mGrjn3E6tY%3D&reserved=0), 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 mechanical engineering sciences. The aim of the Mechanical Engineering program is to build competence in the design and development of thermal, fluid, and mechanical systems, to promote a broad knowledge of the contemporary social and economic context, and to develop the communication skills necessary to excel.

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 faculty 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 and design, heat transfer and energy, robotics, and biomechanics. The student's faculty advisor can provide guidance on these focus areas.

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.

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.

Program Requirements

See also General Requirements (https://e-catalogue.jhu.edu/ksas-wse/undergraduate-policies/academic-policies/requirements-bachelors-degree/) for Departmental Majors and the department's undergraduate advising manuals (https://me.jhu.edu/education/undergraduate-studies/advising/).

The Mechanical Engineering curriculum is structured as follows:

Code	Title	Credits
MATHEMATICS [1]		
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	
Linear Algebra and Differential Equations (select one of the options)		
Option 1		
EN.553.291	Linear Algebra and Differential Equations	4
Option 2		
AS.110.201 & AS.110.302	Linear Algebra and Differential Equations and Applications	8
Statistics Elective at 300-level or above [2]		
EN.553.311	Intermediate Probability and Statistics	4
SCIENCES [1]		
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
EN.530.123	Introduction to Mechanics I	3
EN.530.124	Intro to Mechanics II	2
HUMANITIES AND SOCIAL SCIENCES		
Select one humanities and/or social science elective that is also writing-intensive [3]		3
Select five humanities and/or social science electives [3,4]		15
INTRODUCTORY ENGINEERING AND COMPUTING [1]		
EN.500.114	Gateway Computing: Matlab (AP Computer Science not accepted) [8]	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	2
EN.530.115	MechE Freshman Lab I	1
EN.530.116	MechE Freshman Lab II	1
REQUIRED ENGINEERING COURSES [1]		
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 (select one of the options)		
Option 1		
EN.530.241 & EN.530.243	Electronics & Instrumentation and Electronics and Instrumentation Laboratory [5]	4
Option 2		
EN.520.230 & EN.520.231	Mastering Electronics and Mastering Electronics Laboratory	5
Manufacturing (select one of the options)		
Option 1		
EN.530.254	Manufacturing Engineering	3
Option 2		
EN.530.204 & EN.530.205	Manufacturing Engineering Theory and Manufacturing Engineering Laboratory	3
Management and Leadership (select one of the options)		
Option 1		
EN.660.463	Engineering Management & Leadership	3
Option 2		
EN.660.105 & EN.660.341	Foundations of American Enterprise and Process Innovation and Quality Management	6
Capstone Design [1,7]		
EN.530.403 & EN.530.404	MechE Senior Design Project I and MechE Senior Design Project II	8
MECHANICAL ENGINEERING ELECTIVES [1]		
Select three courses (300-level or higher) in mechanical engineering		9
TECHNICAL ELECTIVES [1]		
Select three engineering, quantitative studies, or natural sciences courses at or above the 300-level, chosen from any combination of courses in engineering, basic sciences, or mathematics selected in consultation with the student's advisor. [6]		9
Total Credits: 126 - 127		

1. Grades below C- not accepted.
2. Other qualified statistics courses can be taken upon the faculty advisor's approval.
3. Six humanities and/or social science electives, of which one must specifically teach writing as a writing-intensive course. See the Distribution tab in the Requirements for a Bachelor's Degree section for two exceptions to the rule that each H/S distribution course be at least 3 credits. Visit Requirements for Bachelor's Degree (https://e-catalogue.jhu.edu/ksas-wse/undergraduate-policies/academic-policies/requirements-bachelors-degree/) for information.
4. To obtain coherence and depth in these humanities and social science electives, at least six credits must be at the 300-level or higher, though with advisor approval, the 300-level or higher course(s) can be replaced by the equivalent number of credits of intermediate language or advanced language courses. While a course grade of C- or higher is preferred, up to 10 credits with a D or D+ grade will be accepted. For more details, see the undergraduate academic advising manual (https://me.jhu.edu/education/undergraduate-studies/advising/).
5. EN.520.230 Mastering Electronics is the alternate effective Fall 2017.
6. These courses are intended to complement the mechanical engineering electives. One of the three technical electives may be a computer language course taken at any level.
7. EN.530.404 Senior Design is counted as the second writing-intensive course requirement. A grade of C- or higher must be earned for both EN.530.403 and EN.530.404 Senior Design to count toward the degree.
8. Students who scored a 5 on the AP Computer Science exam have the option to take:
   1. One of the Gateway Computing Courses (EN.500.113 Gateway Computing: Python or EN.500.114 Gateway Computing: Matlab) and forfeit the AP credits for EN.500.112 Gateway Computing: JAVA, OR
   2. EN.601.220 Intermediate Programming, EN.601.226 Data Structures, or another programming course that is at least three credits approved by the student's faculty advisor, in which the AP Computer Science credits will count towards the student's core computing requirement, (replacing Gateway Computing). EN.601.220 or EN.661.226 could count as a Technical Elective.

A program of not less than 125 credits must be completed to be eligible for the bachelor's degree. All undergraduate students must follow a program approved by a faculty member in the department who is selected as the student's advisor.

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. Students pursuing the Aerospace Engineering Track are required to take at least five of the following courses (which can be counted toward the Mechanical Engineering elective and Technical Elective requirements in the general Mechanical Engineering program):

Code	Title	Credits
Any five of the courses listed below are required. A sixth course from this list, though not required is highly recommended.		
AS.171.321	Introduction to Space, Science, and Technology	3
AS.270.318	Remote Sensing of the Environment	3
EN.530.418	Aerospace Structures	3
or EN.530.619	Aerospace Structures	
EN.530.424	Dynamics of Robots and Spacecraft	3
or EN.530.624	Dynamics of Robots and Spacecraft (Graduate)	
EN.530.425	Mechanics of Flight	3
EN.530.427	Intermediate Fluid Mechanics	3
EN.530.432	Jet & Rocket Propulsion	3
EN.530.438	Aerospace Materials	3
EN.530.470	Space Vehicle Dynamics & Control	3
EN.530.483	Applied Computational Modeling in Aerodynamics and Heat Transfer	3
EN.530.619	Aerospace Structures	3
EN.530.627	Intermediate Fluid Mechanics (graduate)	3

EN.530.638	Aerospace Materials	3

Other courses relevant to the track which don't count toward the requirements include:

AS.171.118	Stars and the Universe: Cosmic Evolution	
Total Credits		**39**

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.

Each student who pursues the Biomechanics track will, in consultation with their academic advisor, choose the set of technical and mechanical engineering course electives that best matches the student's interests. Upon completion of the track, notification of this achievement is placed on the student's academic record and transcript.

A student may specialize in biomechanics once a solid background in the fundamentals of mechanical engineering has been developed through the basic courses. Students pursuing the biomechanics concentration within mechanical engineering are required to take at least four of the following courses. Two among the four should be chosen from the biomechanics-oriented courses, as noted in the footnote below.

Code	Title	Credits
EN.520.495	Microfabrication Laboratory	4
EN.530.410	Biomechanics of the Cell [1]	3
EN.530.426	Biofluid Mechanics [1]	3
EN.530.436	Bioinspired Science and Technology	3
EN.530.441	Introduction to Biophotonics	3
EN.530.443	Fundamentals, Design Principles and Applications of Microfluidic Systems	3
EN.530.445	Introduction to Biomechanics [1]	3
EN.530.448	Biosolid Mechanics [1]	3
EN.530.468	Locomotion Mechanics: Fundamentals	3
EN.530.469	Locomotion Mechanics: Recent Advances	3
EN.530.473	Molecular Spectroscopy and Imaging	3
EN.530.474	Effective and Economic Design for Biomedical Instrumentation	4
EN.530.480	Image Processing and Data Visualization	3
EN.530.636	Bioinspired Science and Technology	3
EN.530.643	Fundamentals, Design Principles and Applications of Microfluidic Systems	3
EN.530.668	Locomotion Mechanics: Fundamentals	3
EN.530.669	Locomotion Mechanics: Recent Advances	3
EN.530.672	Biosensing & BioMEMS [1]	3
EN.530.674	Effective and Economic Design for Biomedical Instrumentation	4
EN.580.424	Neuroengineering and Lab [2]	3
EN.580.452	Cell and Tissue Engineering Lab	3
EN.580.456	Introduction to Rehabilitation Engineering	3
EN.580.457	Introduction to Rehabilitation Engineering: Design Lab	3

[1] Two of the four Biomechanics track courses should be chosen from these biomechanics-oriented courses.

[2] Prerequisite: EN.580.221 Biochemistry and Molecular Engineering, and AS.110.302 Differential Equations and Applications

Sample Program of Study

First Year

First Semester	Credits	Second Semester	Credits
AS.110.108	4	AS.110.109	4
AS.030.101	3	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	Humanities/Social Sciences Elective - Writing	3
Humanities/Social Sciences Elective[1]	3	Humanities/Social Sciences 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.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
Statistics Elective	4	Mechanical Engineering Elective	3
		Technical Elective	3
		Humanities/Social Sciences Elective	3
	15		**17**

Fourth Year

First Semester	Credits	Second Semester	Credits
EN.530.403	4	EN.530.404	4
EN.660.463	3	Mechanical Engineering Elective	3
Mechanical Engineering Elective	3	Technical Elective	3
Technical Elective	3	Humanities/Social Sciences Elective	3
Humanities/Social Sciences Elective	3		
	16		**13**

Total Credits 127

[1] If you are bringing in exam or transfer credit that affords you space in the recommended schedule shown above, you may consider enrolling in an optional First-Year Seminar (FYS) during the fall semester. FYS courses carry course numbers EN.501.xxx.