GENERAL ENGINEERING

The General Engineering program offers both a B.A. with a major in general engineering and a number of non-departmental courses.

Bachelor of Arts in General Engineering

The Bachelor of Arts in General Engineering is a liberal arts degree that is designed to provide students with both a focus in some area of humanities or social sciences and the fundamental engineering principles needed to understand modern technology, innovations, and engineering practices. It is intended for undergraduate students who desire a background in engineering and technology yet have neither the desire nor the intention to become professional engineers. These students may, for example, plan to pursue graduate or professional study in architecture, business, law (e.g., intellectual property, patent law), or medicine. They may wish to work in areas which relate to engineering and technology or to thrive in the global industrial economy. The Bachelor of Arts in General Engineering is a true liberal arts degree with an emphasis in engineering.

This degree is not an engineering degree, and is not suitable for employment as a professional engineer. This program is not accredited by ABET. Students desiring careers as professional engineers should complete a B.S. degree in one of the engineering disciplines offered by the Whiting School.

The distinctive features of the Bachelor of Arts in General Engineering include:

- **Breadth.** Course requirements for the Bachelor of Arts in General Engineering encourage breadth, including mathematics, natural sciences, humanities and/or social sciences, international studies (language or courses and experience in a foreign country), and in engineering. The curriculum also allows for many free electives.

- **Flexibility.** This program is designed to allow students, in consultation with their advisor, the flexibility to choose a program of study that matches their interests. The engineering focus area and the humanities and social science requirements may be departmentally based or may follow a theme designed by the student and his/her advisor. Students are encouraged to minor in any area of their choosing.

- **Interdisciplinary Study.** The distribution requirements are ideal for students who seek to understand areas at the interface between technical fields (such as robotics, nanotechnology, and biomaterials) or the connections between a technical area and a discipline in the humanities or social sciences (for example environment issues and international trade or ethics and biotechnology).

- **International Dimensions of Engineering.** Students are required to develop knowledge of the international dimensions of engineering. They may do this by studying abroad or by taking a combination of language and other classes that develop an understanding of the culture, technology, or society in a foreign country.

Requirements for the B.A. Degree

All undergraduate students majoring in the Bachelor of Arts in General Engineering must follow a program approved by their advisor. Candidates must fulfill the overall requirements for the bachelor’s degree (http://e-catalog.jhu.edu/undergrad-students/academic-policies/requirements-for-a-bachelors-degree) described in this catalog. These include the university writing requirement, distribution requirement and 120 credit minimum. Sample curricula and details on concentrations can be found in the Advising Manual for general engineering (www.engineering.jhu.edu/academics).

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>20</td>
</tr>
<tr>
<td>Natural Sciences</td>
<td>15</td>
</tr>
<tr>
<td>Humanities and Social Sciences</td>
<td>24</td>
</tr>
<tr>
<td>International Dimensions of Engineering</td>
<td>9-12</td>
</tr>
<tr>
<td>Engineering Core</td>
<td>15</td>
</tr>
<tr>
<td>Engineering Focus Area</td>
<td>20</td>
</tr>
<tr>
<td>Electives (to ensure a minimum of 120 credits total)</td>
<td>17</td>
</tr>
<tr>
<td>Total Credits</td>
<td>120-123</td>
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</tbody>
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**Mathematics (20 credits)**

Mathematics is at the core of modern science and technology and a solid foundation is required to understand how contemporary engineering problems are solved. Students are required to take five courses including:

- AS.110.108 (or AS.110.106) Calculus I 4
- AS.110.109 (or AS.110.107) Calculus II (For Physical Sciences and Engineering) 4
- AS.110.113 Honors Single Variable Calculus 4
- One course in statistics 4
- One course at the 200-level or above in either statistics or mathematics 4
- One mathematics or statistics elective 4

| Total Credits | 20 |

**Natural Sciences (15 credits)**

Students are required to take four courses and two laboratory courses including:

- AS.171.101 General Physics: Physical Science Major I * 3-4
- AS.171.103 General Physics I for Biological Science Majors
- AS.171.105 Classical Mechanics I
- AS.171.107 General Physics for Physical Sciences Majors (AL)
- EN.530.123 Introduction to Mechanics I

At least one course chosen from the following: 3

- AS.030.101 Introductory Chemistry I
- AS.030.107 Chemical Principles w/lab: An Integrated Studio Course

Two terms of laboratory course (Integrated lab from AS.030.107 may count as 1 lab) 2

Two elective courses (area code N) 6

| Total Credits | 14-15 |

* EN.530.123, Introduction to Mechanics I, may be used to satisfy the Natural Sciences requirement if taken in conjunction with EN.530.124, Introduction to Mechanics II. EN.530.124 is a new course offering that will be taught in Spring 2018.

**Humanities and Social Sciences (24 credits)**

*Writing Requirement.* Students must complete at least four (minimum of 12 credits) writing intensive courses (catalog code W) and one of these courses must specifically develop writing skills, such as EN.661.110
Professional Writing and Communication or AS.060.113 Expository Writing.

**Humanities or Social Science Focus.** A minimum of four courses (12 credits) must be taken as a coherent group in either the humanities or social sciences, of which two are at the advanced (300+) level.

**Humanities or Social Science Elective.** Three additional courses (9 credits) in either the humanities or social sciences. These electives are typically used to take courses in economics and the history of science and technology, depending on the courses chosen to fulfill the concentration requirements detailed above.

**International Dimensions of Engineering**
Because of the importance of the globalization of technology, all students completing the B.A. in general engineering are required to demonstrate competence in being able to address technical issues within the context of another society. This can be done in one of three different ways.

**First,** students are encouraged to study abroad for a minimum of one fall or one spring semester in any foreign country (except Canada). In that country, they must take the equivalent of a minimum of 12 credits which are transferred to their Hopkins transcript. In this case, these credits can satisfy any degree requirements (Humanities or Social Sciences, Engineering Concentration, Mathematics, Free Electives, etc.).

**Second,** students may complete the equivalent of two semesters of the same foreign language (students may not use language courses in their native language to satisfy this requirement) and one additional course which relates to the culture, economy, social structure, or politics of a country to which uses this foreign language (9 credits).

**Third,** students may demonstrate proficiency in a foreign language by taking an intermediate course in a foreign language (this can include their native tongue) and two additional courses which relate to the culture, economy, social structure, or politics of a country which uses this foreign language (9 credits).

**Engineering Core (15 credits)**
One course (3 credits) that is an introduction to an engineering discipline. Examples include:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN.500.101</td>
<td>What Is Engineering?</td>
<td>3</td>
</tr>
<tr>
<td>EN.520.137</td>
<td>Introduction To Electrical &amp; Computer Engineering</td>
<td>3</td>
</tr>
<tr>
<td>EN.530.111</td>
<td>Intro to MechE Design and CAD</td>
<td>2</td>
</tr>
<tr>
<td>EN.560.141</td>
<td>Perspectives on the Evolution of Structures</td>
<td>3</td>
</tr>
<tr>
<td>EN.570.108</td>
<td>Introduction Environmental Engineering</td>
<td>3</td>
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</tbody>
</table>

One course (at least 3 credits) in a computer language. Examples include:

<table>
<thead>
<tr>
<th>Course</th>
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</tr>
</thead>
<tbody>
<tr>
<td>EN.500.112</td>
<td>Gateway Computing</td>
<td>3</td>
</tr>
<tr>
<td>EN.601.220</td>
<td>Intermediate Programming</td>
<td>4</td>
</tr>
</tbody>
</table>

Three courses in the fundamentals of engineering science (at least one course from three of the following four areas):

**Area 1: Circuits**
EN.520.230 Mastering Electronics

**Area 2: Statics**
EN.530.201 Statics and Mechanics of Materials
or EN.560.201 Statics & Mechanics of Materials

**Area 3: Materials Science**
EN.510.201 Introductory Materials Science for Engineers or EN.510.311 Structure Of Materials

**Area 4: Thermodynamics**
EN.530.231 Mechanical Engineering Thermodynamics or EN.540.203 Engineering Thermodynamics

**Engineering Focus Area (20 credits)**
The engineering focus area must consist of at least six courses (minimum of 20 credits) that are related thematically or departmentally; at least three (3) of which must be at the advanced level (300 or above). While examples of focus areas are provided in the Advising Manual, students are encouraged to develop their own focus areas in consultation with their faculty advisor.

**Free Electives**
Between five and nine full courses (at least 3 credits each) to ensure a minimum of 120 credits in total. The number of courses required will depend on how the International Dimensions requirement is satisfied and on the courses chosen in other areas. Students must select these courses in consultation with their advisor. These free electives are designed to allow students to develop a curriculum of study uniquely suited to their interests.

Students are required to have a minimum cumulative GPA of 2.0 to graduate. Further, a maximum of 12 "D" credits may be counted toward degree requirements. There is a maximum limit of six "D" credits in any combination of courses used to satisfy the Humanities or Social Sciences focus, the Engineering Core and the Engineering Focus Area (47 total credits).

For current faculty and contact information go to http://engineering.jhu.edu/academics/general-engineering/people/

**Faculty**

**Chair**
Michael Falk
Professor (Materials Science & Engineering, Mechanical Engineering, Physics) and Vice Dean for Undergraduate Education. Primary Advisor to the General Engineering Program and Chair of the General Engineering Faculty.

**Professors**
Andrew Douglas
Professor (Mechanical Engineering) and Vice Dean for Faculty, Whiting School of Engineering.

Kalina Hristova
Professor (Materials Science and Engineering).

Daniel Naiman
Professor (Applied Mathematics and Statistics).

Erica Schoenberger
Professor (Environmental Health and Engineering).

Scott Smith
Professor (Computer Science)

Howard Weinert
Professor (Electrical and Computer Engineering).
Courses

EN.500.101. What Is Engineering?. 3.0 Credits.
This is a course of lectures, laboratories, and special projects. Its objective is to introduce students not only to different fields of engineering but also to the analytic tools and techniques that the profession uses. Assignments include hands-on and virtual experiments, oral presentations of product design, and design/construction/testing of structures. Freshmen only or Permission Required. Instructor(s): D. Ayhan
Area: Engineering.

EN.500.103. Hopkins Engineering Sampler Seminar. 1.0 Credit.
This course provides students with an overview of the undergraduate programs in the Whiting School of Engineering. Faculty from various departments will introduce students to their discipline including aspects of their personal research. Freshmen only. Instructor(s): M. Falk
Area: Engineering.

EN.500.110. Engineering Innovation. 3.0 Credits.
To introduce engineering ideas, thoughts, and problem-solving to potential engineering students. The course is intended to establish the framework within which engineers typically operate. Registration Requirement: Algebra II with Trig. Open only to high school students admitted to the Engineering Innovation Summer Program. Undergraduates should refer to EN.500.101. Instructor(s): C. VerHulst; K. Borgsmiller.

EN.500.111. Hopkins Engineering Applications & Research Tutorials. 1.0 Credit.
Instructor(s): Staff
Area: Engineering.

EN.500.112. Gateway Computing. 3.0 Credits.
This course introduces fundamental programming concepts and techniques, and is intended for all who plan to develop computational artifacts or intelligently deploy computational tools in their studies and careers. Topics covered include the design and implementation of algorithms using variables, control structures, arrays, functions, files, testing, debugging, and structured program design. Elements of object-oriented programming. Algorithmic efficiency and data visualization are also introduced. Students deploy programming to develop working solutions that address problems in engineering, science and other areas of contemporary interest that vary from section to section. Course homework involves significant programming. Attendance and participation in class sessions are expected. Instructor(s): I. Sekyonda; J. Selinski; M. Darvish Darab
Area: Engineering, Natural Sciences.

EN.500.125. Spatial Reasoning and Visualization for Engineers. 1.0 Credit.
This course will enhance students ability to imagine and mentally manipulate objects in three-dimensional space—a talent that is important in engineering. Through guided practice and fun hands-on activities, students will hone their spatial skills. This course is only for engineering freshmen. Registration is by invitation only, based on the results of the summer spatial reasoning diagnostic assessment. S/U only. Instructor(s): A. Stephens
Area: Engineering.

EN.500.200. Computing for Engineers and Scientists. 4.0 Credits.
This course introduces a variety of techniques for solving problems in engineering and science on a computer using MATLAB. Topics include structure and operation of a computer, the programming language MATLAB, computational mathematics, and elementary numerical analysis. Co-listed with EN.550.200. Prerequisites: Prereqs: AS.110.107 OR AS.110.109
Instructor(s): J. Yoder; K. Hedrick; T. Lebair
Area: Engineering, Quantitative and Mathematical Sciences.

EN.500.401. Research Laboratory Safety. 1.0 Credit.
An introduction to laboratory safety including chemical, biological, radiation, and physical hazards. Includes information on hazard assessment techniques, laboratory emergencies, and general lab standards for Whiting School of Engineering. The class will feature hands-on exercises with real-life experiments. Intended for students who have not yet begun working in a research laboratory. Instructor(s): D. Kuespert.

EN.500.402. Interdisciplinary Engineering Design I. 4.0 Credits.
This is the first semester of a two-semester long course intended to engage students in the art of engineering design while working on interdisciplinary teams. Student teams must apply for and be accepted into this course prior to registering as a team. Teams must include students from more than one major. Students working in teams of three to six will select a small-scale, industry-suggested design problem in a designated area. A solution to the problem is devised and constructed by the team within limited time and cost boundaries. Oral reports related to the design work will be presented at regular intervals. A substantial prototype with preliminary test results is expected at the end of the first semester. A final device, product, system or method, with evidence of evaluation against project requirements, is expected at the end of the second semester. Area: Engineering, Natural Sciences.

EN.500.403. Interdisciplinary Engineering Design II. 4.0 Credits.
This is the second semester of a two-semester long course intended to engage students in the art of engineering design while working on interdisciplinary teams. Student teams must apply for and be accepted into this course prior to registering as a team. Teams must include students from more than one major. Students working in teams of three to six will select a small-scale, industry-suggested design problem in a designated area. A solution to the problem is devised and constructed by the team within limited time and cost boundaries. Oral reports related to the design work will be presented at regular intervals. A substantial prototype with preliminary test results is expected at the end of the first semester. A final device, product, system or method, with evidence of evaluation against project requirements, is expected at the end of the second semester. Area: Engineering, Natural Sciences.
EN.500.496. Practical Ethics for Future Leaders. 3.0 Credits.
This is a new interdisciplinary course on leadership, decision making, and the application of ethics to real world problems. JHU students are future leaders of innovation across many fields, including but not limited to engineering, business, law, journalism, government, science and medicine. The goal of this new course is to give students a deep and practical grounding in how leaders make decisions, and in particular difficult decisions where there is no clearly right answer. In the first part of the course, we will cover important concepts in the practical application of ethics; in decision making; and leadership. In the second part of the course, we will take a deep look at major ethical issues resulting from the newfound capabilities made possible by emerging technologies. This term, the main question will be, should humans eliminate disease-carrying mosquitoes using gene editing technology? In future terms, the question will be different. The awesome power of emerging technologies to modify our world - our food supply, our health, even people - will only increase and become more pressing in coming years. Questions include: Is modifying wild animals ethical, on its face? Who gets to decide this, and how do they decide? Animals interact with humans and cross borders - can one jurisdiction (county, state or country) make changes to wild populations that would impact others? Both EN.500.496 and EN.500.497 are primarily a combination of online lectures, readings and substantial discussion components during the first 2/3rds of the semester. EN.500.496.01 also incorporates several small group meetings in the final weeks of the semesters.
Prerequisites: If you have already taken EN.500.497, you cannot take EN.500.496.
Instructor(s): D. Mathews; F. Macgabhann; I. Gannot
Area: Humanities, Social and Behavioral Sciences.

EN.500.497. Practical Ethics for Future Leaders. 2.0 Credits.
This is a new interdisciplinary course on leadership, decision making, and the application of ethics to real world problems. JHU students are future leaders of innovation across many fields, including but not limited to engineering, business, law, journalism, government, science and medicine. The goal of this new course is to give students a deep and practical grounding in how leaders make decisions, and in particular difficult decisions where there is no clearly right answer. In the first part of the course, we will cover important concepts in the practical application of ethics; in decision making; and leadership. In the second part of the course, we will take a deep look at major ethical issues resulting from the newfound capabilities made possible by emerging technologies. This term, the main question will be, should humans eliminate disease-carrying mosquitoes using gene editing technology? In future terms, the question will be different. The awesome power of emerging technologies to modify our world - our food supply, our health, even people - will only increase and become more pressing in coming years. Questions include: Is modifying wild animals ethical, on its face? Who gets to decide this, and how do they decide? Animals interact with humans and cross borders - can one jurisdiction (county, state or country) make changes to wild populations that would impact others? Both EN.500.496 and EN.500.497 are primarily a combination of online lectures, readings and substantial discussion components during the first 2/3rds of the semester. EN.500.496.01 also incorporates several small group meetings in the final weeks of the semesters.
Prerequisites: If you have already taken EN.500.497, you cannot take EN.500.496.
Instructor(s): D. Mathews; F. Macgabhann; I. Gannot
Area: Humanities, Social and Behavioral Sciences.

EN.500.501. SAB/JHU General Engineering Research (Abroad). 3.0 Credits.
General Engineering Research Project Abroad for undergraduate participating on summer projects with NUS, EPFL, SJTU, and DTU. Permission required.
Instructor(s): Staff.

Instructor(s): Staff.

EN.500.601. Research Laboratory Safety. 1.0 Credit.
This course provides practical exercises in laboratory safety, employing information on chemical, physical, radiation, and biological hazards. Exercises include topics such as ethics, inherently safer design, and application of safety knowledge and analysis to analyze real and/or constructed experiments. The course is suitable for experienced researchers and for graduate students who have not yet begun working in a research laboratory in Homewood Schools. The course is given on six consecutive weeks in the latter half of the semester to allow time for students to study preliminary materials and take online exams on Blackboard. The preliminary material must be completed before the first class in order to progress in the course unless permission is obtained from the instructor. Offered Spring and Fall semesters.
Instructor(s): D. Kuespert.

EN.500.602. Seminar: Environmental and Applied Fluid Mechanics. 1.0 Credit.
Instructor(s): J. Katz.

EN.500.603. Academic Ethics.
Instructor(s): C. Kavanagh.

EN.500.745. Seminar in Computational Sensing and Robotics. 1.0 Credit.
Seminar series in robotics. Topics include: Medical robotics, including computer-integrated surgical systems and image-guided intervention. Sensor based robotics, including computer vision and biomedical image analysis. Algorithmic robotics, robot control and machine learning. Autonomous robotics for monitoring, exploration and manipulation with applications in home, environmental (land, sea, space), and defense areas. Biorobotics and neuromechanics, including devices, algorithms and approaches to robotics inspired by principles in biomechanics and neuroscience. Human-machine systems, including haptic and visual feedback, human perception, cognition and decision making, and human-machine collaborative systems. Cross-listed Mechanical Engineering, Computer Science, Electrical and Computer Engineering, and Biomedical Engineering.
Instructor(s): L. Whitcomb; P. Kazanzides.

EN.500.781. Preparation for University Teaching. 1.5 Credits.
This course will prepare graduate students to teach at the university level. Topics covered include large and small class teaching, characteristics of student learning, syllabus construction, grading students, and developing a teaching portfolio. Full-time EN Graduate Students only. Co-listed with AS.360.781.
Instructor(s): R. Shingles.

EN.500.851. Engineering Research Practicum. 1.0 - 9.0 Credits.
Instructor(s): Staff.
Cross Listed Courses

Civil Engineering
EN.560.141. Perspectives on the Evolution of Structures. 3.0 Credits.
Why do buildings and bridges look the way they do today? Students will be provided the tools to answer this question for themselves through a study of the history of the design of buildings and bridges throughout the world from both engineering and architectural/aesthetic perspectives. Only simple mathematics is required (no calculus). Students will participate in individual and group critique of structures from engineering, architectural, and social points of view.
Instructor(s): B. Schafer; R. Sangree
Area: Engineering, Quantitative and Mathematical Sciences
Writing Intensive.

Institute for NanoBio Technology
EN.670.495. Animation in Nanotechnology & Medicine. 3.0 Credits.
Instructor(s): M. Rietveld; P. Searson
Area: Engineering, Natural Sciences.
EN.670.616. Introduction to NanoBio Tutorials II. 1.0 Credit.
Ph.D. students and postdoctoral fellows in the HHMI/IGERT/PSOC/CCNE/CNTC training programs study and present topics in nanotechnology for biology and medicine.
Instructor(s): P. Searson.
EN.670.695. Animation in Nanotechnology & Medicine. 3.0 Credits.
Instructor(s): M. Rietveld; P. Searson
Area: Engineering, Natural Sciences.