Engineering 101

2022-2023 program planning guide for first-year engineering students

JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING
Welcome to the Whiting School of Engineering at Johns Hopkins University!

We look forward to meeting you this summer. In the meantime, we have prepared the First-Year Academic Guide and Engineering 101 to get you started. The First-Year Academic Guide includes information for all incoming students at Hopkins, while Engineering 101 is directed specifically to engineering students. Engineering 101 contains information about all of the majors in the School of Engineering, including recommended first semester class schedules. You’ll also find out about some opportunities to join student groups. We hope that these materials help you learn about the Hopkins community and the options available to you.

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Introduction

ACADEMIC ADVISING

Engineering students have two advisors: a professional academic advisor in the WSE Office of Undergraduate Academic Advising and a faculty/departmental advisor in your major.

Professional Academic Advisor

In early June, you will be assigned to a professional academic advisor who will reach out to assist with course selection and answer questions related to fall registration. Your professional academic advisor will provide you with detailed feedback of your first-term schedule after registration occurs in July.

During your time at Hopkins, you may speak with your academic advisor about:

- Basic questions about your major
- Possible change of major or addition of a minor
- Difficulties in a class
- Understanding university policies and procedures
- Learning about various campus resources

Your professional academic advisor will be a resource for you during your entire time as a student. You should remain in consistent contact with them throughout your college career. You can contact them directly or if you have a general question that can be addressed by any academic advisor, email wseadvising@jhu.edu.

Each fall and spring semester, the Office of Engineering Advising holds “Drop-In” advising times that students can utilize when they want to receive assistance or information. Students may meet with other advisors in the Office of Engineering Advising during the drop-in hours.

For additional advising information, please visit our Canvas organization site, WSE Academic Advising.

Faculty/Departmental Advisor

In late August, you will be assigned to a faculty/departmental advisor who will work with you throughout your college career. You will first meet with them during Orientation. This meeting time will be scheduled by your department.

During your time at Hopkins, you may speak with a faculty advisor about:

- Curriculum requirements/graduation plan for your major
- Adjusting your current schedule to add/drop/withdraw from a course
- Opportunities at Hopkins, such as research, internships, and/or study abroad

Each term, the Whiting School of Engineering (WSE) schedules an Engineering Advising Week. This is the time when students schedule appointments with their faculty advisors. These mandatory advising meetings will take place in November in order to choose classes for the spring, and in April to choose classes for summer and fall.

Except during Orientation (when you have a set meeting time), getting in touch with your faculty advisor is your responsibility. Learn your advisor’s email address, phone number, and office hours – and make use of them! Faculty advisors generally post office hours when they expect to be available; other times can be arranged by appointment.

Never wait until the last day of a deadline to try to contact your advisor.

Try to have a list of specific questions when you meet with your faculty advisor. Expect your advisor to give you guidance, but don’t expect them to plan your schedule for you!
PREPARING FOR REGISTRATION

You will be choosing your first semester courses using the information in the Engineering Programs and Course Schedule section of this document and the First-Year Academic Guide. Course recommendations are provided based on students’ intended majors.

If you have already chosen your major, you should follow the appropriate departmental program recommendations, as described in the next section.

How to change your major

When you complete your mandatory Advising Profile, you can either confirm the major you selected when you applied to Hopkins, or you can make a new choice (except BME). Whatever major you indicate on the Profile is what we will consider when assigning faculty/departmental advisors. To make changes to your major over the summer after you have submitted the Advising Profile, contact wseadvising@jhu.edu. Beginning in the fall semester, you can change your major by logging into SIS and clicking Online Forms under the Registration tab.

Not sure about your major?

If you are not yet sure about your major, that is okay! Most engineering majors begin with foundational math and science courses in the first year.

If you are an undecided engineer, we strongly encourage you to enroll in one of the following three options in your first semester:

- Hopkins Engineering Sampler Seminar (EN.500.103)
- ‘What is Engineering?’ (EN.500.101)
- An introductory engineering class related to a major that fits your interests, if available

This fall, you can either choose to follow the recommended course schedule for a major that seems interesting to you, or you can follow the program for Undecided Engineering students. A student who follows this program may change to any engineering department (except BME) at the end of the first year and complete the requirements in time to graduate within the normal four-year period.

IMPORTANT NOTES

- First-semester engineering students are eligible to register for a maximum of 18.5 credits. **Credit overloads will not be permitted.**

- Students take classes in the School of Arts and Sciences (calculus, chemistry, physics) as well as in the School of Engineering (introductory engineering courses, computer programming, discrete math). Most first-year engineering students will take math, physics, an introduction engineering course, and often chemistry. This is a normal load. Don’t panic!

- Hopkins courses follow a Monday/Wednesday/Friday or Tuesday/Thursday schedule. Usually, the MWF classes are one hour and the TuTh classes are 1.5 hours. You can schedule classes back-to-back since instructors dismiss class in time for you to get to the next class.

- Many engineering departments offer introductory courses for their discipline, typically in the fall term only.

- Although science lab courses are typically one credit, students will attend lab courses that may range ~2.5 hours per week and have additional assignments to complete outside of the lab. This may make a course load of 15-16 credits feel more like 17-18 credits.

- There is no foreign language requirement for most engineering degrees, but you may take a language as one of your humanities courses. Review the placement test information on pages 33-34 of the First-Year Academic Guide. In addition to the usual language choices, check out the courses offered through the Center for Language Education such as Chinese, Hindi, and Arabic.

- Students in engineering must complete 18 credits (6 courses at least 3 credits each) designated as Humanities (H) and/or Social Science (S). Although elementary language do not carry an area designator, engineering students may use these courses as substitutes for H courses in meeting the distribution requirement. Students may take a specific course pairing of a 2-credit course and a 1-credit course that have been approved to count towards the H/S distribution requirements in place of a single 3-credit course. More information is available in the Catalogue.
• Advisors do not provide specific recommendations on H/S classes because we want you to take subjects that are interesting to you. You can take whatever you are interested in as long as it is an appropriate level and you have fulfilled the pre-requisites. Conducting an Advanced Search on SIS can help you. For example, if you are looking for classes that carry H and/or S distributions, you can select those two things under the AREA section. For LEVEL, select lower level undergraduate. There are other factors you can select as well, such as Writing Intensive, Open Seats Only, etc.

• The undergraduate courses at JHU range from 100 level to 400 level. For example, EN.500.112 is the course number. EN refers to courses offered in the School of Engineering. The three-digit number after EN is the department number (i.e., 500 is the General Engineering department). The three-digit number after the department number is the course number.

xxx.100 – xxx.199: Introductory undergraduate course
xxx.200 – xxx.299: Intermediate undergraduate course
xxx.300 – xxx.499: Advanced undergraduate course, normally not recommended for first-year students, except for a math course, such as AS.110.302 Differential Equations
xxx.500 – xxx.599: Undergraduate independent study and research
xxx.600 – xxx.899: Graduate course

REGISTERING FOR CLASSES
You will register using the Hopkins online registration system SIS, which you can access through the portal, [https://my.jh.edu](https://my.jh.edu). Registration dates are July 25 through August 5.

You can make changes to your schedule until the last day to add, which is September 9. Deadlines to drop and withdraw can be found at the [Registrar’s Office website](https://my.jh.edu). You must be registered for at least 12 credits at all times.

Descriptions about the courses engineering freshmen commonly take can be found in the last section of Engineering 101. A comprehensive list of Fall 2022 courses can be found [online](https://my.jh.edu).

THINGS TO CONSIDER

MATH
The Department of Mathematics offers the following courses that are relevant to engineering students:

• Calculus I, 110.108
• Calculus II, 110.109
• Linear Algebra, 110.201
• Calculus III, 110.202
• Differential Equation, 110.302

Linear Algebra, Calculus III, and Differential Equations may be taken in any order after completing Calculus II.

The following honors courses are available: Honors One Variable Calculus (110.113) and Honors Linear Algebra (110.212). These courses are much more theoretically based and do not delve as in depth on the application side of the material that most engineering disciplines need. Typically, these courses are strongly recommended for students who wish to pursue a mathematics major and/or minor. It is preferred for most engineering students to take the traditional versions of math courses, which should prove to be sufficiently challenging.
Most engineering majors require an upper-level probability and statistics course. However, it is not generally advisable for students to complete Introduction to Probability (EN.553.420) or Introduction to Statistics (EN.553.430) in their first year at JHU, even if they meet the prerequisite. These courses are very challenging and are recommended for a future semester.

All incoming students are encouraged to take the Math Placement Exam, whether they are hoping to receive math credits based upon AP/IB/GCE or other exam scores. If the Math Placement Exam result is not consistent with AP/IB/GCE or other exam score, refer to the math placement guide below or seek advice from the professional academic advisor.

### Math Placement Exam Considerations:
If you are starting with 110.109 or 110.202 based upon the math placement exam (but you do not have exam or transfer credits for 110.108), you will have 4 or 8 deficit credits from Calculus I or II. Thus, you will need to make up the missing credits by taking a higher-level math course later. Once you complete the higher-level course, you cannot go backwards to take a lower-level course.

### Exam Credit Considerations:
Students who earned credits for 110.108 & 110.109 AND take 110.113 will forfeit 4 credits for 110.109.

Students will forfeit 4 or 8 credits of AP/IB/GCE or other exam credits if they retake 110.108 or 110.109 at JHU.
PHYSICS
The Department of Physics offers the following courses that are relevant to engineering students:

• General Physics: Physical Science Majors I and II, 171.101 and 171.102
• General Physics for Physical Science Majors I and II (AL), 171.107 and 171.108. These courses are the exact same material as 171.101/102, but students are introduced to topics before each class so that the classroom time can be devoted to developing a deeper understanding of the content through faculty-guided discussion with peers and problem-solving activities.
• General Physics Laboratory I and II, 173.111 and 173.112. All general physics sequences utilize the same laboratory courses.
• Classical Mechanics I and Electricity and Magnetism I, 171.105 and 171.106. For students with a strong physics background and intending to pursue a second major or minor should consider taking these courses. The courses are less comprehensive than 171.101/107 & 171.102/108, but they cover the material in greater depth.

Exam Credit Considerations: In most majors, students who earn credits for 171.101 and/or 171.102 via exam are waived of the lab requirements, 171.111 and/or 173.112 (check with your major). Students will forfeit the exam credits for the lecture if labs are taken at JHU.

Note: It is highly encouraged that students wait to take General Physics for Physical Science Majors I and lab (171.101/.107 and 173.111) until after they have completed Calculus I (110.108).

Students who have earned Physics Mech and E&M via exam will not forfeit their credits if they decide to take the Classical Physics sequence, 171.105/106 & 173.115/171.116. Students who are pursuing pre-health or pre-med tracks should consult the Guide One: Pre-Med & Pre-Health Planning booklet for guidance regarding course preparation and exam credits. Students should be aware that the 171.105/106 sequence alone is not adequate preparation for the physics portion of the MCAT exam.

Accept AP Credits (4 credits)
Decline AP Credits to Review Material
Fall: AS.171.102/108 & AS.173.112
Spring: AS.171.102/108 & AS.173.112

Accept AP Credits (4 Credits)
Decline AP credits to Review Material
Fall: AS.171.101/107 & AS.173.111
Spring: AS.171.102/108 & AS.173.112
Spring: AS.171.106 & AS.173.116

AP Physics-Mech:
Score of 4 or 5

AP Physics-E&M:
Score of 4 or 5

AP Physics-E-Mech
and/or E&M:
Score of 4 or 5

No AP Physics

Do Not Take Physics I First Term

Attempt Physics I First Term*

Fall: AS.171.105 & AS.173.115
Spring: AS.171.106 & AS.173.116

Fall: AS.171.105 & AS.173.115
Spring: AS.171.106 & AS.173.116
(Pilot Recommended)

Fall: AS.110.108
Spring: AS.171.101 & AS.173.111
(Pilot Recommended)

Fall: AS.110.108 & AS.171.101/107 & AS.173.111
Spring: AS.171.102/108 & AS.173.112
(Pilot Recommended)

* This is not recommended without further discussion with your academic advisor.

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CHEMISTRY

The Department of Chemistry offers the following courses that are relevant to engineering students:

- Introduction to Chemistry I and Lab, 030.101 & 030.105 (offered in fall and summer session I)
- Introduction to Chemistry II and Lab, 030.102 & 030.106 (offered in spring and summer session II)
- Applied Chemical Equilibrium & Reactivity with Lab, 030.103 (offered in fall)
- Organic Chemistry I, 030.205 (offered in fall and summer session I)

Exam Credit Considerations:

Students who are pursuing pre-health or pre-med tracks should consult the Guide One: Pre-Med & Pre-Health Planning booklet for guidance regarding course preparation and exam credits.

If your major requires a year of general chemistry and you do not earn any AP, IB, or GCE chemistry credit, you must take 030.101 & 030.105 in the fall AND 030.102 & 030.106 in the spring.

If you earn an AP score of 4, you will receive 4 credits for 030.101 & 030.105. Students who receive a score of 4 and accept their AP credits CANNOT start with 030.102 & 030.106 in the spring semester. NO EXCEPTION. If your major requires additional semester of general chemistry, you should take 030.103 in the fall.

If you earn an AP score of 5, IB score of 6/7, or GCE grade of A or B: you will receive 8 credits for 030.101 & 030.105 AND 030.102 & 030.106. If you choose to accept all 8 credits, you will have completed one year of general chemistry if your major requires it. If your major or pre-health track require additional chemistry, you can continue on to more advanced chemistry courses, such as Organic Chemistry, 030.205.

If you choose to accept 4 of your AP credits (forfeit 4 credits for 030.101 & 030.105), you should plan to take 030.103 in the fall (NOTE: Students cannot start with 030.102 & 030.106 in the spring if they did not take 030.101 & 030.105 at JHU, NO EXCEPTIONS). If you choose to forfeit all 8 AP credits and start with 030.101 & 030.105 in the fall, you MUST continue the sequence with 030.102 & 030.106 in the spring.
CHEMISTRY PLACEMENT GUIDE

AP Chemistry Score of 3 or lower -or- No AP Chemistry in High School

- No/ 1 Year of any Chemistry in High School
  - Fall: AS.030.101 & AS.030.105 (PILOT Recommended)
  - Spring: AS.030.102 & AS.030.106

- 1+ years of Chemistry in High School
  - Fall: AS.030.101 & AS.030.105
  - Spring: AS.030.102 & AS.030.106

AP Chemistry Score of 4

- 1+ years of Chemistry in High School
  - Fall: AS.030.101 & AS.030.105
  - Spring: AS.030.102 & AS.030.106

- Decline AP Credits
  - Fall: AS.030.101 & AS.030.105
  - Spring: AS.030.102 & AS.030.106

AP Chemistry Score of 5

- Accep all 8 exam credits
  - Fall: AS.030.205*
  - Spring: AS.030.206*

- Accept only 4 exam credits to review material
  - No Chemistry in 1st year
    - Fall of Sophomore Year: AS.030.205*
  - Spring of Sophomore Year: AS.030.206*

- Decline all 8 AP credits to review material
  - Fall: AS.030.103
  - Fall: AS.030.101 & AS.030.105
  - Spring: AS.030.102 & AS.030.106

* If AS.030.205 and AS.030.206 are not required for your major, you do not need to take additional chemistry courses. You should also consult with your academic advisor whether you should take AS.030.205 in your first semester.

FIRST-YEAR SEMINARS

We hope that you will consider taking a First-Year Seminar (FYS) as an introduction to university academic life. While it is not a degree requirement in the School of Engineering, it is our hope that this experience will set the tone for your undergraduate experience by providing you with a small, discussion-based course and the opportunity to work closely with faculty as you explore a variety of topics.

The FYS courses are designed to engage you as a new member of a thriving academic community. They may help ease your transition to college, encourage you to take risks and explore new topics—alone and with your new classmates—while forming bonds with each other and with our faculty, starting on the first day of classes.

Please take a look at the FYS offering in the School of Engineering if this sounds interesting to you! All of our FYS courses are numbered EN.501.1XX if you wish to search for them in SIS. A general description is listed in the Engineering Course Listing section of this publication beginning on page 67.
Applied Mathematics and Statistics

The Department of Applied Mathematics and Statistics is devoted to the study and development of mathematical disciplines especially oriented to the complex problems of modern society. A broad undergraduate and graduate curriculum emphasizes several branches of applied mathematics: probability, the mathematical representation and modeling of uncertainty; statistics, the analysis and interpretation of data; operations research, the design, analysis, and improvement of operations and processes; optimization, the determination of best or optimal decisions; discrete mathematics, the study of finite structures, arrangements, and relations; scientific computation, which includes all aspects of numerical computing in support of the sciences; and financial mathematics, deriving, analyzing, and extending mathematical models of financial markets.

Getting started
There is a one-credit course that has been designed specifically to enhance the educational experience of our freshmen majors, who are strongly encouraged to enroll it.

The Freshman Experience in Applied Mathematics and Statistics 553.101 aims to provide students with an opportunity to work on an interesting project or interesting topic in a small group setting together with an AMS faculty member.

We want our students to learn how to recognize a proof and do them on their own. This skill is emphasized in the Discrete Mathematics courses 553.171/553.172, which can be used to meet the requirement of at least one course in discrete mathematics.

The above-mentioned courses have only high school mathematics as a prerequisite.

Most courses that can be used to satisfy the requirements for the departmental major have Calculus I and II as prerequisites, and at least Calculus III and Linear Algebra as a co-requisite. Students should plan on completing the calculus sequence and taking a course in linear algebra (Linear Algebra 110.201, or Honors Linear Algebra 110.212).
Activities
The department encourages teams of interested undergraduate students to compete in the COMAP (Consortium for Mathematics and its Applications) International Mathematical Contest in Modeling. The teams tackle a given problem (for example, determining the optimal deployment of tollbooths for the New Jersey Turnpike), formulate an approach, and write a detailed report over the course of a weekend; the reports are examined and ranked by a panel of judges.

The department also has an active club called HUSAM—Hopkins Undergraduate Society for Applied Mathematics—which has many opportunities for student participation, involvement, and leadership. The club sponsors and organizes events that help undergraduate students to network, learn about professional and research opportunities, and discover the many different disciplines where applied mathematics plays a key role. Recent events include a discussion panel composed of Johns Hopkins alumni actuaries, a presentation by a vice president of a major financial institution, an exploration of opportunities in the mathematics group at a national defense agency, and a look inside a major operations research consulting firm.

Looking ahead to senior year…Capstone Experience
You may elect to complete a capstone experience. This consists of taking Modeling & Consulting (553.400) in the fall of your senior year followed by a senior thesis (553.501) during the spring. An oral presentation based on the thesis is required.

Bachelor’s/Master’s Program
Highly motivated and exceptionally well-qualified undergraduates may apply for admission to the combined bachelor’s/master’s program in applied mathematics and statistics. Interested students should apply no later than September of their senior year. Additional information is available online at: http://engineering.jhu.edu/ams/bachelors-masters-program/.

What do our graduates go on to do?
• Actuarial profession
• Analyst for a financial institution
• Operations research and consulting
• Biostatistician working with a pharmaceutical company
• Information Security
• Applied mathematician in industry
• Applied mathematician in a policy/regulatory agency
• Data analyst
• Graduate school
• Law school
• Medical School

Recommended schedule

<table>
<thead>
<tr>
<th>Course #</th>
<th>Credit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Semester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman Experience in Applied Math &amp; Statistics*</td>
<td>553.101</td>
<td>1</td>
</tr>
<tr>
<td>Calculus II or III</td>
<td>110.109 or 110.202</td>
<td>4</td>
</tr>
<tr>
<td>Honors Discrete Mathematics**</td>
<td>553.172</td>
<td>4</td>
</tr>
<tr>
<td>Humanities/Social Science course</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Gateway Computing: Python</td>
<td>500.113</td>
<td>3</td>
</tr>
<tr>
<td>Optional HEART course OR</td>
<td>500.111</td>
<td>1</td>
</tr>
<tr>
<td>First-Year Seminar</td>
<td>501.1xx</td>
<td>1-3</td>
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<tr>
<td>Total Credits</td>
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<table>
<thead>
<tr>
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<th>Credit</th>
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<tbody>
<tr>
<td>Spring Semester</td>
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</tr>
<tr>
<td>Calculus III</td>
<td>110.202</td>
</tr>
<tr>
<td>Linear Algebra</td>
<td>110.201 or 110.212</td>
</tr>
<tr>
<td>or Differential Equations</td>
<td>110.302</td>
</tr>
<tr>
<td>Humanities/Social Science Course</td>
<td>3</td>
</tr>
<tr>
<td>Other elective</td>
<td>3</td>
</tr>
<tr>
<td>Total Credits</td>
<td>14</td>
</tr>
</tbody>
</table>

*Course is highly recommended but not required for AMS degree.

**Discrete Mathematics, 553.171, is also acceptable.
Since its founding more than 50 years ago, the Johns Hopkins Department of Biomedical Engineering has led the nation in developing biomedical engineering as an independent discipline. In addition to the principles of mathematics, physics, and/or chemistry that form the basis of traditional engineering disciplines, fundamental biology and the life sciences are integral to the practice of biomedical engineering. This integration of modern biology with the other basic sciences provides biomedical engineers with a coherent framework for solving fundamental and applied problems related to human health and disease. Developed by our faculty at Johns Hopkins, this model resulted in the original biomedical engineering curriculum, which has been used to educate and train future leaders in the field for the past twenty years.

Today, the faculty and students of the Johns Hopkins Department of Biomedical Engineering continue engineering the future of medicine. As they push the boundaries of discovery and innovation, they are pioneering new disciplines of biomedical engineering with tremendous potential to transform the practice of medicine and improve human health. To prepare students to lead this changing field, we have redefined biomedical engineering education by introducing BME 2.0, a modernized version of our original curriculum that brings the latest research discoveries into the undergraduate program.

The BME 2.0 curriculum provides a foundation in broadly defined core areas of biomedical engineering, while allowing students to specialize in one of seven emerging BME focus areas through advanced project-based courses, research, design opportunities, clinical exposure, and more. There are several unique qualities associated with the BME 2.0 curriculum:

- The BME 2.0 curriculum is based on a series of project-based courses that allow students to work in small groups to solve real-world problems related to BME focus areas. Starting from their first day on campus, students can sequence a genome, build an imager, model disease risk, engineer cells, and more under the guidance of our faculty experts. In our undergraduate BME Design Team program, teams of first- through fourth-year students work with clinical and industry partners to solve critical problems in healthcare and medicine.

- Through courses in biomedical data science and computational medicine, all BME students learn to answer questions of health and disease using complex biomedical datasets. In this way, students gain an in-depth knowledge of fields relevant to biological and medical problem solving.

- The BME 2.0 curriculum also guarantees students the flexibility to pursue research experiences in one of the 1,000+ basic and clinical laboratories throughout the university.

- All BME faculty members are active participants in teaching and shaping the undergraduate curriculum. This ensures that our focus areas align with the latest research developments in the field and that students are learning from the nation’s leading experts in the discipline.

- Throughout their first year, students will meet with a matched BME faculty member for small group mentoring sessions. During their second year, undergraduates are paired with specially chosen faculty mentors based on shared focus areas and interests, ensuring that all students receive individualized academic and professional guidance from experts in their chosen field. Throughout their education, students discover various BME career paths related to research, industry, medicine, and more through our Career Exploration program, which features seminars, panel sessions, alumni visits, and internships.
Core Knowledge and Curriculum

BME faculty have identified many areas of knowledge that are essential components of an education in biomedical engineering:

- Molecular and cellular biology
- Fundamental physics and thermodynamic principles in biology
- Applications of data science and machine learning to biological systems
- Creation, analysis, and simulation of linear and non-linear systems models from knowledge of biological and physiological systems
- Applications of the design process to create systems, tools, processes, or prototypes that solve a specific need

Beginning in the fall semester of your first year, you will complete a set of biomedical engineering, science, and math courses, collectively referred to as the “core curriculum,” to master this body of essential knowledge.

Getting Started... FOUNDATIONS

BME 2.0 begins with a first-year experience known as SCIENCE FOUNDATIONS, which starts in the fall with “Biomedical Engineering & Design”, an introduction to the tools and resources you will use throughout your Hopkins BME education, and its complementary Basecamp mentoring program. Through the Basecamp mentoring program, you will work in a small group with one of our BME faculty advisors to explore interdisciplinary topics related to modern applications of biomedical engineering. SCIENCE FOUNDATIONS also includes “Structural Biology of the Cells,” a required course that introduces you to the fundamentals of biology and the life sciences. Other SCIENCE FOUNDATIONS courses include fundamental physics, chemistry, math, and programming.

Looking Ahead... in your BME Program

Building on the foundation of SCIENCE FOUNDATIONS, the second year curriculum is our ENGINEERING BOOTCAMP for quantitative analysis. These courses in systems controls, modeling, and simulation will form the basis of your toolbox for future investigation and problem solving.

Moving forward in the program, you will take advanced engineering courses in your choice of biomedical engineering focus areas starting in your third year, known as BME RESIDENCY. In these focus area courses, you will apply your toolbox and the fundamentals that you have mastered as you become resident in the study of your chosen field:

- Biomedical Data Science
  Do you want to extract knowledge from biomedical datasets of all sizes to understand and solve health-related problems?

- Computational Medicine
  Do you want to generate solutions in personalized medicine by building and utilizing computational models of health and disease?

- Genomics & Systems Biology
  Do you want to create tools to understand the multi-scaled genetic, molecular, and cellular components of disease?

- Imaging & Medical Devices
  Do you want to build new medical devices and imaging technologies to improve disease diagnosis and guide surgical procedures?

- Immunoengineering
  Do you want to harness the power of the immune system to treat disease and promote tissue regeneration?

- Neuroengineering
  Do you want to apply innovative experimental and data-driven approaches to understand, diagnose, and treat disorders of the brain?

- Translational Cell & Tissue Engineering
  Do you want to develop and translate advanced technologies to enhance or restore function at the molecular, cellular, and tissue levels?

Some of your courses will be biomedical engineering courses; some courses will be required from other departments. Along the way you are encouraged to seek out research and design experiences that complement your engineering interests and pursue extracurricular activities that will round out your undergraduate experience.

In your final year of training, your advanced focus area courses will seamlessly integrate you with the BME community at large. This is BME PRACTICE. Advanced Design, Advanced Research, and other project-based courses will immerse you in the discipline. You are already Engineering the Future of Medicine!
Continuing your Education...with the 3+1 Program

Graduate PhD and master’s programs are the root of research in the department. For accelerated students, the 3+1 hybrid BS/MSE program, allows biomedical engineering students to earn both degrees in as little as four years. Students may be pre-registered to the 3+1 program to receive advising in the planning of their graduate degree. A formal application must be completed in the summer after the junior year for acceptance into the 3+1 Program. Students matriculating with 24 or more relevant credits from AP/IB (basic science, math, and/or computing courses) are typically on track to graduate early or complete both their undergraduate and course-based Master’s degree in four years. Students may still enroll in the 3+1 program if all but one of the student’s undergraduate course requirements are completed by the end of your third year, regardless of AP/IB credits. To remain eligible, you must maintain a minimum cumulative GPA of 3.3 through your third year.

**Fall Semester**

<table>
<thead>
<tr>
<th>Course</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math Course*</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>General Physics I**</td>
<td>171.101/107</td>
<td>4</td>
</tr>
<tr>
<td>General Physics Lab I**</td>
<td>173.111</td>
<td>1</td>
</tr>
<tr>
<td>Intro Chemistry I</td>
<td>030.101</td>
<td>3</td>
</tr>
<tr>
<td>Intro Chemistry Lab I</td>
<td>030.105</td>
<td>1</td>
</tr>
<tr>
<td>Biomedical Engineering and Design</td>
<td>580.111</td>
<td>2</td>
</tr>
<tr>
<td>Gateway Computing***, First-Year Seminar, or Humanities/Social Science Course</td>
<td></td>
<td>3</td>
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</tbody>
</table>

**Total Credits** 18

**Spring Semester**

<table>
<thead>
<tr>
<th>Course</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math Course*</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>General Physics II</td>
<td>171.102/108</td>
<td>4</td>
</tr>
<tr>
<td>General Physics Lab II</td>
<td>173.112</td>
<td>1</td>
</tr>
<tr>
<td>Intro Chemistry II</td>
<td>030.102</td>
<td>3</td>
</tr>
<tr>
<td>Intro Chemistry Lab II</td>
<td>030.106</td>
<td>1</td>
</tr>
<tr>
<td>Structural Biology of the Cell</td>
<td>580.151</td>
<td>3</td>
</tr>
<tr>
<td>Structural Biology of the Cell Lab</td>
<td>580.153</td>
<td>1</td>
</tr>
<tr>
<td>Career Exploration in BME</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

**Total Credits** 17

*MATH COURSE SELECTION*

Select a math course according to your level of preparation as indicated by AP/IB/GCE or other exam score and/or the JHU Math Placement Exam results.

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus I</td>
<td>110.108</td>
<td>4</td>
</tr>
<tr>
<td>Calculus II</td>
<td>110.109</td>
<td>4</td>
</tr>
<tr>
<td>Calculus III</td>
<td>110.202</td>
<td>4</td>
</tr>
<tr>
<td>Linear Algebra and Differential Equations</td>
<td>553.291</td>
<td>4</td>
</tr>
</tbody>
</table>

For double majors:

<table>
<thead>
<tr>
<th>Course</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Algebra</td>
<td>110.201</td>
<td>4</td>
</tr>
<tr>
<td>Differential Equations</td>
<td>110.302</td>
<td>4</td>
</tr>
</tbody>
</table>

It is highly recommended to have both Linear Algebra and Differential Equations completed by the beginning of the sophomore spring semester. Most BME students are encouraged to take the combined Linear Algebra & Differential Equations course (553.291). Students planning to double major in Applied Mathematics and Statistics should plan to take the separate Linear Algebra and Differential Equations courses.

*** Select from any one of the Gateway Computing courses: Java, Python, or MATLAB (500.112, 500.113, or 500.114).

** Physics I can be challenging for students without a solid foundation in Calculus I (even though Calculus I is listed as a co-req in the course description). Note that Physics I may be moved to the spring semester with the understanding that the BME sophomore and junior-year courses can be shifted to the junior and senior year without adding additional time to complete the degree.

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Chemical and Biomolecular Engineering (ChemBE) is dedicated to the design and exploitation of chemical, biological and physical processes, and to the study of phenomena for chemical and biological applications. As a result of the scope and breadth of this rigorous undergraduate program, our students commonly secure employment in the following industries:

- Chemical and pharmaceutical production
- Biomedicine
- Material design
- Biotechnology
- Food industry
- Energy

Research in ChemBE yields new products that include:

- Novel polymers and materials
- Biofuels
- Gene therapy products
- Cells and tissues
- Nanodevices
- Renewable energy
- Drugs, vaccines and drug delivery devices
- Machine learning and data science
- Semiconductors
- Food, beverage, and healthcare products

The demands on the modern engineer are high, and graduates must possess a wide range of skills in order to be competitive in a global market. The ChemBE program successfully satisfies these demands. Students take advanced courses in chemistry, physics, mathematics, and biology. Additionally, students are trained in transport, kinetics, separations, and thermodynamics, which are essential to solving real-world engineering problems. Students also hone their professional and communication skills through report writing, oral presentations, and teamwork, in courses involving experimental project, process design and product design.

Depending on their interests and future career goals, students can choose electives from exciting areas including green engineering, nanotechnology, data analytics, and bioengineering. These courses, along with undergraduate research opportunities offered by our faculty, are designed to prepare graduates for careers in the chemical industry, biotechnology, pharmaceuticals or microelectronics. The curriculum also offers an outstanding foundation for advanced graduate studies in chemical and biomolecular engineering, biomedical engineering, materials engineering, or for medical, law, or business school.

TRACKS: Students also have the opportunity to develop more in-depth specialty in one or two areas within chemical and biomolecular engineering. The ChemBE tracks are interfaces and nanotechnology (IN) and molecular and cellular bioengineering (MCB):

Interfaces and Nanotechnology (IN) Track
Interesting and new physics exist at nanometer length scales, as the surface area of an object begins to approach and exceed its volume. In this track, students are trained in the fundamental sciences used to solve problems in nanotechnology and interfacial science. Students take a chemistry course in Materials and Surface Characterization, an advanced physical chemistry laboratory course, and two electives such as Colloids and Nanoparticles, and Micro/Nanotechnology.

Molecular and Cellular Bioengineering (MCB) Track
Fields in biotechnology and biomedicine often involve processes at biological, cellular and molecular levels. Common areas utilizing skills in the MCB track include the genetic manipulation of cells for protein and vaccine production and the study and treatment of diseases such as arteriosclerosis and cancer. Courses in this track include lectures and laboratory courses in Biochemistry, Cell Biology, and electives such as Metabolic Systems Biotechnology, and Computational Protein Structure Prediction. In addition, students will take a biomolecular engineering laboratory to learn the hands-on skills required for future careers in biological systems at the molecular and cellular level.
Your First Year in ChemBE
The first two years of the curriculum are dedicated to sciences and mathematics. To get started in the program, during your first semester, you’ll take Chemical Engineering Today (540.101), a course which introduces the different career opportunities available to graduates from the department. This course covers real world problems in molecular biotechnology, electronics, law, medicine, biopharmaceuticals, energy, and the environment. A variety of companies and institutions are profiled weekly. You will learn how chemical and biomolecular engineering concepts impact the world and how engineers in industry, academics, medicine, and the not-for-profit sector can make a real contribution.

You have the option to take the first fundamental course in chemical and biomolecular engineering during your second semester, Introduction to Chemical and Biological Process Analysis (540.202). This course will also be available during the first semester of your sophomore year.

Your Last Year in ChemBE
Of particular interest are three senior-level courses entitled “Projects in ChemBE Unit Operations with Experiments,” “Chemical and Biomolecular Process Design with Aspen,” and “Chemical and Biomolecular Product Design” that are designed to develop project management and professional skills in chemical engineering. In the first of these courses, you will work in small teams and learn how to operate different types of process equipment, use your knowledge of engineering to assess their operation, and write a report on your findings. In the second course, you will design a chemical plant, and in the third course, you will create a chemical or a biochemical product, design the process, and produce a detailed forecast of the profit that you expect from the successful marketing and sales process. Some students will have the option to develop a prototype. Students find these courses to be both fun and challenging, as well as an image of real-world problems.

Recommended schedule for a student beginning with Calculus I

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus I</td>
<td>110.108</td>
<td>4</td>
</tr>
<tr>
<td>Intro Chemistry I</td>
<td>030.101</td>
<td>3</td>
</tr>
<tr>
<td>Intro Chemistry Lab I</td>
<td>030.105</td>
<td>1</td>
</tr>
<tr>
<td>Chem Eng Today</td>
<td>540.101</td>
<td>1</td>
</tr>
<tr>
<td>Humanities/Social Science course</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Gateway Python</td>
<td>500.113</td>
<td>3</td>
</tr>
<tr>
<td>Optional HEART course OR</td>
<td>500.111</td>
<td>1</td>
</tr>
<tr>
<td>First-Year Seminar</td>
<td>501.1 xx</td>
<td>1-3</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td><strong>15-18</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring Semester</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus II</td>
<td>110.109</td>
<td>4</td>
</tr>
<tr>
<td>Intro Chemistry II</td>
<td>030.102</td>
<td>3</td>
</tr>
<tr>
<td>Intro Chemistry Lab II</td>
<td>030.106</td>
<td>1</td>
</tr>
<tr>
<td>General Physics I</td>
<td>171.101/ 107</td>
<td>4</td>
</tr>
<tr>
<td>General Physics Lab I</td>
<td>173.111</td>
<td>1</td>
</tr>
<tr>
<td>Humanities/Social Science course</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td><strong>16</strong></td>
<td></td>
</tr>
</tbody>
</table>

Recommended schedule for a student beginning with Calculus II or III and 4 AP credits in Chemistry

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus II</td>
<td>110.109</td>
<td>4</td>
</tr>
<tr>
<td>or Calculus III</td>
<td>110.202</td>
<td>4</td>
</tr>
<tr>
<td>Applied Chemical Equilibrum and Reactivity</td>
<td>030.103</td>
<td>4</td>
</tr>
<tr>
<td>General Physics I</td>
<td>171.101/107</td>
<td>4</td>
</tr>
<tr>
<td>General Physics Lab I</td>
<td>173.111</td>
<td>1</td>
</tr>
<tr>
<td>Chem Eng Today</td>
<td>540.101</td>
<td>1</td>
</tr>
<tr>
<td>Humanities/Social Science course</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Optional HEART course</td>
<td>500.111</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td><strong>17-18</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring Semester</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intro to Chem &amp; Bio</td>
<td>540.202</td>
<td>4</td>
</tr>
<tr>
<td>Process Analysis Gateway to Computing</td>
<td>500.113</td>
<td>3</td>
</tr>
<tr>
<td>(Python)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Physics II</td>
<td>171.102/108</td>
<td>4</td>
</tr>
<tr>
<td>Humanities/Social Science course</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td><strong>14</strong></td>
<td></td>
</tr>
</tbody>
</table>
Civil and Systems Engineering

What is Civil and Systems Engineering (CaSE)?
Civil Engineering has traditionally been the engineering discipline responsible for designing, building, and maintaining the physical infrastructure that enables a society to meet the needs of its people. **Systems Engineering** is a growing discipline that seeks optimal solutions to complex problems involving connectivity among multiple variables. Johns Hopkins’ Department of Civil and Systems Engineering (CaSE) was borne out of an understanding that the physical infrastructure on which our society depends is increasingly interconnected, and we need to understand and consider those connections in order to successfully engineer solutions to the grand challenges we face, including:

- Fostering safe and prosperous urban communities in a complex and uncertain environment;
- Designing innovative solutions for the expansion of our civilization beyond earth’s boundaries;
- Creating quantitative tools for making decisions that ensure healthy communities;
- Developing technologies, systems, and policies that protect communities against evolving threats; and
- Designing sustainable energy production, transport, and planning solutions

Our curriculum is designed to prepare graduates with the knowledge and skills necessary to tackle these highly interdisciplinary grand challenges. In addition to fundamental coursework in science, mathematics, and engineering, as a student majoring in Civil or Systems Engineering, you will learn about the human side of civilizations, putting into context the needs of society and the tools engineers have historically used and currently do use to meet those needs. You will learn how to design new structures, and how to design and manufacture new materials optimized for a particular application – say space! – and you will learn how to create mathematical models to approximate the behavior of a physical system – whether that be an infrastructure system (e.g. energy, water, transportation) or a healthcare system.
While Civil Engineering and Systems Engineering majors take many of the same classes for their first three semesters, their paths diverge in the fourth semester with Civil Engineering majors learning how to analyze and design the physical parts of our infrastructure systems and Systems Engineering majors learning how to use optimization and decision-making models, as well as data, to improve their understanding of system behavior and dynamics. In the senior year, Civil and Systems Engineering majors come back together to complete a design project that integrates traditional Civil Engineering design with Systems Engineering tools and thinking.

Undergraduate students enrolled in the Bachelor of Science program in Civil or Systems Engineering also have an opportunity to continue their education by pursuing a five-year combined bachelor’s / master’s degree program in the Department of Civil and Systems Engineering.

What about research?

CaSE faculty are driven to find solutions to these grand societal challenges through collaborative research, and we welcome undergraduate students to join in our efforts. We have strengths in probabilistic methods of design and analysis that can be applied to the randomness in many building materials, the uncertainties in the design process, and in the environmental loading on structures. We are developing new techniques for building thin-walled structures and designing in ways that incorporate both the knowledge of material properties and the response of materials to repeated cycles of loading on a structure. We are modeling large-scale civil engineering systems related to energy, transportation, and public health, whose optimized performance is critical to the health, safety, and welfare of the public. We are concerned with the soil that must support buildings and how it responds to loading. We are also concerned about civil engineering at the nation’s coastlines and nearshore areas, as the population there continues to grow, while the sea level rises.

Recommended schedule for Civil Engineering majors and Systems Engineering majors

**Fall Semester**

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaSE Collaborative</td>
<td>560.100</td>
<td>.5</td>
</tr>
<tr>
<td>Civilization Engineered</td>
<td>560.191</td>
<td>3</td>
</tr>
<tr>
<td>Introductory Chemistry I</td>
<td>030.101</td>
<td>3</td>
</tr>
<tr>
<td>Math Course*</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Humanities/Social Science elective</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Optional HEART course OR</td>
<td>500.111</td>
<td>1</td>
</tr>
<tr>
<td>First-Year Seminar</td>
<td>501.1xx</td>
<td>1-3</td>
</tr>
</tbody>
</table>

**Total Credits** 14.5-17.5

*MATH COURSE SELECTION*

Students should take a math course each semester, choosing among the required courses shown below. Select a math course according to your level of preparation (as indicated by AP/IB/GCE or other exam score and/or the JHU Math Placement Exam results).

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus I</td>
<td>110.108</td>
<td>4</td>
</tr>
<tr>
<td>Calculus II</td>
<td>110.109</td>
<td>4</td>
</tr>
<tr>
<td>Calculus III</td>
<td>110.202</td>
<td>4</td>
</tr>
<tr>
<td>Linear Algebra and Differential Equations</td>
<td>553.291</td>
<td>4</td>
</tr>
</tbody>
</table>

**Spring Semester**

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaSE Design</td>
<td>560.192</td>
<td>.5</td>
</tr>
<tr>
<td>Electromagnetism &amp; Sensors Lab</td>
<td>560.112</td>
<td>1</td>
</tr>
<tr>
<td>General Physics I</td>
<td>171.101</td>
<td>4</td>
</tr>
<tr>
<td>General Physics Lab I</td>
<td>173.111</td>
<td>1</td>
</tr>
<tr>
<td>Gateway Computing: Python</td>
<td>500.113</td>
<td>3</td>
</tr>
<tr>
<td>Math Course*</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Professional Writing and Communication</td>
<td>661.110</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits** 16.5

**NOTE:** Even if a student earns AP credit for Physics I, he or she MUST still take either General Physics Lab I (173.111) or another 1 credit N laboratory course.
Computer science is the study of models of computation, their physical realizations, and the application of these models to an incredibly diverse and continually evolving set of applications. As such, students who major in computer science have a wide range of directions in which to apply their degree. Whether your dream job is to develop the latest applications for Google, Apple, or Microsoft, construct a truly secure electronic voting system, invent robots for medical or environmental applications, build a universal language translator, or run your own start-up (to name a few), a computer science degree at JHU can get you started.

**PROGRAMS**

We offer both a Bachelor of Science (BS) and a Bachelor of Arts (BA) degree. This gives computer science students the options of pursing a strongly technical program (BS), or crafting a more traditional liberal arts program (BA). Both degrees start with a balanced foundation in computer science, so that majors don’t have to decide whether to pursue a BS or a BA until mid-way through their undergraduate studies. The first two years of study focus on core courses within the major: programming in Java, C, and C++, data structures and algorithms, computer system fundamentals, and math foundations for computer science. This core gives students a strong understanding of how computers work and how we can use them to manipulate data. To complement these required courses, students take distributional courses in math, science, humanities and social science, and may also start exploring the field of CS through courses such as databases, user interfaces and mobile applications, web programming, parallel programming, or software engineering.

In their junior and senior years CS students have great flexibility in choosing their upper level CS, and other distributional courses. In addition to core courses in software engineering, algorithms, and networks, students may choose from courses in artificial intelligence, sensor-based robotics, distributed systems, operating systems, cryptography and security, computer integrated surgery, natural language processing, machine learning, computational genomics, computer graphics and more. A key feature of our major is the tremendous amount of teamwork and collaboration that takes place in the upper level courses. Many of them provide students with opportunities to develop significant term projects in small groups, sometimes with an external client, and other times of the students’ own design.

**FOCUS AREAS**

As students progress through the program, many discover a special interest and want to concentrate their studies in that area. To facilitate this, we have developed several focus areas within the major. These include natural language processing, software engineering, information security, robotics, data-intensive computing, computing fundamentals, systems & networking, computational biology, and business computing. Together these 9 areas represent faculty research strengths and typical career directions, offering specialization options for undergraduate exploration within the department. Regardless of whether you pursue a particular focus or not, our bachelor programs provide excellent preparation for research within the department, summer internships, and post-graduation industry employment or graduate work.

**COMMUNITY**

Students majoring in computer science form a strong community and support system. This is facilitated through course team projects, as well as our own undergraduate computer labs. Students have 24/7 access to these labs, as
well as to our compute servers either directly on the lab machines or remotely from their own laptops. The collaboration lab in particular provides a common gathering place to work on projects, get advice and homework help, and generally socialize with others in the department.

The department is also home to a number of student groups: ACM, ACM-W, HopHacks, UPE, HopAI, and JHUXplore. ACM is our chapter of the Association for Computing Machinery. ACM-W is the affiliated Women in CS (WiCS) group which meets informally every week for “coding circles,” as well as sponsoring a mentorship program and other events throughout the year. HopHacks is the student organizing team for our 36-hour hackathon held on campus every year. UPE stands for Upsilon Pi Epsilon which is the computer science honor society. HopAI is an interdisciplinary student group that organizes events related to artificial intelligence. Our newest student group, JHUXplore provides opportunities to learn and develop user experience skills. You can find more information about these groups later in this publication.

PROGRAM COMBINATIONS
Because of our flexible program requirements, students frequently combine studies in CS with minors, other majors, and sometimes even masters programs in CS or related areas. Some of the most popular minors among CS majors are Entrepreneurship & Management, Robotics, Computational Medicine, Computer Integrated Surgery, and Math (traditional or applied). We also offer a minor in computer science for those pursuing other majors. Double majors may combine studies in CS with almost any other major offered in Engineering or Arts & Sciences.

Due to the close relationship between computer science and electrical engineering, it may be difficult to choose the right course of study. Students who are interested in the intersection of computer science and electrical engineering are encouraged to pursue a Bachelor of Science in Computer Engineering (CE), which is jointly sponsored by the computer science and electrical and computer engineering departments. CE majors take core courses from both departments, and may choose upper level courses from either department.

Do you want to build the next generation of computer hardware or design smart surgical tools? If so, think about majoring in electrical engineering or computer engineering. Both of these programs combine a rigorous education in engineering and the sciences with research experience that lets you put your knowledge to work in the world of high-tech engineering and in advanced studies. You can find more information about these programs elsewhere in this booklet.

At the graduate level, students may pursue a combined bachelor’s/master’s program, which allows undergraduates to begin a masters degree before completing their undergraduate courses. Because it is not necessary for both the bachelor’s and master’s degrees to be in the same field, some students use the combined program as an opportunity to combine their bachelor in CS with a specialized masters program in information security, robotics, data science, or engineering management, or a more traditional graduate field such as applied math or computer engineering.

On the next page you will find our recommended courses for the first year of study as a computer science major. More details on all our programs are readily available on our department website: https://cs.jhu.edu.
Recommended schedule for a student without AP Computer Science

**Fall Semester**
- Calculus I* 110.108 4
- Gateway Computing: Java ** 500.112 3
- FYS: Exploring Computer Science 501.123 1
- HEART course 500.111 1
- Writing Course*** 3
- Humanities/Social Science course 3

**Total Credits** 15

**Spring Semester**
- Calculus II 110.109 4
- Intermediate Programming** 601.220 4
- Mathematical Foundations for Computer Science 601.230 4
- Free Elective 3

**Total Credits** 15

* Select a math course according to your level of preparation (as indicated by AP/IB/GCE or other exam score and/or the JHU Math Placement Exam results). Course choices include Calculus I, II, III, or Linear Algebra.
** Register for a section that is specifically for incoming first-year Computer Science Major students
***Select a writing course from the following choices: 220.105, 661.110, 661.111.

Recommended schedule for a student with AP Computer Science

**Fall Semester**
- Calculus I* 110.108 4
- Intermediate Programming** 601.220 4
- FYS: Exploring Computer Science 501.113 1
- Optional HEART course 500.111 1
- Writing Course*** 3
- Humanities/Social Science course 3

**Total Credits** 15-16

**Spring Semester**
- Calculus II* 110.109 4
- Data Structures 601.226 4
- Discrete Structures 601.230 4
- Free Elective 3
- Humanities/Social Science course 3

**Total Credits** 15

The Electrical and Computer Engineering (ECE) Department takes a human-centric approach to research and education, with a focus on applications in speech processing, medical imaging, bio-photonics, computer-integrated surgery, renewable energy, human inspired electronic systems for perception and cognition, and other cutting-edge technologies that address real-world problems. Our courses cover wide-ranging topics in three broad areas: signal, systems, and control; electro-physics; and computational systems.

**Design a program that fits your interests**

As a department, we take pride in offering a flexible curriculum, yet with sufficient structure that balances the tradeoffs between depth and breadth. For example, working closely with your advisor, as an Electrical Engineering (EE) major you can focus on the fundamentals of signals, image/pattern analysis and machine intelligence, iterative algorithms and optimization, and dynamic systems. You can complement these core courses with classes in another area of ECE to broaden your knowledge in photonics, microelectronics and or embedded computational systems such as Field Programmable Gate Arrays. Another example program could consist of core courses in electrophysics, focusing on semiconductor physics, lasers, solar cells, and integrated photonics, with complementary electives in machine learning and signal processing.

Computer Engineering (CE) majors can pursue a bachelor’s degree in a program jointly sponsored by the ECE and Computer Science departments. CE majors take core courses and electives from both departments, and may choose an ECE advisor with a dual appointment.

**Research is an essential tool**

Hands-on research is one of the best tools for learning. Right from the beginning, you’ll work with your instructors in their area of research as well as on projects of your own. Some of the
areas that faculty are currently researching include parallel signal processing, VLSI analog architectures for machine vision, nonlinear systems, photonics, optical communications, semiconductor devices, biomorphic systems for robotics and sensory information processing, medical imaging, machine learning, solar energy, and much more.

You’re only as good as your tools

The department maintains extensive facilities for teaching and research in Barton Hall, Hackerman Hall, the Wyman Park building, and Clark Hall. Lab classes make extensive use of state-of-the-art design environments such as CADENCE, Xilinx Tools, TI DSP systems, VHDL, and Verilog. The Microfabrication Laboratory in Clark Hall (jointly run with the Biomedical Engineering program) offers opportunity for a hands-on experience with lithography (hard and soft), and deposition and etching of materials. In addition, the department also includes the Computational Sensory-Motor Microsystem Lab, the Cellular Signaling Control Lab, the Image Analysis and Communications Lab, the Complex Systems Science Lab, the Laboratory for Computational Audio Perception, the Photonics and Optoelectronics Lab, the NanoEnergy Lab, the Photoacoustic and Ultrasonic Systems Engineering (PULSE) Lab, the Integrated Photonics Lab, the Neural Systems Analysis Lab, the Computer Vision Lab, the Artificial Intelligence for Engineering and Medicine Lab, the Ultrafast and Nonlinear Photonics Lab, the Laboratory for Computational Sensing and Robotics, and the Sensory Communication and Microsystems Lab.

Current and recent noteworthy accomplishments

- ECE researchers are combining optics, acoustics, and robotics to deliver new technology that will reduce the risk of patient death and other accidental injuries during surgeries.
- Algorithms for speech processing that were pioneered by ECE researchers can be found in most speech recognition applications worldwide.
- ECE researchers have developed a satellite based, high-power fiber-optic laser system to monitor air pollution and atmospheric changes associated with global warming and ozone depletion.
- ECE researchers are pioneering signal processing and algorithm developments to introduce new diagnostic capabilities for ultrasound imaging.
- Researchers have developed an algorithm that improves the clarity of partial MRI scans.
- ECE researchers are developing new technology for flexible, colorful, portable solar cells that can generate renewable energy from the sides of buildings, vehicles, windows, and other surfaces.
- A team of ECE researchers recently created a new lens-free, ultra-miniaturized endoscope—the width of only a few human hairs—that can produce high-quality images of live neuron activity.
- A team of researchers in ECE working with colleagues in Mechanical Engineering and School of Medicine, have developed a wearable acoustic array with embedded AI processing for monitoring cardiovascular system health at home in post-operative patients.
- ECE researchers in collaboration with Northrop Grumman have developed energy efficient machine intelligence perception and cognition chips for “green” data centers and embedded processing in Internet of Things.
- Researchers studying epilepsy are utilizing a seizure-tracking algorithm to detect the source of epileptic seizures in the brain.
- A faculty and student team created a smartphone app that analyzes users’ suffering from COVID-like symptoms in a study to predict geographical areas at risk for outbreaks of the coronavirus.
- Team of researchers in ECE working with colleagues in Mechanical Engineering and School of Medicine, have developed a wearable acoustic array with embedded AI processing for monitoring cardiovascular system health at home in post-operative patients.
What you’ll study

The freshman program is almost the same for Computer Engineering and Electrical Engineering. During your sophomore year, you’ll begin to prepare for upper-level courses by completing specific prerequisite courses. You have the option of choosing to complete upper-level courses in a specific focus area, such as Computing Systems; Integrated Circuits and Microsystems; Machine Learning and Artificial Intelligence; Medical Imaging; Photonics and Optoelectronics; Robotics; or Signals, Systems and Control. Depending on the major and area of emphasis you decide to pursue, you’ll have the chance to choose from a wide range of courses including:

- Electronics
- Electromagnetics
- Sensory Systems
- Control Systems
- Quantum Mechanics
- Optical and Electronic Properties of Materials
- Photonics
- Optoelectronic Devices
- Image Processing and Analysis
- Speech and Audio Processing
- Computer Architecture
- Medical Imaging Systems
- Information Theory and Coding
- Machine Learning
- Machine Intelligence and Perception
- CAD of Digital VLSI Systems
- Semiconductor Devices
- Renewable Energy Engineering

You’ll also take courses in the social sciences and humanities. These classes sharpen your thinking and improve writing and communication skills.

Learning in the real world

Join many of your fellow Hopkins students who take part in an internship at some point in their college career. Recent internships include:

- Microsoft
- Eli Lilly and Company
- IBM
- Northrop Grumman
- Columbia Telecom
- Ernst & Young
- NASA
- Leidos
- Memorial Sloan Kettering Cancer Center
- Booz Allen Hamilton
- Intel
- National Semiconductor
- Capital One
- Applied Physics Laboratory
- Google
- Facebook
- Duolingo

Where do you go from here?

Hopkins graduates take their degrees lots of different places:

- Graduate and professional schools
- Communications & telecommunications firms
- Business
- Government and corporate labs
- Research and teaching
- Industrial labs
Recommended schedule for Electrical Engineering

**Fall Semester**

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math course*</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>General Physics I</td>
<td>171.101/107</td>
<td>4</td>
</tr>
<tr>
<td>General Physics Lab I</td>
<td>173.111</td>
<td>1</td>
</tr>
<tr>
<td>Intro to ECE</td>
<td>520.137</td>
<td>3</td>
</tr>
<tr>
<td>Gateway Computing Python</td>
<td>500.113</td>
<td>3</td>
</tr>
<tr>
<td>Optional HEART course</td>
<td>500.111</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td></td>
<td>15-16</td>
</tr>
</tbody>
</table>

**Spring Semester**

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Physics II</td>
<td>171.102/108</td>
<td>4</td>
</tr>
<tr>
<td>Digital Sys. Fundamentals</td>
<td>520.142</td>
<td>3</td>
</tr>
<tr>
<td>Comp. Modeling/ECE</td>
<td>520.123</td>
<td>3</td>
</tr>
<tr>
<td>Intermediate Programming</td>
<td>601.220</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

*MATH COURSE SELECTION*

Students should take a math course each semester, choosing among the required courses shown below.

Select a math course according to your level of preparation as indicated by AP/IB/GCE or other exam score and/or the JHU Math Placement Exam results). Students beginning at the Calculus I level should discuss when to take Physics I and lab with an academic advisor.

Course Name               | Course #   | Credit |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus I</td>
<td>110.108</td>
<td>4</td>
</tr>
<tr>
<td>Calculus II</td>
<td>110.109</td>
<td>4</td>
</tr>
<tr>
<td>Calculus III</td>
<td>110.202</td>
<td>4</td>
</tr>
<tr>
<td>Linear Algebra</td>
<td>110.201</td>
<td>4</td>
</tr>
<tr>
<td>Differential Equations</td>
<td>110.302</td>
<td>4</td>
</tr>
</tbody>
</table>

Environmental Engineering

Housed in the Department of Environmental Health and Engineering, environmental engineering involves the application of physical, chemical, biological, and social sciences to protect human health, enhance the quality of human life, and protect ecosystems. Environmental engineers plan, design, and operate technological systems to prevent, control, or remediate pollution. They evaluate and design public policy and conduct research to understand and solve environmental problems.

Our degree program is flexible enough to accommodate students with a variety of interests in Environmental Engineering.

Our program provides ideal preparation for future employment in business, industry, or government for subsequent training at the graduate level, either in Environmental Engineering or in a field such as environmental law, public health, or medicine. Graduates in this field work in private consulting firms, industrial firms, regulatory agencies, nongovernmental agencies (NGOs), international agencies, research laboratories, and universities.
The Department of Environmental Health and Engineering (EHE) offers:

- an undergraduate Bachelor of Science (B.S.) degree in Environmental Engineering
- five focus areas within the environmental engineering major:
  - Environmental Management and Economics
  - Environmental Engineering and Science
  - Public Health (Environmental Health Engineering)
  - Environmental Health Engineering
  - Land, Air, and Water Resources
  - Energy Systems Analysis
- three minors:
  - a minor in environmental engineering
    (designed to allow other engineering students to pursue an interest in environmental engineering and to incorporate aspects of this field into careers in their own discipline)
  - a minor in environmental sciences
    (designed to encourage and facilitate studies in environmental science by students completing degrees in natural sciences e.g. chemistry, biology, physics.)
  - a minor in engineering for sustainable development
    (designed to expose students to some of the key issues related to development, methods of information-gathering in diverse and difficult settings, and working effectively with non-engineers on complex problems)
- a five-year concurrent (B.S./M.S. or B.S./M.S.E.) program.

The department offers electives in such areas as ecology, hydrology, water and wastewater treatment processes, environmental systems analysis, energy, and environmental policy studies.

EHE has undergraduate exchange programs available with the University of Utrecht, which is the Netherlands’ lead environmental sustainability university, and Comillas Pontifical University in Madrid, which is the top private university in the energy systems area. Courses are available in English. If you are interested in learning more about the exchange programs, you should contact the EHE department.

### Recommended schedule for Environmental Engineering

#### Fall Semester

<table>
<thead>
<tr>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math course*</td>
<td>4</td>
</tr>
<tr>
<td>Intro Chemistry I</td>
<td>030.101</td>
</tr>
<tr>
<td>Intro Chem Lab I</td>
<td>030.105</td>
</tr>
<tr>
<td>Intro to Environ. Eng.</td>
<td>570.108</td>
</tr>
<tr>
<td>Optional HEART course OR</td>
<td>500.111</td>
</tr>
<tr>
<td>First-Year Seminar</td>
<td>501.1xx</td>
</tr>
</tbody>
</table>

**Total Credits:** 15-18

#### Spring Semester

<table>
<thead>
<tr>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math course*</td>
<td>4</td>
</tr>
<tr>
<td>Intro Chemistry II</td>
<td>030.102</td>
</tr>
<tr>
<td>Intro Chem Lab II</td>
<td>030.106</td>
</tr>
<tr>
<td>General Physics I</td>
<td>171.101</td>
</tr>
<tr>
<td>General Physics Lab II</td>
<td>173.111</td>
</tr>
<tr>
<td>Gateway Computing: Python or MATLAB**</td>
<td>500.113 or 500.114</td>
</tr>
</tbody>
</table>

**Total Credits:** 16

#### *MATH COURSE SELECTION

You should select a math course according to your level of preparation (as indicated by AP/IB/GCE or other exam score and/or the JHU Math Placement Exam results).

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus I</td>
<td>110.108</td>
<td>4</td>
</tr>
<tr>
<td>Calculus II</td>
<td>110.109</td>
<td>4</td>
</tr>
<tr>
<td>Calculus III</td>
<td>110.202</td>
<td>4</td>
</tr>
<tr>
<td>Linear Algebra and Differential Equations OR</td>
<td>553.291</td>
<td>4</td>
</tr>
<tr>
<td>Differential Equations</td>
<td>110.302</td>
<td>4</td>
</tr>
<tr>
<td>Probability/Statistics</td>
<td>553.3xx</td>
<td>3-4</td>
</tr>
</tbody>
</table>

**Although not required for the major requirement, students who take Gateway Computing: MATLAB are encouraged to take Bootcamp: Python (500.133) for one credit. Students who take Gateway Computing: Python are recommended to take Bootcamp: MATLAB (500.134) for one credit.**
Materials Science and Engineering

Materials are essential to the implementation of any engineered technology, from the smallest integrated circuit to the strongest artificial muscles to the longest bridge. In almost every technology, the performance, reliability, or cost is determined by the materials used. As a result, the drive to develop new materials and processes (or to improve existing ones) makes materials science and engineering one of the most important and dynamic engineering disciplines. Because the field encompasses so many different areas, it is often categorized according to types of materials (metals, ceramics, polymers, semiconductors) or to their applications (biomaterials, electronic materials, magnetic materials, or structural materials).

The central theme of materials science and engineering is that the relationships among the structure, properties, processing, and performance of materials are crucial to their function in engineering structures. Materials scientists seek to understand these fundamental relationships, and use this understanding to develop new ways for making materials or to synthesize new materials. Materials engineers design or select materials for particular applications and develop improved processing techniques. Since materials scientists and engineers must understand the properties of materials as well as their applications, the field is inherently interdisciplinary, drawing on aspects of almost every other engineering discipline as well as physics, chemistry, and biology.

Three B.S. degree tracks are offered by the Department of Materials Science and Engineering.

(1) **Standard Materials Track.** The standard materials track is intended for those students with general materials science and engineering interests. It permits the student to tailor the degree program by allowing a broad range of choices for upper level science and engineering electives.

(2) **Biomaterials Concentration.** The biomaterials track is intended for those students with a focused interest in biomaterials.

(3) **Nanotechnology Concentration.** The nanotechnology track is intended for those students with a focused interest in nanotechnology.

**Description of the Biomaterials Concentration**

Biomaterials is an exciting and rapidly developing field at the interface of materials science, engineering, biology, chemistry and medicine. It is an interdisciplinary field that requires thorough understanding of materials properties and interactions of materials with the biological environment. Our unique biomaterials program is designed to provide a broad educational basis with emphasis on principles and applications of biomaterials. It is designed to provide a firm grounding in the physics, chemistry, and biology of materials, as well as breadth in general engineering, mathematics, humanities and social science.

Our curriculum covers a variety of topics including biomimetic materials and natural materials, host responses to biomaterials and biocompatibility, as well as applications of biomaterials, particularly to tissue engineering, regenerative medicine, drug delivery, medical devices and implants. Students enrolled in this concentration will take a series of lecture courses and a laboratory course, as well as conduct a senior design project focusing on design, synthesis, processing, characterization,
and applications of biomaterials. The goal of the biomaterials concentration in the Department of Materials Science and Engineering is to train students in the basic principles of materials science and engineering as they apply to the development of novel biomaterials that benefit human health. Students under this concentration will receive among the best educations for successful careers in biomaterials engineering or biomedically-related fields.

**Description of the Nanotechnology Concentration**

Nanotechnology advances the utilization of materials and devices with extremely small dimensions. Nanotechnology is a visionary field, as micro- and nano-structured devices impact all fields of engineering, from microelectronics (smaller, faster computer chips) to mechanical engineering (micromotors and actuators) to civil engineering (“smart”, self-healing nanocomposite materials for buildings and bridges) to biomedical engineering (drug delivery, biosensors and tissue engineering). Materials science is central to nanotechnology because the properties of materials can change dramatically when things are made extremely small. A wide (and sometimes unexpected!) variety of phenomena associated with nanostructured materials allow us to envision radically new devices and applications that can only be made with nanostructured materials.

Under the nanotechnology concentration, the Department of Materials Science and Engineering offers a curriculum designed to train students in the fundamental interdisciplinary principles of materials science including physics and chemistry, and also expose students to cutting edge nanomaterials research, both through elective classes and in research laboratories. Students in the nanotechnology concentration will be well-prepared for successful careers in materials science and engineering across a wide range of disciplines.

**Recommended schedule**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall Semester</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculus I*</td>
<td>110.108</td>
<td>4</td>
</tr>
<tr>
<td>Intro Chemistry I**</td>
<td>030.101</td>
<td>3</td>
</tr>
<tr>
<td>Intro Chemistry Lab I**</td>
<td>030.105</td>
<td>1</td>
</tr>
<tr>
<td>General Physics I</td>
<td>171.101/107</td>
<td>4</td>
</tr>
<tr>
<td>General Physics Lab I</td>
<td>173.111</td>
<td>1</td>
</tr>
<tr>
<td>Foundations of MSE</td>
<td>510.106</td>
<td></td>
</tr>
<tr>
<td>OR First-Year Seminar</td>
<td>501.1xx</td>
<td>1-3</td>
</tr>
<tr>
<td>Optional HEART course</td>
<td>500.111</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td></td>
<td><strong>13-17</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spring Semester</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculus II</td>
<td>110.109</td>
<td>4</td>
</tr>
<tr>
<td>Intro Chemistry II</td>
<td>030.102</td>
<td>3</td>
</tr>
<tr>
<td>Intro Chemistry Lab II</td>
<td>030.106</td>
<td>1</td>
</tr>
<tr>
<td>General Physics II</td>
<td>171.102/108</td>
<td>4</td>
</tr>
<tr>
<td>General Physics Lab II</td>
<td>173.112</td>
<td>1</td>
</tr>
<tr>
<td>Gateway Computing: Python***</td>
<td>500.113</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>

*You should select a math course according to your level of preparation (as indicated by AP/IB/GCE or other exam score and/or the JHU Math Placement Exam results). Students beginning at the Calculus I level should discuss when to take Physics I and lab with an academic advisor.

**Students who earned a score of 5 on AP Chemistry may enroll in Introductory Organic Chemistry I (030.205) in the fall semester. Students who earned a score of 4 on AP Chemistry may enroll in Applied Chemical Equilibrium and Reactivity with Lab (030.103) in fall semester to fulfill the MSE requirement for chemistry. An elective can be selected in the spring semester.

***Gateway Computing: Java (500.112) is also acceptable. However, students are encouraged to take Bootcamp: Python 500.133 for 1 credit if they need exposure to Python.*
Mechanical Engineering and Engineering Mechanics

THE MECHANICAL ENGINEERING (ME) MAJOR emphasizes mechanical and thermal systems analysis and design. Students develop a wide range of fundamental skills required of the mechanical engineering professional and choose upper-level technical electives for further in-depth study. We offer formal tracks in Aerospace Engineering and Biomechanics, allow students to pursue special interests in engineering, physics, biology, mathematics, management, and humanities. Students interact with a multidisciplinary faculty both in the classroom and in research laboratories. Some double-majors can be completed with these degrees, depending on the number of outside credits previously earned. A 5-year combined bachelor’s/master’s degree is available.

The modern engineer must be well versed in communication and teamwork skills. These are developed in a number of courses that involve laboratory exercises, report writing, and oral presentations. In addition to the two-semester capstone senior design course, the students’ development in solving design problems is cultivated and encouraged through design electives and special design projects assigned in many of the courses.

TRACKS: Students are encouraged to develop depth in one or two areas within mechanical engineering. Your faculty advisor can help you choose courses that form tracks in areas such as mechanics and design, thermo-fluids and thermo-fluid systems, robotics, aerospace engineering, and biomechanics. The Aerospace Engineering and Biomechanics tracks have formal course requirements.

The Aerospace Engineering track helps students develop knowledge in areas such as advanced dynamics, flight mechanics, propulsion, aerospace materials and structures, signal processing, control systems, astrophysics and space systems. Students pursuing this track are required to take at least five eligible courses, which count toward the requirements of the Mechanical Engineering and Technical electives in the general ME program. Another popular track in ME is Biomechanics. The essence of mechanics is the interplay between forces and motion. In biology, mechanics is important at the macroscopic, cellular, and subcellular levels. ME Students pursuing this track are required to take at least four eligible courses, which count toward the requirements of the Mechanical Engineering and Technical electives in the general ME program.

Recommended schedule for Mechanical Engineering

**Fall Semester**

<table>
<thead>
<tr>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus I</td>
<td>110.108</td>
</tr>
<tr>
<td>Intro to Chemistry</td>
<td>030.101</td>
</tr>
<tr>
<td>MechE Undergraduate Seminar I</td>
<td>530.107</td>
</tr>
<tr>
<td>Intro to MechE Design and CAD</td>
<td>530.111</td>
</tr>
<tr>
<td>MechE Freshman Lab I*</td>
<td>530.115</td>
</tr>
<tr>
<td>Intro to Mechanics</td>
<td>530.123</td>
</tr>
<tr>
<td>Humanities/Social Science Writing Intensive course</td>
<td>3</td>
</tr>
<tr>
<td>Optional HEART course</td>
<td>500.111</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td><strong>16.5-17.5</strong></td>
</tr>
</tbody>
</table>

**Spring Semester**

<table>
<thead>
<tr>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus II</td>
<td>110.109</td>
</tr>
<tr>
<td>MechE Undergraduate Seminar II</td>
<td>530.108</td>
</tr>
<tr>
<td>Gateway Computing: MATLAB**</td>
<td>500.114</td>
</tr>
<tr>
<td>MechE Freshman Lab II*</td>
<td>530.116</td>
</tr>
<tr>
<td>Intro to Mechanics II</td>
<td>530.124</td>
</tr>
<tr>
<td>Humanities/Social Science course</td>
<td>3</td>
</tr>
<tr>
<td>Humanities/Social Science course</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td><strong>16.5</strong></td>
</tr>
</tbody>
</table>

**Special Note:** 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 during the fall semester. FYS courses carry course numbers EN.501.1XX.
If a student earns AP Physics credits, he or she MUST take the Physics laboratory courses, either 530.124 Intro to Mechanics II or 173.111. Physics Lab II, 173.112, is also required. This is an exception to University policy as the Mechanical Engineering Department has chosen to require the lab courses.

*IMPORTANT NOTE for MECHANICAL ENGINEERING and ENGINEERING MECHANICS MAJORS: Students who scored a “5” on the AP Computer Science exam have the option to take either a) one of the Gateway Computing courses, in which case the AP Computer Science credits will be forfeited, or b) 601.220 Intermediate Programming or 601.226 Data Structures in which case the AP Computer Science credits will count toward the student’s core computing requirement (replacing Gateway Computing).

THE ENGINEERING MECHANICS (EM) MAJOR
is designed to provide students with a highly flexible but rigorous foundation in solid and fluid mechanics. Students choose an area of specialization in preparation for technical careers or graduate and professional school. The major offers numerous technical electives and allows students to pursue special interests in engineering, physics, biology, mathematics, management, and humanities. Some double-majors can be completed with these degrees, depending on the number of outside credits previously earned. A 5-year combined bachelor’s/master’s degree is available. Courses in the basic sciences and mathematics and in other engineering disciplines, including electrical, civil and materials are required. The major offers elective opportunities in diverse areas such as the physical and mathematical sciences, aerospace engineering, biomedical engineering, and environmental engineering. Students interact with a multidisciplinary faculty both in the classroom and in research laboratories.

The modern engineer must be well versed in communication and teamwork skills, which are developed in courses that involve laboratory exercises, report writing, and recording of oral presentations. Development in solving design problems is cultivated through design electives and special design projects assigned in many of the courses, up to and including the capstone senior design course.

TRACKS: Engineering Mechanics is a highly flexible program, ideal for students who want to specialize in any area of mechanics. Students who pursue tracks within this major, in consultation with their EM advisors, choose a set of technical and engineering course electives that best matches the student’s interests.

The Aerospace Engineering track helps students develop knowledge in areas such as advanced dynamics, flight mechanics, propulsion, aerospace materials and structures, signal processing, control systems, astrophysics and space systems. Students pursuing this track are required to take at least five eligible courses, which count toward the requirements of the Engineering Mechanics and Technical electives in the general EM program.

Another popular track in EM is Biomechanics. The essence of mechanics is the interplay between forces and motion. In biology, mechanics is important at the macroscopic, cellular, and subcellular levels. EM Students pursuing this track are required to take at least six eligible courses, which count toward the requirements of the Engineering Mechanics and Technical electives in the general EM program.
Our time has seen the rapid development of a broad range of technological, scientific, and engineering innovations that shape the way in which contemporary society functions. The pace of these developments will become even faster and more global in this century. The Bachelor of Arts in General Engineering is designed to provide students with the fundamental engineering principles needed to understand the basics of, and to work with, modern technology, innovations and engineering practices.

The B.A. degree with a major in General Engineering is intended for undergraduate students who want to obtain a background in engineering and technology but do not intend to become licensed professional engineers. This degree might be appropriate for you if you plan to pursue graduate or professional study in architecture, business, law (e.g. intellectual property, patent law) or medicine. You may wish to work in areas that relate to engineering and technology such as public policy or business, and prepare yourself to thrive in the global industrial economy.

In this program, you will have a great deal of flexibility in your course selection, within broad guidelines. You will have significant math, science, and engineering requirements, but you will also have the opportunity to include more humanities, social science, and writing courses than a typical engineering program. In your program, you will need to make choices that provide exposure to the international dimensions of engineering (either by study abroad or relevant coursework).

**Recommended schedule**

### Fall Semester

<table>
<thead>
<tr>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus I or II</td>
<td>110.108 or 110.109</td>
</tr>
<tr>
<td>or other math course</td>
<td>110.xxx</td>
</tr>
<tr>
<td>Intro Chemistry I</td>
<td>030.101</td>
</tr>
<tr>
<td>Intro Chemistry Lab I</td>
<td>030.105</td>
</tr>
<tr>
<td>Intro Engineering course*</td>
<td>530.115</td>
</tr>
<tr>
<td>Humanities/Social Science Writing Intensive course</td>
<td>530.123</td>
</tr>
<tr>
<td>Optional HEART course</td>
<td>500.111</td>
</tr>
<tr>
<td>Total Credits</td>
<td>16.5-17.5</td>
</tr>
</tbody>
</table>

**Special Note:** 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 during the fall semester. FYS courses carry course numbers EN.501.1XX.

### Spring Semester

<table>
<thead>
<tr>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus II</td>
<td>110.109</td>
</tr>
<tr>
<td>Gateway Computing:</td>
<td></td>
</tr>
<tr>
<td>MATLAB**</td>
<td>500.114</td>
</tr>
<tr>
<td>MechE Undergraduate Seminar I</td>
<td>530.108</td>
</tr>
<tr>
<td>MechE Freshman Lab II*</td>
<td>530.116</td>
</tr>
<tr>
<td>Intro to Mechanics II</td>
<td>530.124</td>
</tr>
<tr>
<td>Basic Science Elective</td>
<td>530.107</td>
</tr>
<tr>
<td>Humanities/Social Science course</td>
<td>530.123</td>
</tr>
<tr>
<td>Total Credits</td>
<td>16.5</td>
</tr>
</tbody>
</table>

*Alternate introductory course sequence: 500.101, What is Engineering (3) or other acceptable introduction to engineering course, plus 171.101/171.107, Physics I (4) and 173.111, Physics Lab I (1).

**See page 30 for the IMPORTANT NOTE.**
Undecided Engineering

The following core curriculum has been developed for students who are undecided about a specific major. Completing this program will allow you to transfer into any engineering department (except BME) during or at the end of your first year and complete the requirements in time to graduate within the normal four year period. All engineering students enroll in an introductory engineering course. You may choose to take What Is Engineering? 500.101, a three credit course combining hands-on projects and lectures to introduce engineering as a field of study, a profession, and an academic pursuit. However, you may choose to take an introductory engineering course offered by one of the major departments instead. Another course that is encouraged for undecided engineering students to take is 500.103, Hopkins Engineering Sampler Seminar, in order to become familiar with the major and minor programs available in the Whiting School of Engineering.

### Schedule for a student beginning with Calculus I

**Fall Semester**

<table>
<thead>
<tr>
<th>Course</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus I</td>
<td>110.108</td>
<td>4</td>
</tr>
<tr>
<td>Intro Chemistry I</td>
<td>030.101</td>
<td>3</td>
</tr>
<tr>
<td>Intro Chemistry Lab I</td>
<td>030.105</td>
<td>1</td>
</tr>
<tr>
<td>Intro Engineering course</td>
<td>1-3</td>
<td></td>
</tr>
<tr>
<td>Humanities/Social Science course</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Optional HEART course OR First-Year Seminar</td>
<td>500.111</td>
<td>1</td>
</tr>
<tr>
<td>First-Year Seminar</td>
<td>501.1xx</td>
<td>1-3</td>
</tr>
</tbody>
</table>

**Total Credits**: 13-18

**Spring Semester**

<table>
<thead>
<tr>
<th>Course</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus II</td>
<td>110.109</td>
<td>4</td>
</tr>
<tr>
<td>Intro Chemistry II</td>
<td>030.102</td>
<td>3</td>
</tr>
<tr>
<td>Intro Chemistry Lab II</td>
<td>030.106</td>
<td>1</td>
</tr>
<tr>
<td>General Physics I</td>
<td>171.101</td>
<td>4</td>
</tr>
<tr>
<td>General Physics Lab I</td>
<td>173.111</td>
<td>1</td>
</tr>
<tr>
<td>Humanities/Social Science course</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Total Credits**: 16

### Schedule for a student beginning with Calculus II or III

**Fall Semester**

<table>
<thead>
<tr>
<th>Course</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus II</td>
<td>110.109</td>
<td>4</td>
</tr>
<tr>
<td>or Calculus III</td>
<td>110.202</td>
<td>4</td>
</tr>
<tr>
<td>General Physics I</td>
<td>171.101/107</td>
<td>4</td>
</tr>
<tr>
<td>General Physics Lab I</td>
<td>173.111</td>
<td>1</td>
</tr>
<tr>
<td>Intro Chemistry I</td>
<td>030.101</td>
<td>3</td>
</tr>
<tr>
<td>Intro Chemistry Lab I</td>
<td>030.105</td>
<td>1</td>
</tr>
<tr>
<td>Intro Engineering course</td>
<td>1-3</td>
<td></td>
</tr>
<tr>
<td>Optional HEART course</td>
<td>500.111</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total Credits**: 16-18

**Spring Semester**

<table>
<thead>
<tr>
<th>Course</th>
<th>Course #</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus III</td>
<td>110.202</td>
<td>4</td>
</tr>
<tr>
<td>or other math</td>
<td>110.xxx</td>
<td>4</td>
</tr>
<tr>
<td>General Physics II</td>
<td>171.102/108</td>
<td>4</td>
</tr>
<tr>
<td>General Physics Lab II</td>
<td>173.112</td>
<td>1</td>
</tr>
<tr>
<td>Intro Chemistry II</td>
<td>030.102</td>
<td>3</td>
</tr>
<tr>
<td>Intro Chemistry Lab II</td>
<td>030.106</td>
<td>1</td>
</tr>
<tr>
<td>Humanities/Social Science course</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Total Credits**: 16

*Students may select one Intro Engineering course from the following choices: 500.101, 500.103, 540.101, 560.100, 520.137, 570.108, 510.106.*
The Laboratory for Computational Sensing and Robotics (LCSR) offers an interdisciplinary minor in computer integrated surgery (CIS). To complete the minor in CIS, you will work with an advisor from the LCSR. The minor is particularly well-suited for students interested in computer integrated surgery issues who are majoring in a variety of disciplines, including biomedical engineering (BME), computer science (CS), computer engineering (CompE), electrical engineering (EE) and mechanical engineering (ME).

To satisfy the requirements for the minor in CIS, you must have a fundamental background in computer programming and computer science. Required fundamental mathematics courses include Calculus I, II and III, and Linear Algebra. Moving beyond the foundation, you’ll take at least six courses directly related to concepts relevant to CIS, including Computer Integrated Surgery I. Other course choices include courses in imaging, such as Computer Vision, Image Processing and Analysis, and Medical Imaging Systems; and courses in robotics, such as Robotic Sensors and Actuators, Mechatronics, and Introduction to Robotics.

For more information, visit our website at https://lcsr.jhu.edu/computer-integrated-surgery-minor/.
Computational Medicine Minor

Computational Medicine (CM) integrates engineering, computer science, and mathematics to build computer models of disease, personalize these models using patient data, and apply them to diagnose and treat individual patients. CM has application in many disciplines such as genetics, genomics, molecular networks, cellular and tissue physiology, organ systems, and pharmacology.

The CM minor offered through the Institute for Computational Medicine (ICM) is available to undergraduates in the Whiting School of Engineering and the Krieger School of Arts and Sciences who have sufficient mathematical, biology, and programming background. You will be advised by an ICM faculty member who conducts research in CM. Working with your advisor, you may tailor your coursework and research in the areas of CM that interest you. While research is optional, it can provide valuable hands-on experience.

Upon completion of the prerequisite courses, you will complete three core CM courses and 12 additional credits of CM elective courses for a total of at least 18 credit. You will also attend six ICM Distinguished Seminars at your own pace by graduation.

For more information regarding the CM minor, visit https://icm.jhu.edu/academics/undergraduate-programs/undergraduate-minor/.

Robotics Minor

The Laboratory for Computational Sensing and Robotics (LCSR) offers a robotics minor that helps undergraduate students at Johns Hopkins University advance their knowledge in robotics. Any student from any department within the university can work toward the minor. To complete the minor in Robotics, you will work with an advisor from LCSR.

Robotics is fundamentally integrative and multidisciplinary. Therefore, any candidate for the robotics minor must cover a set of core skills that cut across these disciplines, as well as obtain advanced supplementary skills. Core skills include:

Robot kinematics and dynamics (R)
Systems theory, signal processing, control (S)
Computation and sensing (C)

Supplementary advanced skills may be obtained in specialized applications—such as space, medicine, or marine systems—or in one of the three core areas listed above.

For more details, please visit https://lcsr.jhu.edu/robotics-minor/
Engineering for Sustainable Development Minor

Engineers are increasingly called upon to help devise solutions to the tremendous problems of poverty, inequality, and social and environmental dislocation that afflict major parts of the globe in the 21st century, including our own.

Working as an engineer in this context involves negotiating highly complex social, economic and political realities and dealing with a wide range of institutions and actors, including national and local governments, multilateral lenders such as the World Bank, diverse non-governmental organizations (NGOs) and local communities. It also involves working in interdisciplinary teams with social scientists, public health and medical workers, humanitarian aid workers, bankers, politicians and the like.

“Sustainable” development implies a development path that is socially equitable, culturally sensitive, and environmentally appropriate over a multi-generational time frame.

The minor in engineering for sustainable development exposes students from all engineering disciplines to some of the key issues related to development, methods of information-gathering in diverse and difficult settings and working effectively with non-engineers on complex problems. We begin with a one-semester core course that surveys the various issues involved, followed by an individually-designed but coherent program organized around a particular theme, disciplinary approach or region of the world.

All courses must be completed with a grade of C- or better to qualify for the minor. At least two semesters of foreign language study are strongly recommended but not required. Students who participate in a Study Abroad program for a semester can, with the minor advisor’s consent, use this experience to count in place of one of the required courses.

Structure and Content of the Minor

Students pursuing the minor are required to take seven courses. The core course is 570.110, Introduction to Engineering for Sustainable Development. Six additional courses will be selected in a program devised in consultation with the minor advisor.

Of the six additional courses:

- Three must be grouped around a specific theme, region or within a specific discipline. Themes might include, for example, public health, environment, or economic development. Regions include Africa, Latin America or Asia. Disciplinary concentrations might be in anthropology, economics, geography, history, political science, public health or sociology.
- Two of the courses must be at the 300-level or above.
- One of the courses must cover methods for gathering and evaluating information about communities you might one day work for. Examples include:
  - 070.132 Invitation to Anthropology
  - 070.317 Anthropological methods
  - 230.202 Research Methods for the Social Sciences
  - 230.265 Research tools for global sociology and development
  - 190.426 Qualitative research
- The value of this program will be enhanced by some form of hands-on experiential project, whether at a field site in a developing country, in support of field-workers in other divisions of the university or in distressed communities in Baltimore. This experience is not required for the minor, but we hope to provide guidance to students interested in pursuing such a project.

The minor is housed in the Department of Environmental Health & Engineering.

Contact Professor Erica Schoenberger at ericas@jhu.edu for more information.
Energy Minor

Energy touches all aspects of the human experience and is central to nearly every global challenge the world faces today, from raising the standards of living around the world to the existential threat of climate change. The scientific basis of energy is inherently multidisciplinary, and social and behavioral sciences are also crucial to understanding the economics and policy driving technology adoption. The Energy minor program addresses the growing need for trained engineers and scientists in the many sectors that develop, manage, and propagate these technologies.

The Energy minor is jointly administered by the Department of Earth and Planetary Sciences in the Krieger School of Arts and Sciences and the Department of Electrical and Computer Engineering in the Whiting School of Engineering and is affiliated with the Ralph O’Connor Sustainable Energy Institute (ROSEI, https://energyinstitute.jhu.edu/) which provides additional support and co-curricular opportunities to students in the program. If you have questions regarding the minor, please direct them to Professor Susanna Thon at susanna.thon@jhu.edu.

The Energy minor is designed to allow students majoring in a diverse set of disciplines to develop additional expertise in energy and to position them to become leaders in the energy field, either directly as entering professionals in industry, government laboratories, and other organizations, or as students in the best graduate programs. It consists of 18–20 credits of energy-related courses in three areas: (a) fundamentals, (b) science and policy context, and (c) technical energy electives. Students are encouraged to select electives to fit their particular interests and career goals.

Elective courses that can count toward the minor are those focused on science and policy issues related to energy and relevant technical skills and knowledge areas. The joint KSAS and WSE Directors of Undergraduate Studies (DUS) distribute a list of approved courses for the minor each semester, and these courses are denoted with the POS tags ENGY-SCIPOL and ENGY-TECH in the Schedule of Classes. Approval for other appropriate courses can be sought by emailing one of the DUS’s. All courses must be taken for a letter grade, and students must earn a grade of C- or better to apply the course to the minor. Consult the Energy minor’s website for additional information: https://energyinstitute.jhu.edu/energy-minor/.
The primary goal of the Center for Leadership Education (CLE) is to provide Hopkins students with the knowledge and skills necessary to become leaders in public and private for-profit and non-profit enterprises. This is accomplished by focusing on innovation and entrepreneurship from a multidisciplinary viewpoint and offering students a diversified learning experience that emphasizes the concepts, practices and skills necessary for effective leadership. In addition, the CLE administers a number of minors: Accounting and Financial Management; Entrepreneurship and Management; Leadership Studies; and Marketing and Communications (many students choose to double minor).

Furthermore, the CLE boasts a talented and dedicated faculty with many years of private enterprise experience in their respective fields. These faculty also advise varied experiential learning programs supported by the CLE.

The CLE is focused on meeting student needs, whether a student wants to enter the corporate world; start a new venture; work in consulting or financial services; or pursue a professional graduate degree. Engineering students often find that a background in innovation, entrepreneurship, and communications is crucial for professional advancement. Employers are particularly interested in engineering students who have taken a variety of courses in innovation and entrepreneurship and demonstrate the ability to work in multi-disciplinary teams. All undergraduate courses and minors offered by the CLE are open to students in the Kreiger School of Arts and Sciences, the Whiting School of Engineering, the School of Public Health, and the Peabody Institute.

At the graduate level, the CLE directs the Master of Science in Engineering Management (MSEM) program, which bridges the gap between technology and enterprise by equipping students with the technical expertise and leadership skills they need to advance their career in the fast-paced world of technology.

Typically, selected Hopkins undergraduates can complete a concurrent BS and MSEM degree in five years and receive a 50 percent tuition fellowship for their MSEM degree.

In addition to academics, the CLE offers many experientially-based programs to help students gain valuable real-world experience. Student groups and events include Hopkins Student Enterprises, the Marshal Salant Student Investment Team, the annual JHU HopStart: Hopkins New Venture Challenge and professional internships for academic credit.

For more information about CLE programs, please visit http://web.jhu.edu/leadership.

**CLE administered minors**

The **Accounting and Financial Management minor** offers Hopkins students a focused, quantitative minor that will prepare them more effectively for careers in small companies, major corporations and consultancies, as well as acceptance into professional graduate programs.

This minor enables students in all disciplines to complement their major fields of study with the academic training necessary for them to compete within the expanding marketplace. Requirements for the minor can be found at https://engineering.jhu.edu/cle/accounting-financial-management/.

The **Entrepreneurship and Management (E&M) minor** provides Johns Hopkins Arts and Sciences, Engineering and Peabody students with the fundamentals of marketing, finance, accounting, management, law and leadership. The minor’s three core courses provide a strong foundation in the fundamentals of entrepreneurial enterprises, and the minor’s upper-level electives provide students with the skills necessary to advance in the public and private sectors. The courses in the E&M minor are engaging and challenging with a focus on enterprise-related issues with practical applications. Requirements for the minor can be found at https://engineering.jhu.edu/cle/programs-minors/em_minor/.
The **Leadership Studies minor** helps students position themselves as leaders among their peers in entrepreneurial ventures in private industry, government, and academia. Through a multidisciplinary approach, students will learn about transformational leadership, contributing to community growth and coalition development, building relationships with a range of stakeholders, managing brands and messaging, and establishing and managing social enterprises.

The **Marketing and Communications (M&C) minor** offers students a broad array of courses designed to equip them to lead in the fields of marketing and communications and complements major courses of study in departments across campus. Students will begin with the minor’s four core courses, which will provide them with a foundation in the fundamentals of entrepreneurial enterprises. Students will then select four upper-level electives from a variety of courses preparing them for careers in product or marketing management at a large-scale enterprise or in the creative side of the marketing field, including areas such as advertising, public relations, and social media.

As a starting point, there are several courses available to freshmen who wish to build a foundation for entrepreneurship and communications. Please see the course listings section in the back of this guide for detailed course descriptions.

- 660.105 Foundations of American Enterprise
- 660.203 Financial Accounting
- 660.250 Identifying and Capturing Markets
- 661.110 Professional Writing and Communications
- 661.250 Oral Presentations

Courses are open to all students regardless of whether they choose to declare a minor or not.

**Master of Science in Engineering Management (MSEM)**

The MSEM program bridges the gap between technology and enterprise by equipping engineers with the leadership and professional skills to succeed in the professional world. On the technical side, all students complete five advanced engineering and science courses. On the management side, students participate in a cohort program, taking three management courses together in the first semester: Strategies for Innovation and Growth, Strategies for Accounting and Finance, and Professional Presentations. The following spring, MSEM students take half-semester courses in Managing People and Leading Change and may choose among a varied slate of electives to fill out their course load. In between semesters, students participate in a three-week course, officially titled The Practice of Consulting and unofficially referred to as the Immersion Experience. This course allows teams of students to immerse themselves in consulting projects, some abroad and some in the U.S. Students often cite the Immersion Experience as the highlight of the MSEM program.
EXPERIENCE ENTREPRENEURSHIP

Professional Internships
Gaining valuable work experience during college is critical for success after graduation. The CLE sponsors select students for internships for academic credit each semester. Our faculty internship coordinator works closely with approved students to help them secure internships in fields like communications, finance and marketing. Freshmen who may be interested in this opportunity in the future are encouraged to review our requirements and stop by our office for advice.

Student Organizations
The CLE supports a number of enterprise-focused student associations and professional societies including the Women in Business, the JHU Chapter of the American Marketing Association, the Marshal Salant Student Investment Team, consulting groups for nonprofit and for-profit organizations, and organizations that foster student entrepreneurship. For more information about these organizations, please see pages 41-60 and visit the referenced websites found there.

HopStart: Hopkins New Venture Challenge
HopStart provides an opportunity for students to develop a business plan based on their novel idea or innovative technology. Starting with a concept, students work with mentors to build an understanding of their target market, analyze potential competitors and craft an effective market entry strategy. Finalists present their ideas to a panel of experts and more than $40,000 in prizes are awarded across three categories: General Ventures, Medical Technology and Life Science Ventures, and Sustainability Ventures. The competition is open to full-time and part-time undergraduate and graduate students, including postdocs, from any of the nine academic divisions of the University. To learn more, visit http://hopstart.jhu.edu.

Space Science and Engineering Minor

The objective of the minor is to prepare a student for a career in space science and space engineering, either directly as an entering professional in industry, government laboratories, and other organizations, or as a student in a graduate program. The educational goals of the minor are to enable students to:

• Apply an understanding and mastery of the fundamental scientific, engineering, and mathematical principles obtained through the major subject of study to space science and space engineering
• Help to develop an understanding and capacity for interdisciplinary approaches to technical activities

• Improve the ability to work in multidisciplinary teams, which are typical in space and other complex technical activities, through interdisciplinary education and internship(s) or equivalent experience(s). Students seeking a minor in space science and engineering take five courses: Introduction to Space Science and Technology (AS.171.321), plus four additional courses that are chosen by the student and approved by an advisor. Students are required to submit a proposal and course plan to their advisor early in their program, prior to taking the courses. The minor in space science and engineering also carries an internship (or equivalent experience) requirement.

Detailed information about the minor is available in the handbook for the minor, available at https://spacestudies.jhu.edu/space-minor/
Pre-Professional Advising for Engineers

The mission of the Office of Pre-Professional Programs and Advising is “to serve as the university leader in providing advising, resources, services, and programs that support Homewood undergraduates and alumni pursuing professional education in medicine, other health professions, and law.” Our office offers individual advising appointments, drop-in appointments, freshman workshops, medical school webinars, application workshops, online guides and resources, and other services to assist you with every step of your journey to graduate or professional school. Our goals are to encourage students to pursue a holistic approach to education, to be reflective about learning and decision-making, and to demonstrate social responsibility and a commitment to volunteerism in preparation for a career of service.

Pre-Health Students
The Pre-Professional Advising Office encourages all pre-health students to download and read Guide One: Pre-Med and Pre-Health Planning at Johns Hopkins University. The guide, which is updated in the summer, includes an overview of pre-health curricular requirements, course planning considerations, and a planning checklist. Guide One can be found here: https://studentaffairs.jhu.edu/preprofadvising/pre-medhealth/guides/.

Pre-Health 101
As a first-year student interested in the health professions, you will be attending a “Pre-Health 101” workshop during freshman year. Attendance at Pre-Health 101 is required prior to scheduling your first individual appointment with a Pre-Professional advisor. Registration instructions will be available at the beginning of the fall semester.

*Pre-law students are not required to attend a workshop and can therefore schedule an individual advising appointment at any time.

Staying Connected
The summer before you arrive on campus, you will automatically be put on the “jhugradyear2026health” or “jhugradyear2026law” listserv, depending on your articulated interests. It is essential that all pre-professional students at Hopkins be on a listserv to receive our newsletter, information on workshops, events, internships, volunteer opportunities, etc. It is essential that all pre-professional students at Hopkins be on a listserv to receive our newsletters, information on workshops, events, internships, volunteer opportunities, etc. We also suggest students follow us on Instagram @jhuprehealth to hear about programs and activities as they arise.

In closing, the Pre-Professional Advising Office welcomes you to Johns Hopkins University and looks forward to working with you in the years ahead. For more information about Pre-Professional Advising, please take the time to browse our website: http://studentaffairs.jhu.edu/preprofadvising/.
Study Abroad Opportunities for Engineers

Students at Johns Hopkins have numerous possibilities for studying abroad. Maybe you’ve always wanted to learn about high tech entrepreneurship in Israel, study wind energy in Denmark, conduct robotics research in Singapore, or develop affordable health care solutions in Uganda. The sky really is the limit if you choose to investigate all the opportunities you have for going abroad.

If you are interested in going abroad, you should get started on the planning process early - even as early as your freshman year. Here are some things to start thinking about:

• Do I want to take a language to prepare myself for going abroad?
• Will I want to take my classes abroad in English or in another language?
• When is the best time in my academic career to study abroad (spring of sophomore year, or junior year, or intersession or summer?)
• Am I more interested in studying abroad or researching, interning, or volunteering abroad?
• What countries would I like to travel to?

For more information on general study abroad opportunities, visit the Study Abroad Office in Levering Hall or visit our website: https://studyabroad.jhu.edu/. The study abroad advisors can help you choose the best program to meet your academic, cultural, and other goals.

In addition to general study abroad opportunities, there are international experiences designed specifically for engineering students:

• Hopkins Engineering Exchange Programs: A number of engineering departments sponsor exchange programs that directly support major and minor requirements at world-renowned universities such as the Danish Technical University (DTU), École Polytechnique Fédérale de Lausanne (EPFL), the National University of Singapore (NUS), the Technion—Israel Institute of Technology, and Universidad Carlos III in Madrid. Most of the Hopkins Engineering Exchanges also offer students the opportunity to earn 3 credits and collaborate on international engineering projects for 8 weeks during the summer. Summer engineering projects are available at DTU, EPFL and NUS, as well as at Shanghai Jiao Tong University and Universidad Carlos III in Madrid. Students may apply to the Vredenburg Travel Fund for assistance in covering the cost of these and other summer engineering projects. Students who are interested in an exchange program should consult a study abroad advisor.

• Vredenburg Travel Fund: This fund is only open to sophomore and junior engineering majors. It provides an opportunity for students to apply their engineering skills to a research experience, a community service project, or an internship abroad during the summer. Students submit project proposals, and approximately 12-18 students receive the award each year. The fund covers travel and living expenses abroad, and is a great way to get some hands-on experience in the engineering field while experiencing a different culture. The Vredenburg Travel Fund has been called “one of the best opportunities at Hopkins” and has sent over 100 students to places around the world including Chile, Tanzania, Australia, India, China, England, Denmark, and Singapore, just to name a few. For information on this funding, email vredenburg@jhu.edu.
GETTING INVOLVED IN STUDENT GROUPS

The following student organizations are co-curricular groups committed to enhancing your academic and professional growth. These groups range from student chapters of professional organizations to groups of students who share similar backgrounds or interests. Participating in these groups is a great way to meet new people, learn more about your major, make professional connections and have fun. To contact a student group, visit Hopkins Groups and search the group's name. This will bring you to their page where you can find additional information.

Hopkins Groups at Johns Hopkins University is located at https://jhu.campusgroups.com/home_login

Alpha Eta Mu Beta (AHMB)

Alpha Eta Mu Beta (AHMB) is the International Biomedical Engineering Honor Society. Established in 1979, AHMB was formed to recognize and encourage excellence in the field of Biomedical Engineering and Bioengineering. The Hopkins chapter was originally established in 1996. Membership into AHMB consists of those individuals in the field of Biomedical Engineering or Bioengineering who through their attainments in college or in practice have manifested a deep interest and marked ability in their chosen life work. The purpose of AHMB is to bring these individuals into closer union so as to promote an understanding of the profession. Members are recognized in an outstanding manner for having conferred honor on their Alma Mater by distinguished scholarship, exemplary character, honorable activities, and leadership.

AHMB's mission is:
1. To encourage participation in those activities that may be beneficial to the profession of Biomedical Engineering/Bioengineering.
2. To further unify the student body of the departments of Biomedical Engineering and Bioengineering in presenting its needs and ideals to the faculty.
3. To create a closer student-faculty relationship by periodically bringing together the thoughts and needs of both.
4. To assist and cooperate with all organizations and persons working for the interests of Biomedical Engineering and Bioengineering.
5. To benefit its members by the association and experience that can come from bringing together a group with similar interests, objectives and abilities.
6. To promote the professional development and welfare of its members.
Established in 1904, Alpha Kappa Psi is the oldest and largest business fraternity in the world. It is recognized as the premier developer of principled business leaders. Since the founding of the Rho Psi chapter at Johns Hopkins University in 2001, we have continued to attract JHU’s highest-achieving students to foster a community of growth, brotherhood, and success.

What We Do:
AKPsi advances and sustains each brother’s business interest, while ensuring a close, communal brotherhood that supports each member’s development. Our members and alumni have worked in diverse industries, at companies such as Google, Amazon, Facebook, JPMorgan, Bain & Co., McKinsey & Co., Bridgewater Associates, Capital One, Bloomberg, and Goldman Sachs. Some have successfully established their own companies and subsequently became finalists at TechCrunch Disrupt, the world’s premier startup competition. Others have founded their own non-profit organizations. In general, joining the brotherhood means having access to the following:

- A thorough introduction to entrepreneurship, finance, consulting, or marketing depending on your field of interest
- Networking and professional development, including resume review, interview prep, and industry knowledge, with fellow brothers and other chapters in the area
- Access to an alumni database containing nearly 20 years’ worth of highly successful Rho Psi chapter alumni in diverse fields of industry including engineering, medicine, media, and traditional business
- 70+ experienced brothers eager to help you with any professional, academic, or social needs that you may have

How to Join:
AKPsi conducts a fall rush for sophomores and upperclassmen and a spring rush open to all classes. We carefully assess each candidate through a series of socially and professionally geared events, focusing on each candidate’s drive and passion for learning. If chosen, you will go through a six-week business-focused pledging process that will provide an in-depth introduction to one of the four fields of business as well as prepare you to become a long-term contributing member of the fraternity. Visit our Facebook page at www.facebook.com/johnshopkinsakpsi and our Instagram at instagram.com/akpsi_jhu for more information.
In January 2007, the student chapter of the American Institute of Chemical Engineers (AIChE) changed its name to the American Institute of Chemical Engineers / Society for Biological Engineering (AIChE/SBE) to reflect the organization’s shift in focus to incorporating both biological engineering and chemical engineering affairs. AIChE/SBE is committed to furthering the educational experience of chemical and biomolecular engineering students and all other interested students at Johns Hopkins. The chapter’s mission is to create a network of upstanding undergraduate students dedicated to chemical and biomolecular engineering and the pursuit of knowledge. The chapter serves as a liaison between the student body, the department faculty, and chemical and biological engineering professionals in industry. The main purposes of the chapter are to organize social activities, educational forums, and inspirational talks, and to facilitate social interaction amongst students, professors, and professionals.

Some of our events include...
- Networking Events such as Lunch n’ Learns with faculty and industry professionals and Research panels,
- Professional development events such as scheduling workshops with upperclassmen and diversity and inclusion workshops,
- Seasonal Events such as Halloween Party and ChemBE Formal in the Spring,
- Social events such as weekly social hours and monthly game nights, and
- Production of department-related items such as apparel and senior yearbooks.

Interested?
View our organization on Hopkins Groups or e-mail aiche.hopkins@gmail.com to request being placed on the mailing list. E-board elections take place every Spring (exception is Fall for freshman class reps) and are open to all ChemBE undergraduates!
Our organization’s mission is to provide a social forum for civil engineering students to network, collaborate on engineering projects, participate in service projects, and otherwise enrich their education with extracurricular, civil engineering-based opportunities...and to have fun!

**What we do:**

- We organize field trips to interesting sites in the area. Past trips have included local infrastructure improvement projects such as the Druid Lake Reservoir project, the Jericho covered bridge rehabilitation, and our own Gilman Hall.
- We sponsor trips to monthly ASCE Maryland Chapter meetings where students and practicing engineers can network and socialize.
- We organize trips to monthly ASCE SEI Maryland Section meetings where students can participate in technical presentations, field trips, and social events.
- We participate in ASCE regional conferences with other civil engineering programs in the mid-Atlantic region.
- We host a BBQ on campus every fall and spring, which brings together students, faculty, and staff from the department.
- We participate in community service projects including Presidents Day of Service and the Maryland Wood Bridge Challenge.

**Interested?**

- Email us at [asce.jhuchapter@gmail.com](mailto:asce.jhuchapter@gmail.com).

And be sure to come to one of our BBQs on the Latrobe patio! There you’ll meet the officers and learn more about being an active member in our student chapter.
The JHU ASME chapter aims to enhance students’ academic and professional aspirations by providing them with opportunities to get involved with research and find internships. The chapter also organizes social events that allow students to interact and connect with other students, faculty members, alumni, and engineering professionals in the Baltimore area.

What we do:

Lunch with Professors Series: ASME hosts lunches with prominent JHU Mechanical engineering professors roughly three times a semester with delicious food delivered from local restaurants. Through these lunches, the chapter provides students with the opportunity to interact with professors and other faculty members in a casual setting outside of class. These lunches also provide students with an excellent opportunity to get involved with research as these professors are often seeking to hire students as undergraduate research assistants. The professors also use these lunches as a way to gain feedback about the mechanical engineering curriculum and advising, and so it is a very easy way for students to voice their thoughts in a casual setting. ASME also asks for feedback after each lunch about what can be done better next time, and potential professors to invite next.

ASME Excursions: The ASME chapter attends trips to facilities related to mechanical engineering, occasionally with the Baltimore ASME chapter, consisting of important Baltimore mechanical engineers. Recent trips have included brunch at Little Havana, a private tour of the Baltimore Museum of Industry, and trips to Camden Yards and the Fort McHenry Tunnel.

Alumni Connections and Jobs Database: A number of alumni members support our efforts and help students build their careers. By connecting students with these alumni and offering students the opportunity to be mentored by a member of our alumni or attend a speech by the alum, the chapter hopes to provide students with the ability to find an internship or job that fits their interests and careers aspirations.

Volunteers for Medical Engineering: The ASME-VME team is dedicated to helping disabled children and adults in the Baltimore area by creating highly specialized medical devices on a client by client basis. The expanding team works closely with its clients to make sure each design is aesthetic, functional, and cost-effective and each member is highly involved with the design and manufacturing process. The VME mission statement states, “The goal is to provide independence through technology to those in Baltimore City, where more than 14% of the population has a disability and 21% live in poverty.” Students are welcome to join these specialized teams as well as be a member of the general ASME club or executive board.

Interested in Joining the ASME Executive Board?
The ASME Executive Board consists of many dedicated and hardworking students who fill the following positions: President, Treasurer, Alumni Relations Liaison, Department Liaison, ASME Baltimore Coordinator, and Social Chair. The students in these positions work together to plan lunch with JHU professors, social events such as mechanical engineering formals hosted at the Baltimore engineers club, professional events such as internship or job panels, or excursions into Baltimore mechanical engineering facilities. The ASME Executive Board members work together to connect students with professors, internships, and the greater mechanical engineering community. ASME is always looking for new students dedicated to this mission. If you have any questions, look for our emails, forwarded by the mechanical engineering department, or reach out at asme.jhu@gmail.com.
Association for Computing Machinery (ACM)

We are the JHU student chapter of the Association for Computing Machinery, the first international computing organization. Our members are dedicated to promoting a passion for computer science in the Hopkins community in various forms. We host events every week, including panels with industry recruiters like Bloomberg, technical interview preparation workshops, resume reviews, social events, special topic lectures with CS professors, and more. We also compete in the International Collegiate Programming Contest (ICPC), which is the largest computer science contest in the world. Students competing in ICPC can develop algorithmic thinking skills, add their skills to their resumes, and get job interviews!

Key Events:
- Resume/Internship Workshop with tech companies like Bloomberg
- Krasnopoler Lecture with Distinguished guest speakers. Some of our past speakers include:
  - Alex Halderman: Sloan Research Fellowship award winner (2021 fall)
  - Jaime Teevan: Chief Scientist at Microsoft (2022 spring)
  - Ed Catmull: Co-Founder of Pixar (2021 spring)
- Mock Technical Interviews with members who had internship/working experiences at FAANG and other big tech companies
- Internship panel with members who interned at FAANG and other big tech companies
- Monthly social nights to engage with peers in the Hopkins community

Interested?
To become a member of ACM, you must attend at least three meetings during the current academic year. All members have access to our ACM lounge in Malone Hall and are registered on the official, national ACM page as a member of JHU ACM. For more information, you can find us on Hopkins Groups.

Biomedical Engineering Society (BMES)

Our mission:
“To promote awareness of biomedical engineering knowledge and its utilization”
- National BMES

The BMES chapter at Johns Hopkins is a student-run organization dedicated to serving the BME community. In addition to providing academic services, BMES also hosts social events, which serve to foster a sense of camaraderie among students and faculty.

What we do:
- Graduate/Medical School Advising Session: Puzzled by the medical or graduate school admission process? Attend our advising session, and listen to guest speakers from the BME department and medical campus speak on the latest in admission strategy.
- BME Winter Social: A wonderful evening for the entire Hopkins BME community where students, staff, and faculty mingle with each other. Enjoy fully catered hors d’oeuvres, and music by the Hopkins Jazz Band for a relaxing night.
- Student Mentor Program: Each incoming freshman is assigned an upperclassman (selected through an application process) who will provide academic and social guidance.
- Socials: Fall dessert socials, spring picnics, movie nights.

Interested?
All students whose declared major is BME will automatically receive event announcements from BMES. Dedicated students should email jhu.bmes@gmail.com for volunteer opportunities, and there are opportunities in the fall for freshmen to apply to the BMES board. For more information, visit our Hopkins Groups page.
Design, Build, Fly

Design, Build, Fly (DBF) members are united by their keen interest in flight vehicles and collaborative engineering projects. Together they learn about the design of aircraft, with focuses on structures, aerodynamics, propulsion, and controls.

Every April, the team creates an RC airplane to compete against 100+ universities from around the world at a competition hosted by the American Institute of Aeronautics and Astronautics. The design challenge changes each year, so the team constantly engages in innovative engineering. Examples of previous competitions include: a passenger aircraft for bouncy balls, a fighter plane to emulate aircraft carrier operations, and a mini airplane to take off from another airplane already in flight.

DBF at JHU not only fosters design and manufacturing skills, but also collaboration within the team and with the international DBF community. Members of all background are welcome and zero experience is required!

Interested?
Visit our Facebook page: https://www.facebook.com/JHU.DBF/, and email dbf@jhu.edu for more information.

Earthquake Engineering Research Institute (EERI)

The objective of the Earthquake Engineering Research Institute (EERI) is to reduce earthquake risk by (1) advancing the science and practice of earthquake engineering, (2) improving understanding of the impact of earthquakes on the physical, social, economic, political, and cultural environment, and (3) advocating comprehensive and realistic measures for reducing the harmful effects of earthquakes. The EERI Johns Hopkins Student Chapter contributes to these objectives by holding special seminars and sharing information, news, and recent scientific advances regarding earthquake engineering and seismic risk mitigation with undergraduate and graduate students.
Engineers Without Borders-USA seeks to partner with low-resource communities to work together on environmentally and economically sustainable engineering projects while developing internationally responsible students. As undergraduate students at Johns Hopkins University, we share the university’s long-standing interests and commitment to public health, human welfare, and environmental responsibility, and we therefore intend to apply our own abilities and time toward the fulfillment of this mission. For more info, visit the national EWB-USA website at www.ewb-usa.org and the Johns Hopkins chapter website at http://ewb.jhu.edu.

What we do:

• Developmental projects with partnered communities. These projects are partnerships between students, faculty, professional engineers, and the host community. Students work on the designs of the projects during the semester, and small teams are formed to travel to the communities to implement the projects during breaks.

• In recent years, EWB-JHU worked on two international projects in Guatemala and Ecuador. While these specific projects focused on the design of a water distribution system, bridge, and stormwater drainage system, they incorporate many non-engineering skills, such as fundraising, translating, and communicating with project stakeholders.

• EWB-JHU also has two local Baltimore-based active projects; they focus on teaching STEM topics to elementary school students and designing solution to local community challenges, such as drainage issues at an urban farm and revitalizing outdoor spaces and abandoned buildings to create community spaces.

• In addition to engineering students, students from various majors such as health sciences, anthropology, international relations, writing seminars and economics can contribute to the successful implementation of the projects. In short, any student can participate in EWB!

• EWB-JHU aims to educate members on the importance of understanding a community’s culture, politics, and history to design a project that properly addresses their needs. Member trainings and workshops are opportunities for members to learn how to be ethical engineers and apply these skills to their work in EWB.

Why get involved?

• Partner with communities both locally and internationally to address pressing challenges

• Gain important analytical thinking and problem solving skills relevant to a variety of careers

• Have unique practical learning experiences with other college students

• Connect with members of the communities we work with, and with other members of EWB-JHU who share a passion for helping others

• Build your knowledge and abilities

• Build something with meaningful impact

• Give yourself outstanding opportunities for personal growth

Interested?

Email us at ewb.jhu@gmail.com or visit us at www.facebook.com/jhuewbusa/.
HopAI

The Artificial Intelligence Society at Johns Hopkins strives to connect students and academics from different fields of study and levels of expertise who share a common interest and curiosity for Artificial Intelligence (AI). It provides a platform for this diverse community to educate one another about AI and to examine the present and future issues and impacts of AI from varying perspectives. Through multidisciplinary discussion and debate, HopAI encourages awareness of work in varying fields of study and creates an integrative network across Johns Hopkins University. The organization cultivates interdisciplinary conversation and collaboration that is crucial for innovation and success for students at the university. Check out our website on Hopkins Groups at https://jhu.campusgroups.com/hopai/home/.

Hopkins Baja, “Blue Jay Racing”

The JHU Baja SAE team, otherwise known as Blue Jay Racing, is a student-run team in the Department of Mechanical Engineering that designs, builds, and tests a single-seat off-road vehicle every year. The team was founded in 2004 and has completed 18 vehicles to date. Each year, the team competes against 100+ other collegiate teams at three events across the country. Blue Jay Racing gives students the unique opportunity to go beyond what the classroom has to offer and gain valuable hands-on engineering experience in a collaborative environment. No previous experience is required to join - check out our website for more details: http://baja.jhu.edu.

HopHacks

HopHacks is the original student-run hackathon at Johns Hopkins University, running every year since Fall 2013! A hackathon is an event where groups of students work on a software or hardware project over the course of a few days, competing for amazing prizes in various categories. HopHacks is open to students of all skill levels and coding experience! HopHacks provides a nurturing environment with mentorship, food, space, and time for students to work on projects that can turn into startups, or to learn new technologies and skills that prepare them for the real world. We attract sponsor companies such as Google, Microsoft, Amazon, JHU APL, and Bloomberg, who send representatives to our events to provide mentorship, recruit students, and provide swag!

Why Should I Join?

Our annual hackathon is held every September and recruiting for our organizing team happens every spring! Keep an eye out for our promo on social media and around campus. For more information, visit us on Hopkins Groups.
Hopkins Rocketry, “AstroJays”

The JHU Rocketry Team (the AstroJays) is an interdisciplinary team of students that designs, builds, and launches high-powered rockets. Our mission is to improve upon an innovative science and engineering community for rocket and space science enthusiasts at JHU by providing hands-on opportunities in aerospace and related disciplines for students of all majors and skill levels.

The team is split into four subsystems (Avionics, Propulsion, Recovery, and Structure) that work together on projects to bring them to completion.

- Avionics designs and programs the on-board and grounded electronics that control the rocket’s functions.
- Propulsion researches, develops, and builds rocket engines, including hybrid- and liquid-fuel motors.
- Recovery develops unique and reusable systems to safely bring the rocket back to earth.
- Structure builds the body of the rocket and oversees its crucial structural components.

What We Do:
Alongside multiple subscale and certification launches every year, the AstroJays aim to compete annually in high-powered rocketry competitions such as the Spaceport America Cup or FAR 1030. Throughout the year, the team works on researching, designing, developing, testing, and implementing new and experimental aerospace solutions.

Interested?
Visit us at Hopkins Groups and https://www.facebook.com/hopkinsrocketry/ to see photos and posts of what we’re working on now.

Hopkins Undergraduate Society for Applied Mathematics (HUSAM)

The Hopkins Undergraduate Society for Applied Mathematics (HUSAM) is an active community of applied mathematics and statistics undergraduates whose goal is to advance educational and professional opportunities in the mathematical sciences for Johns Hopkins University undergraduates as well as the broader community. HUSAM brings together the applied mathematics community through campus events which provide career information, academic research, professional networking, general enrichment, and broad social opportunities. We host experts and alumni from different mathematical sciences professions, popular speakers, corporate recruiters, and we organize social gatherings. Aside from this, HUSAM bridges between students and faculty at Johns Hopkins. Membership is free and open to all, and the members are a dynamic and exciting group of individuals from all walks of life. Please feel free to contact us for more information.
Materials Research Society (MRS)

The Materials Research Society at JHU connects students with faculty, alumni, and guests who have experience in industry, government, academia, and research laboratories. Our chapter’s mission is to encourage materials research, facilitate connections between students and professionals, and expose students to the vast and exciting field of materials science and engineering that extends outside the classroom.

MRS provides a selection of the following:
- Seminars by faculty, alumni, and guests on various aspects of their research or career paths
- Departmental and chapter social events
- Field trips to industrial, corporate, and government labs
- Upperclassmen panels on research at Hopkins and summer research/internships
- Alumni networking events
- Ability for students to attend and present at MRS conferences
- Exploratory lab experiences, such as edible hydrogels, ceramics, niobium jewelry

Interested?
For more information, look for us on Hopkins Groups.

Institute of Electrical and Electronics Engineers (IEEE)

The Johns Hopkins University student chapter of the Institute of Electrical and Electronic Engineers plays a big role in undergraduate life in the ECE department. Our students are vocal leaders who are committed to academic, professional, and personal growth and are dedicated to creating a dynamic, inclusive, and supportive community. The organization has several working committees, including a social, academic, career, outreach, and diversity committee. IEEE members are committed to fostering relationships among students, faculty, employers and professional engineers.

JHUXplore Club

JHUXplore at JHU introduces and explores the exciting field of user experience (UX), an interdisciplinary field that includes psychology, graphic design, cognitive science, and of course computer science. Ever wondered why your favorite app is so addictive and easy to use? It’s all in the user experience! Learn about important UX principles and techniques to help you develop your app or website!

Our club function is a mix of knowledge and application: we hold weekly GBMs, speaker events, and workshops to teach UX concepts; and competitions, nonprofit projects, and fun campus events to get some hands-on experience with what we learn.

Check out our website: https://jhu.campusgroups.com/jhuxplore/home/

Any questions? Email us at pli36@jh.edu or jhuxplore0@gmail.com.
Medical Technology Network at Johns Hopkins (MTN)

The Medical Technology Network is a student-run organization that provides educational and experiential opportunities to learn about the medical technology field in order to encourage the generation of creative and innovative solutions to current medical problems. Our mission is to promote the development of medical technology innovation at JHU by: (1) facilitating networking opportunities with students and recruiters, (2) hosting speaker series events with academic and industry professionals, (3) educating students about soft and technical skills related to medical technology development, and (4) providing a space to explore and practice medical technology venture. Through collaborations with various professional organizations throughout the JHU network, we bring in engineers, medical personnel, IP lawyers, entrepreneurs, venture capitalists, and more to make medical technology accessible to all interested students!

MedHacks

MedHacks is the nation’s premier medical hackathon. Each year, hundreds of students, clinicians, and engineers come from across the world to innovate at the crossroads of medical entrepreneurship and technological development. It is an event that provides hundreds of like-minded students and professionals with the creative space to tackle some of the world’s most pressing medical issues. Over the course of a weekend, teams of these individuals come together at Johns Hopkins University to research, code, and present their projects to a panel of judges.

Last year, over 1000 participants - consisting of clinicians, data scientists, software engineers, and students of all education levels - attended our first virtual hackathon. Projects that come out of MedHacks often go on to join incubators, have IP filed on their inventions, and turn into full-fledged and heavily funded startups.

Apply to the MedHacks event to be part of the next wave of innovation in medicine! A dedicated team of students organizes this annual hackathon, so also look out for applications to join the organizing team in the winter!
National Society of Black Engineers (NSBE)

We are the Johns Hopkins University Chapter of NSBE, the National Society of Black Engineers. We are a student run organization committed to the recruitment, retention, and successful graduation of blacks and other minorities in engineering and other related technical and scientific fields. The official mission of NSBE, as a national organization, is to increase the number of culturally responsible black engineers who excel academically, succeed professionally, and positively impact the community. As such, NSBE acts as a vehicle to promote unity, emphasize effective leadership, and provide an organizational support network. We do want to put special emphasis that this organization is inclusive to everyone, despite racial or ethnic background. We offer great resources to multicultural STEM students that we’d love to share with you.

What we do:

- Attend NSBE’s phenomenal conferences, where we get the chance to network with students from around the country, land internships from top companies and institutions, win prizes and scholarships, and much more. In the past, our students have had offers from companies such as Intel, Chevron, Boston Scientific, JP Morgan & Chase, Boeing, and Leido’s. The list grows every year!
- Host workshops to help students perfect their resumes, navigate through a career fair, and make use of online resources such as Handshake & LinkedIn.
- Get involved with our Baltimore community through our Engineering Outreach program at the Baltimore Leadership School for Young Women (BLSYW). We introduce the girls to different engineering disciplines, followed by a hands-on activity related to the field.
- Get to know our NSBE family through game nights and social gatherings!

Interested?

Our general body meetings are welcome to all students at all levels (undergraduate and graduate). To learn more about NSBE at the national level, feel free to check out the national website at [http://www.nsbe.org](http://www.nsbe.org). You can also email us at nsbe.jhu@gmail.com. We look forward to meeting you soon.
Optical Society of America (OSA Student Chapter)

The Optical Society at Johns Hopkins was founded in 2013 with the goal of promoting awareness about optical sciences and optical engineering. Our primary affiliation is with the department of Electrical and Computer Engineering. We are the hub for anything light related. We actively host events that include ice-cream socials, career talks, intersession courses and Hopkins wide photonics conference. We also have a directory of all the labs across the university that use light in their research. Contact us and we will be happy to help you get started with your optics career. (https://engineering.jhu.edu/ece/osa/)

oSTEM

Who we are:
Out in Science, Technology, Engineering & Mathematics (oSTEM) is a national student society dedicated to increasing the participation of people who identify with lesbian, gay, bisexual, transgender, queer, or asexual (LGBTQA) communities in disciplines related to science, technology, engineering, or mathematics (STEM). Allies are invited to join.

Our mission:
• To serve and affirm people who identify as LGBTQA.
• To promote the participation from and development of LGBTQA communities in STEM disciplines.
• To educate and develop students of STEM disciplines, preparing them for graduation. To support and contribute to the dynamic network sustained by oSTEM Incorporated.
• To provide education, outreach, and professional resources to students on campus.
• To actively recruit and address the needs of diverse LGBTQA groups within the University community, inclusive of those who are historically underrepresented with regards to gender, gender identity or expression, and ethnic background.

What we do:
• Host talks by prominent figures of the LGBTQA community.
• Co-sponsor events with other local oSTEM chapters and LGBTQA organizations.
• Attend yearly oSTEM National Conferences for professional development, workshops, networking, etc.
• Professional development workshops for building resumes, cover letters, business cards.
• Panel discussions on topics such as: Being out in the workplace, Academia vs. Industry vs. Government.
• Host social events to connect with the Hopkins LGBTQA community.

Interested?
• Attend our weekly general body meetings and other events. Contact ostem.jhu@gmail.com for more information.
Robotics Club

We are a project based club that provides Hopkins students with the resources to build robots. If you have an idea for a robotics project, we want to hear about it!

We hold weekly meetings for members to collaborate and form design teams to work on the projects they’re interested in. We also hold technical workshops where anyone can start learning how to use the tools that bring designs and ideas into reality.

Some past projects include a musical staircase, outdoor gaming theater, Segway tour guide, guitar playing robot, and hexacopter.

Society for Biomaterials (SFB)

The purpose of this student chapter of the Society for Biomaterials (SFB) at JHU is to encourage the development, dissemination, integration and utilization of knowledge in the field of biologically related materials among students and faculty of the Johns Hopkins University with members of industry, government research facilities, and other academic institutions. Also, the Society for Biomaterials (SFB) is the host of the annual Mid-Atlantic Biomaterials Day research conference.

Our activities include:
- Seminars and lectures by experts in the biomaterials field
- Trips to biomaterials conferences
- Field trips to industrial, corporate and government labs
- Advising sessions for underclassmen
- Exploring research and internship opportunities for members
- Organizing an annual Mid-Atlantic Biomaterials conference
Society of Hispanic Professional Engineers (SHPE)

SHPE is a national organization that promotes the development of Hispanics in engineering, science, and other technical professions to achieve educational excellence, economic opportunity, and social equity.

We aim to provide mentoring and professional resources to Hispanic students in STEM majors.

What We do?

• Provide mentorship opportunities for underclassmen as they navigate adjusting to college.
• Collaborate with corporate partners and alumni speakers to host professional development workshops.
• Attend Regional and National Conferences where students have opportunities to network with and interview for hundreds of companies every year.
• Community outreach programs like Hop into Engineering where we host 40 Baltimore High School students for a day of engineering activities
• Host social events like game nights, Holiday Parties, trivia nights, tie-dye events, and much more!

Interested in Learning More?
Email us at Hopkins.SHPE@gmail.com or follow us on Instagram @JHUSHPE.

Society of Women Engineers (SWE)

The Society of Women Engineers, or SWE, is a national organization committed to supporting women in engineering. The JHU Chapter of SWE is dedicated to providing opportunities for members to socialize and network both within the university and with local professional engineers and engineering firms. We also support opportunities to serve the community, with a focus on encouraging middle and high school girls to pursue careers in engineering, science, and math.

What we do:

• Monthly networking and social opportunities, such as Study with SWE, professional workshops, industry and alumni panels
• Outreach programs, such as the annual Tower of Power event with WSE, and Q&A sessions for middle and high schools
• Sponsor members to attend the national conference, taking place annually in October
• Annual networking banquet with students, faculty, and industry representatives

Interested?
Email us at jhu.swe@gmail.com or visit Instagram (@jhuswe). Contact us via email or sign up on Hopkins Groups to join our email list.
Students for the Exploration and Development of Space (SEDS)

Our goal is to unify and strengthen the Hopkins Space community by increasing students’ participation in the space industry and creating a fun place for people who love space to come together! We host speakers, get-togethers, go on trips in the Baltimore/DC area, and run a number of projects, including a CubeSat, searching for asteroids, a policy team, a telescope club, and more! We also promote current space news, scholarships, and internship applications.

We are an interdisciplinary club and encourage all to attend meetings and events!

Tau Beta Pi (Engineering Honor Society)

Tau Beta Pi is the only engineering society representing the entire engineering profession. It is the nation’s second-oldest society, founded to recognize students of distinguished scholarship and exemplary character.” For more info visit the national Tau Beta Pi website at www.tbp.org.

What we do:

• Mentoring events — we invite underclassmen to ask current TBP members for advising information concerning classes, majors, and careers.
• Speaker events — professionals from industry and academia are invited to share their experiences with members and offer advice on future professional endeavors.

Becoming a member:
The top 1/5 of the senior class and the top 1/8 of the junior class are invited to join Tau Beta Pi. However, many of our activities are open to and for the benefit of all students and will be publicized throughout the year. If you would like to learn more, contact us at jhutbp@gmail.com.

Theta Tau (Professional Engineering Fraternity)

Theta Tau is recognized as the nation’s oldest and the premiere co-ed professional engineering fraternity. The Theta Delta chapter of Theta Tau was installed in May 2011 at the Johns Hopkins University.

What we do:

The purpose of Theta Tau is to develop and maintain a high standard of professional interest among its members, and to unite them in a strong bond of fraternal fellowship. Some opportunities provided to members are:

• Professional development and networking with speakers from different fields of engineering.
• Opportunity to travel to other chapters around the area, including UPenn, GWU.
• Scholarships through the Theta Tau Education Foundation

How to join:

Theta Tau carefully follows a program in the selection and development of its members that stresses the importance of high professional ethics and exemplary practices. At the beginning of both the fall and spring semesters, there are open rush events and information sessions. Candidates must submit their resume, be interviewed, go through a six week pledging process and then finally be initiated as a brother into Theta Tau.

Interested?

Email us at jhuthetatau@gmail.com or visit us on our Hopkins Group page and at www.facebook.com/jhuthetatau.
Women in Computer Science (ACM-W)

Women in Computer Science is the official ACM-W chapter at Johns Hopkins and serves as a support group and professional resource for women/non-binary individuals in computing (all are welcome!). From weekly coding circles to tech talks with major companies to panels/workshops to our annual mentorship program, we provide a range of opportunities for our members to connect, learn, and bond.

Check out http://jhuwics.herokuapp.com/index.html to learn more and reach out to us at jhuwics@gmail.com!

Women of Mechanical Engineering Network (WoMEN)

The Women of Mechanical Engineering Network (WoMEN) helps foster community and make connections amongst womxn in the mechanical engineering and engineering mechanics majors. Every year, an appointed class representative works with their classmates to plan a fun event where everyone can take a break from studying and hang out with their classmates! There are also general body meetings where we plan the events for the group as a whole, such as class registration events, and a senior panel where you can ask about job applications, internships, and graduate school. We also engage in fun activities like creating designs for sweaters and tote bags and hosting pizza and movie nights during midterm season. Joining WoMEN will enable you to bond with the other womxn in the department, gain important knowledge about classes and internships, and make friendships that will last beyond graduation!
PROFESSIONAL SOCIETIES/ASSOCIATIONS
The JHU undergraduate chapter of the national American Marketing Association (AMA) was established in December 2008. AMA student members are connected to a network of 40,000 experienced marketers throughout the U.S., including leading marketing academics, researchers and practitioners from every industry. Our mission is to provide members with valuable opportunities in the marketing field, to network with established companies and professionals, and to practice marketing skills through volunteer community involvement. To learn more, visit our page on Hopkins Groups.

ENTREPRENEURSHIP AND FINANCE GROUPS
JHU Undergraduate Consulting Club aims to help the undergraduate student body learn more about consulting as a career track. We host events and provide resources that give students insight into the field of consulting and connect them with recruiters from firms. This will facilitate our members becoming competitive candidates for entry-level and internships positions within consulting firms. To learn more, visit: https://jhu.campusgroups.com/jhucc/home/.

Marshal L. Salant Student Investment Team provides Hopkins undergraduate students the opportunity to make actual investment decisions while managing a portfolio. By participating in this highly competitive investment program, students will receive a unique experience that will enhance their career opportunities. A portion of profits earned by the portfolio will be dedicated to providing scholarship support for undergraduate students in the Schools of Engineering and Arts & Sciences. The Marshal L. Salant Student Investment Program is jointly sponsored by the Whiting School of Engineering, the Zanvyl Krieger School of Arts & Sciences, and the Office of Investment Management. To learn more, visit our page on Hopkins Groups, https://jhusalant.com/home.
Women in Business at Johns Hopkins University was created with the goal of expanding the network of undergraduate women pursuing professional careers. The group provides resources to discover which field is right for each individual and presents women opportunities to pursue their field of interest. Events include student and alumni panels, networking events, career advancement workshops and a mentorship program. For more information, visit our website https://jhuwib.weebly.com/.

TCO Labs, Inc. is a 501(c)(3) nonprofit organization with a student group chapter at Johns Hopkins University focused on building a stronger entrepreneurial ecosystem at the JHU Homewood campus and getting students involved in Baltimore’s innovation community. TCO runs the student-venture incubator on campus, The Hatchery, which works with 10-12 student teams every semester to help them take their ideas to the next level. Additionally, TCO hosts a variety of events, from workshops to entire conferences focused on entrepreneurship, as well as works with school departments to incorporate entrepreneurship into academic programs. Finally, we connect students to opportunities at startups at Hopkins and in Baltimore for contract work, internships, and full-time positions. We are always looking for motivated students to join one of our eight functional teams: Marketing, Finance, Programming, Technology, Outreach, Incubation (Hatchery), Media/Design. To learn more, visit our website, https://tcolabs.org/.

SOCIAL ENTREPRENEURSHIP

JHU Enactus works together to create sustainable change. They create social and commercial enterprises and collaborate with leaders across the globe to ensure the most deep and meaningful impact. They aim to address the UN Sustainable Development Goals through their projects while creating a fun and stimulating atmosphere for their members. To learn more, visit us on Facebook, https://www.facebook.com/EnactusJHU/.

Students Consulting for Non-Profit Organizations (SCNO) is a national organization of undergraduate students committed to developing communities through pro bono consulting engagements with non-profit organizations. The Johns Hopkins Chapter carries out these engagements with a focus on sustainable business. We believe the future health and success of an organization is equally, if not more important, than addressing current issues. For more information, visit our website https://jhuscno.wixsite.com/jhuscno/services.
This section describes the courses most commonly taken by engineering freshmen. This is by no means a comprehensive listing of all the courses that are available to you. The full list of Fall 2021 courses can be found online at https://sis.jhu.edu/classes/. You should use the information on the website to pick the specific lecture and section times for the courses you plan to take. As you select your courses, keep in mind that first-semester engineering students are allowed to register for a maximum of 18.5 credits. Credit overloads WILL NOT be permitted.

If you are entering the university with Advanced Placement (AP), International Baccalaureate (IB), General Certificate of Examination (GCE), or other foreign examination credit and take an equivalent course at JHU for credit, then the AP/IB/GCE (and/or other foreign exam) credits will be removed. Please refer to the university catalogue for information on examination credit and JHU course equivalencies.

If there is room in your schedule, consider adding a 1-credit HEART course (EN.500.111) or a 1-3 credit First-Year Seminar (FYS) (EN.501.1XX) to your fall course load. For more details on HEART courses, see www.engineering.jhu.edu/HEART. For more details on WSE FYS courses, please search in SIS for the individual course descriptions.
BIOLOGY

GENERAL BIOLOGY I (3) ................................................................................................... 020.151 (N)
This course is an introduction to biology from an evolutionary, molecular and cellular perspective. Specific topics and themes include evolutionary theory, the structure and function of biological molecules, mechanisms of harvesting energy, cell division, classical genetics and gene expression.

GENERAL BIOLOGY LAB I (1) .......................................................................................... 020.153 (N)
Coreq: 020.151
This course reinforces the topics covered in AS.020.151. Students participate in a semester-long project, identifying bacteria from Homewood campus soils using molecular biology techniques. Other laboratory exercises cover aspects of evolution, genomics and biochemistry. Cross-listed with Behavioral Biology. Student must have enrolled in AS.020.151 either this term or in past terms. Students who have credit for AP Biology but take General Biology Lab I will lose four credits of AP Biology credit. Cross-listed with Behavioral Biology.

CHEMISTRY

INTRODUCTORY CHEMISTRY I (3) ................................................................................... 030.101 (N)
Coreq: 030.105 • Offered Fall & Summer only.
An introduction to the fundamental principles of chemistry. The main topics are atomic and molecular structure at the level of electron dot structures and VSEPR geometries, the periodic table, stoichiometry and the balancing of chemical equations, the gas laws, the law of mass action and chemical equilibrium, acids and bases, and elementary chemical thermodynamics.

APPLIED CHEMICAL EQUILIBRIUM AND REACTIVITY W/LAB (4) .................................... 030.103 (N)
Prereq: AP Score of 4 or 5; IB HL Score of 6 or 7
This course will review an advanced introductory chemistry sequence in a single semester. Chemical equilibrium, reactivity and bonding will be covered. These topics will be explored through laboratory experiments and problem solving, and discussing these principles in the context of current research. Students who have previously enrolled in AS.030.101 or AS.030.105 may not earn credit for AS.030.103 and students enrolled in AS.030.103 may not enroll in or receive credit for AS.030.102/AS.030.106.

INTRODUCTORY CHEMISTRY LABORATORY (1) .............................................................. 030.105 (N)
Coreq: 030.101 • Offered Fall & Summer only
Laboratory work includes quantitative analysis and the measurement of physical properties. Open only to those who are registered for or have successfully completed Introductory Chemistry 030.101. Note: Midterm exams will be held on select Wednesdays at 8AM, announced the first day of class. They will not conflict with AS.020.151 (General Biology) exams.

ORGANIC CHEMISTRY 1 (4) ............................................................................................. 030.205 (N)
Prereq: 030.102 OR 030.103 OR 030.204 • Offered Fall & Summer only
The fundamental chemistry of the compounds of carbon. Methods of structure determination and synthesis. The mechanisms of typical organic reactions and the relations between physical and chemical properties and structures.
ECONOMICS

ELEMENTS OF MACROECONOMICS (3) ................................................................................. 180.101 (S)
Offered Fall & Summer only
An introduction to the economic system and economic analysis, with emphasis on total national income and output, employment, the price level and inflation, money, the government budget, the national debt, and interest rates. The role of public policy. Applications of economic analysis to government and personal decisions. Prerequisite: basic facility with graphs and algebra.

ENGLISH

INTRODUCTION TO LITERARY STUDY (3) ............................................................................. 060.107 (H,W)
This course serves as an introduction to the basic methods of and critical approaches to the study of literature. Some sections may have further individual topic descriptions; please check in SIS when searching for courses.

MATHEMATICS

Please see page 34-35 in the First-Year Academic Guide for information about the JHU mathematics placement test. You can also learn about which math to take on our Canvas site, WSE Academic Advising.

CALCULUS I (4) ......................................................................................................................... 110.108 (Q)
Offered Fall & Summer only
Differential and integral calculus. Includes analytic geometry, functions, limits, integrals and derivatives, polar coordinates, parametric equations, Taylor’s theorem and applications, infinite sequences and series. Some applications to the physical sciences and engineering will be discussed, and the courses are designed to meet the needs of students in these disciplines. Participation in the PILOT Learning Program (peer led team learning) is a mandatory part of this course. Enrolled students will be contacted prior to the start of term with registration information.

CALCULUS II (4) ......................................................................................................................... 110.109 (Q)
Prereq: A score of 5 on AP AB exam or 3 or 4 on AP BC exam
Differential and integral calculus. Includes analytic geometry, functions, limits, integrals and derivatives, polar coordinates, parametric equations, Taylor’s theorem and applications, infinite sequences and series. Some applications to the physical sciences and engineering will be discussed, and the courses are designed to meet the needs of students in these disciplines. Participation in the PILOT Learning Program (peer led team learning) is a mandatory part of this course. Enrolled students will be contacted prior to the start of term with registration information.

HONORS ONE VARIABLE CALCULUS (4) .............................................................................. 110.113 (Q)
This is an honors alternative to the Calculus sequences AS.110.106-AS.110.107 or AS.110.108-AS.110.109 and meets the general requirement for both Calculus I and Calculus II (although the credit hours count for only one course). It is a more theoretical treatment of one variable differential and integral calculus and is based on our modern understanding of the real number system as explained by Cantor, Dedekind, and Weierstrass. Students who want to know the “why’s and how’s” of Calculus will find this course rewarding. Previous background in Calculus is not assumed. Students will learn differential Calculus (derivatives, differentiation, chain rule, optimization, related rates, etc), the theory of integration, the fundamental theorem(s) of Calculus, applications of integration, and Taylor series. Students should have a strong ability to learn mathematics quickly and on a higher level than that of the regular Calculus sequences.
LINEAR ALGEBRA (4) .......................................................................................................... 110.201 (Q)
Prereq: A score of 5 on the AP BC exam or C- or better in 110.107, 110.109, or 110.113
Vector spaces, matrices, and linear transformations. Solutions to systems of linear equations.
Eigenvalues, eigenvectors, and diagonalization of matrices. Applications to differential equations.

CALCULUS III (4) ............................................................................................................. 110.202 (Q)
Prereq: A score of 5 on the AP BC exam or C- or better in 110.107, 110.109, or 110.113, 110.202, or 110.302
Calculus of functions of more than one variable: partial derivatives; multiple integrals, line and surface integrals; Green’s theorem, Stokes’ Theorem, and Gauss’ Divergence Theorem. Participation in the PILOT Learning Program (peer led team learning) is a mandatory part of this course. Enrolled students will be contacted prior to the start of term with registration information.

HONORS LINEAR ALGEBRA (4) ..................................................................................... 110.212 (Q)
Prereq: A score of 5 on the AP BC exam or B+ or better in 110.107, 110.109, 110.202 or 110.302
This course includes the material in AS.110.201 with some additional applications and theory.
Recommended for mathematically able students majoring in physical science, engineering, or mathematics. AS.110.211-AS.110.212 used to be an integrated yearlong course, but now the two are independent courses and can be taken in either order.

DIFFERENTIAL EQUATIONS WITH APPLICATIONS (4) ........................................ 110.302 (Q)
Prereq: A score of 5 on the AP BC exam or C- or better in 110.107, 110.109, 110.113, 110.201, 110.202, 110.211, or 110.212
This is a course in ordinary differential equations (ODEs), equations involving an unknown function of one independent variable and some of its derivatives, and is primarily a course in the study of the structure of and techniques for solving ODEs as mathematical models. Specific topics include first and second ODEs of various types, systems of linear differential equations, autonomous systems, and the qualitative and quantitative analysis of nonlinear systems of first-order ODEs. Laplace transforms, series solutions and the basics of numerical solutions are included as extra topics. Participation in the PILOT Learning Program (peer led team learning) is a mandatory part of this course. Enrolled students will be contacted prior to the start of term with registration information.

PHYSICS AND ASTRONOMY

GENERAL PHYSICS FOR PHYSICAL SCIENCE MAJORS I (4) ................................. 171.101 (E,N)
Recommended Coreqs: 110.106, 110.108, or 110.113 AND 173.111 • Offered Fall, Spring, & Summer
First semester of two-semester sequence. In this term, the topics covered include the basic principles of classical mechanics and fluids as well as an introduction to wave motion. Midterm exams for every section are given during the 8 AM section time! Accordingly, students registering for sections at times other than 8 AM must retain availability for 8 AM sections as needed.

GENERAL PHYSICS FOR PHYSICAL SCIENCE MAJORS II (4) ................................. 171.102 (E,N)
Prereq: C- or better in 171.101, 171.103, 171.105 or 171.107 or 530.123 • Coreq: 110.107 or 110.109 OR 110.113 AND 173.112 • Offered Fall, Spring, & Summer
Second semester of two-semester sequence. In this term, the topics covered include wave motion, electricity and magnetism, optics, and modern physics. Midterm exams for every section are given during the 8 AM section time! Accordingly, students registering for sections at times other than 8 AM must retain availability for 8 AM sections as needed.
CLASSICAL MECHANICS I (4) ................................................................. 171.105 (E,N)  
Recommended Coreqs: 110.108 AND 173.115 · Offered Fall only  
An in-depth introduction to classical mechanics intended for physics majors/minors and other  
students with a strong interest in physics. This course treats fewer topics than 171.101 and 171.103  
but with greater mathematical sophistication. It is particularly recommended for students who intend  
to take 171.201-202 or 171.309-310.

GENERAL PHYSICS FOR PHYSICAL SCIENCES MAJORS I (AL) (4) ......................171.107 (E,N)  
Recommended Coreqs: 110.106, 110.108, or 110.113 AND 173.111  
This course is the first part of a two-semester sequence in general physics is identical in subject  
matter to 171.101-102. The first course covers mechanics, heat and sound, but differs in instructional  
format. Rather than being presented via lectures and discussion sections, it is instead taught in  
an “active learning” style with most class time given to small group problem-solving guided by  
instructors. Midterm exams for every section are given during the 8 AM section time! Accordingly,  
students registering for sections at times other than 8 AM must retain availability for 8 AM sections  
as needed.

GENERAL PHYSICS LAB I (1) ............................................................................ 173.111 (N)  
Coreq: 171.101, 171.103, or 171.107 · Offered Fall, Spring & Summer  
Experiments performed in the lab provide further illustration of the principles discussed in General  
Physics. Students are required to take this course concurrently with General Physics unless they  
already have received credit for the lab. Note: First and second terms must be taken in sequence.

GENERAL PHYSICS LAB II (1) ............................................................................ 173.112 (N)  
Recommended Prereq: 173.111 · Coreq: 171.102, 171.104, or 171.108 · Offered Fall, Spring & Summer  
Experiments are chosen from both physical and biological sciences and are designed to give students  
background in experimental techniques as well as to reinforce physical principles.

CLASSICAL MECHANICS LABORATORY (1) ......................................................... 173.115 (N)  
Coreq: 171.105 · Offered Fall only  
Experiments chosen to complement the lecture course Classical Mechanics I, II, 171.105-106 and  
introduce students to experimental techniques and statistical analysis.

WRITING SEMINARS

INTRODUCTION TO FICTION & POETRY I ....................................................... 220.105 (H,W)  
An introduction to basic strategies in the writing of poetry and fiction, with readings by Joyce,  
Woolf, Baldwin, Munro, Garcia Marquez, Donne, Bishop, Yeats, Komunyakaa, Tretheway, and others.  
Students will learn the elements of the short story and try their hand at a variety of forms: realist,  
fantastical, experimental. They’ll also study the basic poetic forms and meters, from the ballad to  
the sonnet, iambic pentameter to free verse. Students will compose short stories and poems and  
workshop them in class. This course is a prerequisite for most upper level courses. This course is part  
one of the year-long Introduction to Fiction and Poetry, and must be taken before AS.220.106.
APPLIED MATHEMATICS AND STATISTICS

FRESHMAN EXPERIENCE IN APPLIED MATHEMATICS & STATISTICS (1)................................. 553.101
The aim of this course is to provide students with an opportunity to work on a project in a small group setting together with an AMS faculty member. Projects can be varied in nature depending on the faculty member working with a group. The goal of a group could be to develop knowledge of a domain area in which mathematics is applied, to develop knowledge of some technique(s) in applied mathematics, to bring applied mathematics to bear on some application, or to develop knowledge in some foundational topic in mathematics. Faculty will present possible topics to students in the first week of classes. Students will be asked to rank their interests (first choice, second choice, etc.), and will provide their schedules. Based on their preferences, their schedules, and subject to group size limitations, students will be organized into groups of size at most 3, and will be assigned to course sections in the second week of classes. One faculty member will lead each section and will arrange to meet with the group once per week for an hour.

DISCRETE MATHEMATICS (4) ........................................................................................................ 553.171 (Q)
Introduction to the mathematics of finite systems. Logic; Boolean algebra; induction and recursion; sets, functions, relations, equivalence, and partially ordered sets; elementary combinatorics; modular arithmetic and the Euclidean algorithm; group theory; permutations and symmetry groups; graph theory. Selected applications. The concept of a proof and development of the ability to recognize and construct proofs are part of the course. Recommended Course Background: Four years of high school mathematics.

HONORS DISCRETE MATHEMATICS (4)...................................................................................... 553.172 (Q)
Introduction to the mathematics of finite systems. Logic; Boolean algebra; induction and recursion; sets, functions, relations, equivalence, and partially ordered sets; elementary combinatorics; modular arithmetic and the Euclidean algorithm; polynomials rings, group theory; permutations groups and Galois theory; graph theory. Selected applications. The concept of a proof and development of the ability to recognize and construct proofs and analyze algorithms are part of the course. Recommended Course Background: Four years of high school mathematics.

Special Note: Seats reserved for incoming undergraduate Applied Mathematics and Statistics students.

LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS (4)...................................................... 553.291 (E,Q)
An introduction to the basic concepts of linear algebra, matrix theory, and differential equations that are used widely in modern engineering and science. Intended for engineering and science majors whose program does not permit taking both 110.201 and 110.302.

BIOMEDICAL ENGINEERING

BIOMEDICAL ENGINEERING AND DESIGN (2).............................................................. 580.111 (E,N)
Working in teams with upperclassmen this course (1) introduces biomedical engineering freshmen to an orderly method for analyzing and modeling biological systems, (2) introduces engineering principles to solve design problems that are biological, physiological, and/or medical, and (3) considers the ethical and professional responsibility in developing biomedical engineering solutions to health care challenges. Freshmen are expected to use the informational content being taught in calculus, physics and chemistry and to apply this knowledge to the solution of practical problems encountered in biomedical engineering. BME Freshmen only.
CHEMICAL & BIOMOLECULAR ENGINEERING

**CHEMICAL ENGINEERING TODAY (1)** ................................................................. **540.101 (E)**
A series of weekly lectures to introduce students to chemical and biomolecular engineering and its role as a profession in addressing contemporary technological, social, ethical, and economic issues in today’s world. The lectures will include examples of how chemical and biomolecular engineers apply the principles of physics and chemistry to develop new products, improve process efficiencies, and alleviate the strain on the ecosystem through the design of novel environmentally conscious processes. In addition, the lectures will highlight exciting new areas now being advanced by chemical and biomolecular engineers, such as biochemical engineering, tissue engineering, nanoparticle fabrication, and processing smart polymers for applications in computer technology and as sensors. Freshmen Only.

CIVIL ENGINEERING

**CIVILIZATION ENGINEERED (3)** ................................................................. **560.100 (E)**
Civilizations have always faced challenges – whether naturally occurring or manmade – and have had to design solutions in order to survive. Our modern civilization is no different; we face major societal challenges related to resilient cities, human safety and security, decision-making and healthcare, energy infrastructure, and space exploration and habitation, among others, and solving these challenges will require an interdisciplinary approach. This course will look to the past – studying the engineering solutions developed by ancient civilizations – and at the current state of affairs – in preparation for designing solutions to the grand challenges of the future.

**CaSE COLLABORATIVE (.5)** ................................................................. **560.191 (E,N)**
From sketching to 3D printing, students in this course will work directly with the tools that civil and systems engineers use to plan and communicate their ideas. Hands-on learning activities will help students develop these skills, with an emphasis on communication and collaboration using graphical tools such as CAD and GIS software and physical specimens fabricated with manual construction and 3D printing.
COMPUTER SCIENCE

INTERMEDIATE PROGRAMMING (4) ..................................................................................................................601.220 (E)
Prereq: AP CS, 500.112/113/114/132/133/134
This course teaches intermediate to advanced programming, using C and C++. (Prior knowledge of these languages is not expected.) We will cover low-level programming techniques, as well as object-oriented class design, and the use of class libraries. Specific topics include pointers, dynamic memory allocation, polymorphism, overloading, inheritance, templates, collections, exceptions, and others as time permits. Students are expected to learn syntax and some language specific features independently. Course work involves significant programming projects in both languages.

DATA STRUCTURES (4) .................................................................................................................................601.226 (E,Q)
Recommended Prereqs: AP CS, 500.112/132 or 601.220
This course covers the design and implementation of data structures including arrays, stacks, queues, linked lists, binary trees, heaps, balanced trees (e.g. 2-3 trees, AVL-trees) and graphs. Other topics include sorting, hashing, memory allocation, and garbage collection. Course work involves both written homework and Java programming assignments.

ELECTRICAL & COMPUTER ENGINEERING

INTRODUCTION TO ELECTRICAL AND COMPUTER ENGINEERING (3) ................................................. 520.137 (E,Q)
Freshmen only
An introductory course covering the principles of electrical engineering including sinusoidal wave forms, electrical measurements, digital circuits, and applications of electrical and computer engineering. Laboratory exercises, the use of computers, and a design project are included in the course.

ENTREPRENEURSHIP AND MANAGEMENT

FOUNDATIONS OF AMERICAN ENTERPRISE (3) .......................................................................................660.105 (S)
5 sections listed in SIS. Section 9 is for Clark Scholars only
This course is designed as an introduction to the terms, concepts, and values of business and management. The course comprises three broad categories: the economic, financial, and corporate context of business activities; the organization and management of business enterprises; and, the marketing and production of goods and services. Topic specific readings, short case studies and financial exercises all focus on the bases for managerial decisions as well as the long and short-term implications of those decisions in a global environment.

FINANCIAL ACCOUNTING (3) .......................................................................................................................660.203
The course in Financial Accounting is designed for anyone who could be called upon to analyze and/or communicate financial results and/or make effective financial decisions in a for-profit business setting. No prior accounting knowledge or skill is required for successful completion of this course. Because accounting is described as the language of business, this course emphasizes the vocabulary, methods, and processes by which all business transactions are communicated. The accounting cycle, basic business transactions, internal controls, and preparation and understanding of financial statements including balance sheets, statements of income and cash flows are covered. No audits.
IDENTIFYING AND CAPTURING MARKETS (3)..........................................................660.250
In this course, students will learn how to identify individual and organizational market needs through entrepreneurial thinking. Exposure to a broad range of organizations—from startups to more established businesses, and a variety of industry sectors, including information technology, healthcare, biomedical engineering, transportation, mass media and energy—will provide students with insight into the role that marketing plays in an organization’s ability to identify, capture and grow these markets.

FIRST-YEAR SEMINAR (FYS)

FIRST-YEAR SEMINARS (FYS) (1-3) ........................................................................501.1XX
The WSE First-Year Seminar (FYS) courses are unique offerings created as an introduction to university academic life. They are small, discussion-based classes that give new students the opportunity to explore a variety of topics and work closely with faculty. Each class is designed to help foster engagement with classmates, instructors, and JHU as a whole. Enrollment in a FYS is optional for Engineering students.

GENERAL ENGINEERING

WHAT IS ENGINEERING? (3) ................................................................................500.101 (E)
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.

HOPKINS ENGINEERING SAMPLER SEMINAR (1) ........................................500.103 (E)
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.

HOPKINS ENGINEERING APPLICATIONS & RESEARCH TUTORIALS (HEART) (1) .......... 500.111 (E)
The HEART program provides new undergraduate students with a window on cutting-edge engineering research and its applications to society. These small classes are taught by advanced graduate students and postdoctoral fellows. Students will be introduced to cutting-edge engineering research and learn how that research impacts society. These tutorials will be useful to students as they evaluate their potential role in research projects. For details, see www.engineering.jhu.edu/HEART.

GATEWAY COMPUTING: JAVA (3) ........................................................................500.112 (E)
Some sections are freshmen only
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.
GATEWAY COMPUTING: PYTHON (3) ................................................................................. 500.113 (E)
Sections 1-4 will use examples drawn from BME.
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.

BOOTCAMP: JAVA (1) ...................................................................................................... 500.132 (E)
Not open to students who have completed or earned credits for EN.500.112, 601.107 or 600.107
Prereqs: EN.500.113 OR EN.500.114 OR EN.530.112 OR EN.520.123, 510.202 or 580.200
This on-line course provides students who have already achieved a basic understanding of programming and computational thinking in one programming language with an opportunity to apply these skills in another programming language. Students will be expected to complete projects to demonstrate proficiency in the new language. Satisfactory/unsatisfactory only.

BOOTCAMP: PYTHON (1) ................................................................................................ 500.133 (E)
Not open to students who completed or earned credits for EN.500.113 or 580.200
Prereqs: EN.500.112 or EN.500.114 OR EN.601.107, 510.202 or 530.112 or 520.123
This on-line course provides students who have already achieved a basic understanding of programming and computational thinking in one programming language with an opportunity to apply these skills in another programming language. Students will be expected to complete projects to demonstrate proficiency in the new language. Satisfactory/unsatisfactory only.

BOOTCAMP: MATLAB (1) ............................................................................................. 500.134 (E)
Not open to students who have completed or earned credit for EN.500.114
Prereqs: Not open to students who have completed EN.500.114, EN.510.202, EN.520.123, EN.530.112, EN.540.111 EN.540.305, EN.580.200, or EN.553.281, EN.500.112 or EN.500.113[+] OR EN.601.107
No longer listed in SIS as a requirement.
This on-line course provides students who have already achieved a basic understanding of programming and computational thinking in one programming language with an opportunity to apply these skills in another programming language. Students will be expected to complete projects to demonstrate proficiency in the new language. Satisfactory/unsatisfactory only.

ENVIRONMENTAL HEALTH AND ENGINEERING

INTRODUCTION TO ENVIRONMENTAL ENGINEERING (3) ............................................. 570.108 (E)
Overview of environmental engineering, including water and air quality, water supply and wastewater treatment, hazardous and solid waste management, pollution prevention, global environmental issues, public health considerations and environmental laws, regulations and ethics. Cross listed with Public Health Studies.

ENVIRONMENT & SOCIETY (3) ...................................................................................... 570.222 (H,S)
Humans make their living in the environment. How we do that changes nature and changes us. This class explores human impacts on the environment, how we have thought about our relationship to nature over the millennia, and contemporary environmental discourses.

ENVIRONMENTAL ENGINEERING CHEMISTRY—CURRENT AND EMERGING TOPICS (3) ........................................................................................................ 570.239 (E,N)
Students will utilize their chemistry knowledge to understand contemporary environmental issues in various media. Lectures will discuss the chemical phenomena leading to and resulting from air and water pollution issues. Climate change impacts to air and water chemistry will also be covered.

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MATERIALS SCIENCE AND ENGINEERING

FOUNDATIONS OF MATERIALS SCIENCE & ENGINEERING (3) ........................................ 510.106 (E,N)
Basic principles of materials science and engineering and how they apply to the behavior of materials in the solid state. The relationship between electronic structure, chemical bonding, and crystal structure is developed. Attention is given to characterization of atomic and molecular arrangements in crystalline and amorphous solids: metals, ceramics, semiconductors and polymers (including proteins). The processing and synthesis of these different categories of materials. Basics about the phase diagrams of alloys and mass transport in phase transformations. Introduction to materials behavior including their mechanical, chemical, electronic, magnetic, optical and biological properties.

MSE DESIGN TEAM I (3) .............................................................................................. 510.135 (E,N)
This course is the first half of a two-semester course sequence for freshmen majoring or double majoring in materials science and engineering (MSE). This course provides a broad exposure to various aspects of planning and conducting independent research in a team setting (3 to 6 students on each team). In this course, MSE freshmen working with a team leader and seniors on the team, apply their general knowledge in MSE to develop the solution to open-ended problems. Materials Science & Engineering Freshman Only. Recommended Course Background: EN.510.106, EN.510.109, or equivalent courses. *The team will meet 150 minutes per week at a time to be designated by the instructor.

MECHANICAL ENGINEERING

MECHANICAL ENGINEERING UNDERGRADUATE SEMINAR I (.5)............................... 530.107 (E)
Mechanical Engineering, Engineering Mechanics, or Undecided Engineering freshmen
A series of weekly seminars to inform students about careers in mechanical engineering and to discuss technological, social, ethical, legal, and economic issues relevant to the profession. Part 1 of a year-long sequence.

INTRO TO MECHE DESIGN & CAD (2)........................................................................ 530.111 (E)
Mechanical Engineering, Engineering Mechanics, or Undecided Engineering Freshmen
This course introduces students to the basic engineering design process and to fundamental concepts and knowledge used in the design of mechanical devices and systems. Students will explore the range of tools utilized in design practice, beginning with the skills of hand-drawing, exploring ways to articulate visual ideas, and concluding with the standards of presentation and CAD tools typical in professional practice.

MECHANICAL ENGINEERING FRESHMAN LABORATORY 1 (1)....................................... 530.115 (E)
Mechanical Engineering, Engineering Mechanics, or Undecided Engineering Freshmen
Hands-on laboratory complementing EN.530.111, including experiments, mechanical dissections, sketching and CAD, and a cornerstone design project. Experiments and mechanical dissections connect physical principles to practical engineering applications. Sketching and CAD work build the students’ design and communication skills. The design project allows students to synthesize a working system by combining knowledge of mechanics and design with practical engineering skills.

INTRO TO MECHANICS I (3) ......................................................................................... 530.123 (E,N)
Mechanical Engineering, Engineering Mechanics, or Undecided Engineering Freshmen
This course offers an in-depth study of the fundamental elements of classical mechanics, including particle and rigid body kinematics and kinetics, and work-energy and momentum principles. Part 1 of a year-long sequence.
PROFESSIONAL COMMUNICATION PROGRAM

PROFESSIONAL WRITING & COMMUNICATION (3) .................................................... 661.110 (S,W)
This course teaches students to communicate effectively with a wide variety of specialized and non-specialized audiences. Projects include production of resumes, cover letters, proposals, instructions, reports, and other relevant documents. Class emphasizes writing clearly and persuasively, creating appropriate visuals, developing oral presentation skills, working in collaborative groups, giving and receiving feedback, and simulating the real world environment in which most communication occurs.

IMPROVISATIONAL TECHNIQUES FOR COMMUNICATION (3) ........................................... 661.128
This course can help you learn how to increase your self-confidence, interpersonal skills, emotional intelligence, and personal effectiveness in a wide variety of social settings—both academic and professional. Using scenarios that encourage creative problem solving, collaboration, imaginative movement, radical acceptance, and deep play, this course can help you be more effective in whatever it is you want to do. This course is appropriate for students in any discipline or major.