

Syllabus

EN.800.130 Biomedical Engineering Innovation, Summer 2025

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About the Course

Description

Biomedical Engineering Innovation introduces biomedical engineering to high school students by (1) modeling biological systems and designing experiments to test those models and (2) introducing engineering principles to solve design problems that are biological, physiological, and/or medical. Students are expected to use the informational content being taught in math, physics, and biology and to apply this knowledge to the solution of practical problems encountered in biomedical engineering.

For more information, visit the [JHU EI website](#).

Prerequisites

Prerequisites for this course are the following:

- High school algebra II and trigonometry
- High school physics
- As and Bs in high school math and science courses

Objectives

By the end of the course, you will be able to:

- Use mathematical and physics principles to model physiological systems
- Develop experiments to test mathematical models
- Design and evaluate a product (e.g., electrical circuit) to meet a specific biomedical need
- Summarize the results of each project in a written and/or oral presentation

Modules

- Module 1: Introduction to Modeling
- Module 2: Human Efficiency

- Module 3: Oxygen Transport
- Module 4: Cardiovascular System
- Module 5: Arduino and Biosensors
- Module 6: Final Project

Textbook and Lab Kit

This course does not have a textbook. All course materials are found on the course Canvas site.

The materials you will need for hands-on projects are available in the Biomedical Engineering Innovation lab kit available for purchase from [Quality Science Labs](#). Please order your lab kit as soon as possible if you have not already, it can take a while to receive the kit, especially if shipping internationally. If you have issues ordering your lab kit, please contact the Engineering Innovation office at ei@jhu.edu. If you will be travelling during the course of the program, please look ahead to the work you will be doing while away and bring any necessary lab materials with you.

Teaching Team

The course is taught by an instructor with support from teaching assistants (TA) and/or graders. Teacher biographies and contact information can be found in Canvas under the Getting Started module.

While your teachers will not be “on call” for the course, they will make every effort to respond to your questions and reply in a timely fashion. Once the course begins, **please contact your teachers through Canvas Inbox rather than email.**

Schedule

While this course is largely self-paced, there are regular deadlines that you must meet. A calendar with exact dates for your course, including due dates, is available in Canvas. The calendar presents *due* dates, not the dates you are expected to work on an assignment. You are encouraged to start assignments at the beginning of the module, so they are complete by the deadline.

Expect to spend 14-20 hours per week on this course during the summer or 7-10 hours per week in the fall or spring. We recommend that you set aside time each day to view the conversations occurring in the **Discussion** area.

Unless otherwise noted, **all submissions are due by 11:59pm in the Eastern time zone of the United States**. This is true for all students regardless of their local time zone. Note that Maryland observes daylight savings time, so there is a time change in March and November each year.

Study sessions will be held on a regular basis using video calls in Zoom. The study session schedule will be set during the first week of the course to best accommodate the schedules of participating students.

Access

Required Software

You will need access to a computer with the following capabilities:

- Access to a spreadsheet application that will allow you to analyze data*
- Access to a word processing program that can be used to write your course lab reports*
- Access to a presentation program, so you can create a presentation for your final project*
- Ability to install free Arduino IDE software on the computer

- Ability to upload videos to the internet
- USB port to communicate with the Arduino
- Reliable internet access

*All students are granted a Microsoft Office 365 license during the program.

Johns Hopkins Online Account

The Johns Hopkins Enterprise Directory (JHED) system is an online, comprehensive source of contact information for Johns Hopkins University faculty, staff, and students that grants access to the following resources:

- [Canvas](#) – access the course materials (lecture videos, assignments, etc.)
- [Zoom](#) – communicate with the class and instructional staff
- [Microsoft Office 365](#) – access Word, Excel, PowerPoint, OneDrive, etc.
- [myJHU](#) – view and update your student profile
- [SIS](#) – view your final grade at the end of the course
- [Library](#) – access online reference materials

Sign into these applications using JHEDID@jh.edu (**NOT @jhu.edu**) and your password.



Sign in

[Can't access your account?](#)

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← kborgsm1@jh.edu

Enter password

[Forgot my password](#)

Sign in

New students should receive an email from the registrar containing their JHED ID shortly after enrollment. Instructions for activating the account are provided in the Online Account Activation Instructions Form during course enrollment. Contact webregistration@jh.edu or call 410-516-8080 for assistance, if needed.

Canvas – Course Materials

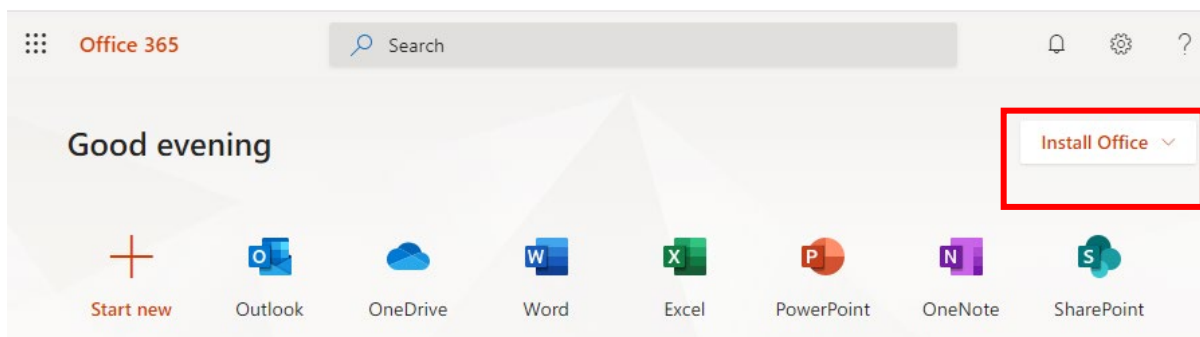
All course materials will be provided through Canvas (canvas.jhu.edu). Sign into Canvas using your JHEDID@jh.edu (**NOT @jhu.edu**) username and password. If you have difficulty logging in or accessing the course on Canvas, please contact the Help Desk at cmtshelp@jh.edu.

The course materials are divided into modules, which can be accessed by clicking **Modules** on the Canvas course menu. A module will have several sections including the overview, lecture videos, discussions, and assignments. You will have access to the Canvas site for one month following the last day of class.

Microsoft Office 365 Software

While you are enrolled in the course, you will have access to the software included in the Microsoft Office 365 Suite such as Microsoft Word, PowerPoint, and Excel. You will need your JHED to download the software to your device.

- Go to <https://www.office.com/> and click Sign In.
- Sign in using JHEDID@jh.edu (**NOT @jhu.edu**) and your password.
- When you land on the Office.com home screen, you can click Install Office in the upper right corner.



Communication

Course Announcements

Important announcements will be posted to Canvas. You should check for new announcements each day.

Canvas Inbox

Canvas Inbox (also called Conversations) can be used for communication outside of class. Inbox is a two-way messaging tool used instead of email to communicate with members of a course, a group, or an individual user. You can communicate with other people in your course at any time. Check out the [Canvas Inbox guide](#) for more information. When reaching out to the teaching team during the course, you should contact the 'Teachers' group instead of individual teachers by name. This will send a message to the instructor and all TAs.

You are encouraged to discuss the course content with your peers. Be respectful and reach out to a teacher if you believe someone is behaving inappropriately. Recall that you are bound by the Academic Integrity policy for the duration of this course.

Canvas Notifications

Ensure you don't miss any important notifications by [choosing your preferred email address](#) and customizing your Canvas notification settings to notify you of changes immediately or as part of a daily summary. See the [Canvas Notifications guide](#) for more information.

Study Sessions

Study sessions will be held multiple times a week as Zoom Meetings. Study sessions are a good opportunity for you to interact live with the teaching staff and with your peers. If there's content from the video lectures that you don't understand, send your questions to the teachers ahead of time, so they can prepare to cover that topic.

The links to the Zoom meetings will be posted on Canvas. If you need additional assistance, you can make an appointment with an instructor or TA.

Grading

Submission Format

Documents should be submitted in PDF format. Videos should be created in .mp4 or .mov formats, [uploaded to Panopto](#) and shared via Canvas.

Typed submissions are preferred, but handwritten work can be scanned or photographed and included within a Word document. One option is to use a program like [CamScanner](#) to digitize handwritten work. Please take the time to ensure scans are not blurry, handwriting is legible, pictures are not sideways, and text and photos are not too small.

Late Policy

Do not wait until the last minute to upload your work to Canvas! Large video files may take an hour or more to upload.

Because this course moves at a fast pace, submitting work late is problematic. Often, feedback received on an earlier assignment can be used to improve your work on later assignments, so receiving delayed feedback can have downstream effects. Care has been taken to ensure all due dates allow time for you to attempt the assignment and ask questions if needed. After that, a 50% late penalty will be applied every day the assignment is late. Exceptions can be made for genuine hardships experienced during the course, so please contact your teaching team as soon as possible to let them know why an assignment is or will be late if you believe you should get an exception.

Grade Questions and Regrade Policy

You may submit work to be regraded if you feel there is an error in how it was graded. You must do this within 48 hours of the grade being posted in Canvas. Send a Canvas message to the teachers in which you clearly indicate what portion of the work you would like to have regraded and explain the rationale for your request. The new grade may be higher, the same, or lower than the original grade. Once work is regraded, it may not be submitted for another regrading analysis.

Grade Calculation

Final grades will be determined by the following weighting:

Item	# Points	% of Grade
Final Project	240	24%
Assignments	160	16%
Arm Model Lab (Lab 1)	155	15.5%
Cardiovascular System Lab (Lab 2)	155	15.5%
Arduino Design Project	120	12%
Discussions	60	6%
Quizzes	50	5%
Asking Questions	30	3%

Surveys	30	3%
TOTAL	1000	

Final Grade Letters

Your grading scheme—chosen at the time of enrollment—is either a Letter Grade or Satisfactory/Unsatisfactory Grade. You can switch grading schemes by submitting a [request to the Registrar](#) on or before the deadline. The deadline for Summer 2025 is July 22.

The final grade letter or S/U is based on the final grade percentage according to the table below. To calculate the final grade percentage:

1. Determine the number of points you earned for each item in the Grade Calculation table by following the instructions given in the syllabus section titled Major Deliverables.
2. Add the number of points you earned for each item in the Grade Calculation table.
3. Divide by the total possible number of points (1000) and convert this value to a percentage.

Letter Grade	S/U Grade
97% ≤ A+	Satisfactory (S): 70% and above Unsatisfactory (U): Below 70%
93% ≤ A < 97%	
90% ≤ A- < 93%	
87% ≤ B+ < 90%	
83% ≤ B < 87%	
80% ≤ B- < 83%	
77% ≤ C+ < 80%	
73% ≤ C < 77%	
70% ≤ C- < 73%	
67% ≤ D+ < 70%	
63% ≤ D < 67%	
F < 63%	

Major Deliverables

Final Project

The Final Project is a chance for you to investigate an area of biomedical engineering. You will choose from one of the three options: 1) write a research paper that reviews current literature, 2) design an experiment, or 3) develop a prototype of a biomedical device. Your project may be a completely new idea, or it can be an extension of a previous project in the course. You will create a scientific poster summarizing the work you did for your Final Project and then record a video presentation of the poster. Projects completed as part of this course are not considered independent research and do not meet the threshold for publication.

Item	# Points	% of Grade
Final Project Research	20	2%
Design Review 1	20	2%

Final Project Proposal	20	2%
Design Review 2	20	2%
Final Project Draft	30	3%
Design Review 3	20	2%
Final Project Peer Review	20	2%
Final Project Final Submission	80	8%
Final Project Reflection	10	1%
TOTAL	240	24%

Assignments

There are one or two assignments in each module to give you practice with the course content. Each of the following assignments is worth 20 points:

- Assignment 1-1
- Assignment 1-2
- Assignment 2-1
- Assignment 2-2
- Assignment 3
- Assignment 4
- Assignment 5-1
- Assignment 5-2
- Assignment 6

The lowest Assignment grade will be dropped. So, the highest eight Assignment grades will count toward your final grade for a total of 160 possible points (16% of your final grade).

You can access the Assignments using the links provided in the Canvas modules. You are required to submit your answers to Canvas as a PDF file. All work must be shown and legible to earn full credit. Solutions without justification will not be considered complete and the grade will be adjusted down accordingly.

Arm Model Lab (Lab 1) and Cardiovascular System Lab (Lab 2)

The labs are an opportunity for you to design and conduct your own experiments. Prior to conducting the lab, you will submit a lab plan that describes your hypothesis, your method, and the data you plan to collect.

Item	# Points	% of Grade
Lab Plan	20	2%
Lab Report (1 st Submission)	35	3.5%
Lab Peer Review	20	2%
Lab Report (Final Submission)	70	7%
Lab Reflection	10	1%

TOTAL (each lab)	155	15.5%
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Arduino Design Project

The Arduino Design Project is worth up to 120 points. For this project, you will design a prototype of a biomedical sensor using one of the sensors in your lab kits and an Arduino microcontroller. This introduces you to biomedical sensors, Arduino coding, and measuring uncertainty. Projects will include a 1-minute video demonstration of your sensor in action.

Discussions

In each module of the course, you will respond to a Discussion prompt in Canvas. This is an excellent opportunity to seek constructive feedback from your peers and to relate the BMEI coursework to your personal experiences. Each discussion is worth 10 points:

- Peer Review Practice (Parts 1 and 2)
- Module 1 Discussion
- Module 2 Discussion
- Module 3 Discussion
- Module 4 Discussion
- Module 5 Discussion
- Module 6 Discussion

The lowest Discussion grade will be dropped. So, the highest six Discussion grades will count toward your final grade for a total of 60 possible points (6% of your final grade).

Quizzes

Each module includes a quiz composed of multiple choice and fill-in-the blank style questions. The quizzes are designed to test the concepts and skills covered in the module lectures, so you should plan to complete all lecture videos and readings before attempting the Quiz. Each of the following is worth 10 points:

- Module 1 Quiz
- Module 2 Quiz
- Module 3 Quiz
- Module 4 Quiz
- Module 5 Quiz
- Module 6 Quiz

The lowest Quiz grade will be dropped. So, the highest five Quiz grades will count toward your final grade for a total of 50 possible points (5% of your final grade).

Quizzes are untimed, and you will be allowed to attempt each quiz up to 2 times. Feedback on the quiz will be available after the quiz due date.

Asking Questions

Due to the online nature of the course, it is difficult for the instructor to know whether students have questions about the material. Students should not hesitate to ask questions during Study Sessions or by posting to the Asking Questions discussion in Canvas. Other students likely have the same questions! If a question arises while completing your course work, please post a question to the Asking Questions discussion. Your teachers will respond to postings, and other students can answer postings as well. If you correctly answer a question posed by a peer, you will receive credit towards your Asking Questions module total.

Students are encouraged to ask and answer questions in each module of the course and can earn up to 5 points in each module for asking or answering questions:

- Module 1 Asking Questions
- Module 2 Asking Questions
- Module 3 Asking Questions
- Module 4 Asking Questions
- Module 5 Asking Questions
- Module 6 Asking Questions

The six Asking Questions grades will count toward your final grade for a total of 30 possible points (3% of your final grade).

Surveys

There is an anonymous survey at the end of each module where we encourage you to share your thoughts and opinions about the module content and assignments. In a constant effort to improve the course, we want to make sure that the content and assignments are as clear as possible and that you have enough time to complete the requirements. Please share your thoughts with us. Each course improvement survey is worth 5 points:

- Module 1 Course Improvement Survey
- Module 2 Course Improvement Survey
- Module 3 Course Improvement Survey
- Module 4 Course Improvement Survey
- Module 5 Course Improvement Survey
- Module 6 Course Improvement Survey

The six Survey grades will count toward your final grade for a total of 30 possible points (3% of your final grade).

Policies

External Course Evaluation

The Engineering Innovation office hires an external evaluator to assess the strengths and weaknesses of this course. Student feedback is essential to that process. Survey responses are anonymous; neither the teaching team nor the Engineering Innovation office can match students to survey responses.

A pre-course survey will be sent by email approximately one week before the first day of class. A post-course survey will be sent by email at the end of the course. Your participation is voluntary but highly appreciated.

Academic Integrity

All students are required to read, know, and comply with the Procedures for Dealing with Issues of Academic Misconduct as detailed in the enrollment form you signed.

This policy prohibits academic misconduct, including but not limited to the following: cheating, plagiarism, submitting the same or substantially similar work to satisfy the requirements of more than one course without permission, submitting as one's own the same or substantially similar work of another, knowingly furnishing false information to any agent of the University for inclusion in academic record, falsification, forgery, alteration, destruction or misuse of official University documents or seal.

While we encourage you to collaborate with your fellow students, all work submitted must be fully your own. Lab reports, assignments, quizzes, and projects must be done on your own. Direct copying of written work or computer code is considered cheating and will result in a grade of zero on the assignment and could result in failing the course.

Plagiarism is defined as taking the words, ideas, or thoughts of another and representing them as one's own. If you use the words of another, present the words in the correct quotation notation (indentation or enclosed in quotation marks, as appropriate) and include a complete citation to the source.

For the full Academic Misconduct policy, see the [Pre-Collegiate Programs Academic Ethics Policy and Procedures](#).

Generative Artificial Intelligence (AI) Tools

Use of generative artificial intelligence (AI) tools such as Bard and ChatGPT can augment learning experiences when used appropriately. You may use generative AI to brainstorm and refine ideas, find reliable sources, outline, check grammar, and format bibliographies. You should note, however, that the material generated by these programs may be inaccurate, incomplete, biased, or otherwise problematic. You are ultimately responsible for what you submit.

Use your interaction with AI as a learning experience. Then, let your submitted work reflect your improved understanding. All writing and calculations you submit must be your own. Beyond bibliographies, you are not allowed to copy and paste material generated by AI and use it in your submitted work. Including AI-written content in any part of your submitted work will be considered academic misconduct.

Disability Services

Johns Hopkins University and the Engineering Innovation program are committed to making all courses, support services, and facilities accessible to students with disabilities. If you will need disability related accommodations, you will need to start the process of requesting accommodations with the [Student Disability Services](#) (SDS) and provide documentation of your disability as well as your need for accommodations. It is recommended that Engineering Innovation students complete this step as early as possible to ensure there is time to request and implement accommodations..

Learn about [how to get started with student disability services](#) and/or contact [Student Disability Services](#) for more information.

Discrimination and Harassment

JHU will not tolerate harassment, sexual harassment (including sexual violence), discrimination, or retaliation in the workplace or educational environment whether committed by managers, faculty, administrators, staff, students, or by visitors to our institution of higher learning. If you are a victim of any such situation, you are strongly encouraged to file a complaint through official university channels.

You may reach out to the Engineering Innovation office at ei@jhu.edu or submit [a Discrimination and Harassment Report Form](#) to the JHU Office of Institutional Equity.