JOHNS HOPKINS Biomedical Engineering Innovation

Syllabus

EN.500.130 Biomedical Engineering Innovation

Instructors and TAs

This course has at least one dedicated instructor and teaching assistant (TA), or more! Information about your specific instructors and TAs is in the **Syllabus & Course Information** area of the Blackboard course menu.

Communication

We prefer that students contact us via Microsoft Teams.

We encourage you to post questions to the **General or Module Channels** in Microsoft Teams so that your classmates can benefit from the answer to your questions as well—your classmates might even know the answer to your question and respond to you before an instructor does! To send an instructor a direct message in Microsoft Teams, select **Chat** on the left-hand menu of Teams and click the **New Chat** icon () above the chat list pane. Then type in the name of the instructor(s) you would like to send a message to.

When emailing, please be sure to include course number in the subject line. We will make every effort to respond to your inquiry within 48 hours or earlier. If an issue is urgent, please indicate "urgent" within the subject line of the email and we will respond as soon as is practical.

Asking Questions

Students can ask questions in **Microsoft Teams** or through **email**. While your instructors will not be “on call” for the course, they will make every effort to respond to your questions and reply in a timely fashion. Please refrain from sending private messages to your instructors—instead, ask questions in **Microsoft Teams** as much as possible so that the entire class can benefit from reading the answer. Students can make appointments with Instructors to ask questions through Zoom videoconferencing.

Expectations

- This course requires a **steady commitment of your time**. While it is largely self-paced, there are weekly deadlines that you must meet. You should review the **Course Schedule** and **Calendar** for specific due dates. For a 12 or 10-week course expect to spend 7-10 hours a week and for a 5 or 6-week course expect to spend 14-20 hours per week. Depending upon your comfort with the material covered, some weeks may not require as much time to complete while other weeks may require more.
- Engineers regularly encounter problems that are **open-ended** and which require them to **make assumptions**. For this reason, assignments in this course will require you to make assumptions. **Don’t be afraid to ask questions**, but it is our hope that you become more comfortable in making assumptions as you progress through this course. Many of the assignments are written so that you will not simply enter data into an equation and solve for an answer.
- Because this course moves at a fast pace, late work will not be accepted. However, you will receive partial credit for the portion of the assignment you do submit. For this reason, **submitting something on time is better than submitting nothing**.

JOHNS HOPKINS WHITING SCHOOL of ENGINEERING

- The assignments and grades are not meant to be punishing—they are meant to challenge you and help you grow. If you're struggling, ask questions and do your best. Honest work will be recognized and rewarded.

Course Description

Engineering Innovation is an exciting college-level summer program for motivated high school students with an aptitude in math and science and an interest in (or curiosity about) engineering. This program has been available to high school students since 2006. In the program, students learn to think and problem-solve like engineers and have the opportunity to earn Johns Hopkins University (JHU) credit.

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 will model human efficiency, the arm, and the cardiovascular system. 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.

Prerequisites

- High school algebra II and trigonometry
- High school lab science (biology, chemistry and physics)
- As and Bs in high school math and science courses

Course Objectives

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

- Use mathematical and physics principles to model physiological systems, specifically the static and dynamic arm, circulatory system, and human efficiency
- Develop experiments to test mathematical models
- Analyze signal data gathered by analog sensors
- Undergo the design process of creation, synthesis and integration for mechanical project and evaluate the success of the design to meet the desired need
- Summarize the results of each project in a written and/or oral presentation

Course Structure

All course materials will be provided through the Blackboard Learning Management Systems (LMS). Login to Blackboard using your Johns Hopkins credentials (JHED Login ID), which you should have received in an email from the registrar. It is a string of 3-8 characters that typically begins with the first letter of your first name, contains the starting letters of your last name, and ends in a number. If you need assistance logging in, please email webregistration@jhu.edu or call 410-516-8080.

The course materials are divided into modules which can be accessed by clicking Course Modules on the course menu. A module will have several sections including the overview, lecture videos, discussions, and assignments. You are encouraged to preview all sections of the module before starting. Specific dates for each module are noted in the **Course Schedule**. You should regularly check the **Calendar** and **Course Schedule** for assignment due dates. All due dates are for 11:59pm EST (Eastern).

Course Materials

This course does not have a textbook, but will instead include various lecture videos and readings provided by the instructors through Blackboard.

All additional course materials will be provided to the student as part of the course. There will be a **lab kit** of materials needed for the various labs in the course which will be mailed out to students after the third week of the course.

If you have issues receiving your lab kit, please contact the Engineering Innovation Office at ei@jhu.edu or 410-516-0735.

Required Software

Microsoft Teams

This course will use Microsoft Teams for our Discussions and general communication. This is a platform that works in your browser, on your desktop, and has an app for tablet and phone (iOS and Android). This will allow you to participate in the Discussions and ask questions from whatever device you are most comfortable. As part of your Participation grade for the course, you are expected to login and check Microsoft Teams throughout each module. You should ask questions, answer your classmates' questions, post answers to the Discussion questions, and participate in Office Hour meetings.

To access Teams, click the **Microsoft Teams** link on the course menu. Then sign in with your JHU email using **@jh.edu** (NOT @jhu.edu) and JHU password. You should see our Team listed on the left-hand side with the Team channels (discussion areas) listed below.

There are various channels for discussion, including a **General** channel that is for discussion general topics and questions related to the course. Use the **Module** channels for questions and topics related to specific modules.

For more information, check out the Microsoft Support information for getting started with Microsoft Teams. If you have difficulty logging in or accessing Microsoft Teams, please contact the Help Desk at ep-help-desk@jhu.edu.

Technical Requirements

You should refer to **Help & Support** on the course menu for a general listing of all the course technical requirements.

Student Coursework Requirements

It is expected that each module will take approximately 2-5 hours per day to complete in a 5- or 6-week course, or 7-10 hours per week in a 10- or 12-week course. Here is an approximate breakdown of the different activities:

- listening to the video slide presentations and completing quizzes
- participating in course activities such as Office Hours, Discussions, etc.
- completing pre-lab assignments and additional readings
- completing the Lab Report or Project for each module, preparing a Lab Report or presentation with results of the lab, and completing post-lab Reflections

This course will consist of the following basic student requirements:

Participation (10% of Final Grade Calculation)

This course is highly interactive and depends on student participation to be successful. You are not alone in completing this course and we want to make sure you feel part of a larger community with your classmates. To this end, the Participation grade will consist of different activities in each module which encourage you to interact with your instructors and classmates, such as the following:

- Asking questions (Microsoft Teams)
- Discussion postings (Microsoft Teams)
- Completing Course Improvement Surveys

- Submitting Peer Reviews of your classmates' Lab Reports and Final Projects

Each module will have a total of 20 points for the Participation component of the grade. You can earn these points by completing any of the participation activities, which will add up to at least 30 points possible. This means that you do not have to participate in all of the participation activities for a module—only enough for you to earn the 20 needed points. However, you are highly encouraged to participate much more than the minimum. Your instructors and classmates are an important resource for succeeding in this course and you should interact with them as much as possible!

Refer to the **Participation Guidelines** for more information about the Participation grading.

Quizzes (5% of Final Grade Calculation)

Most modules will contain a Quiz that assesses your knowledge of the previous module's topics. Quizzes will contain multiple choice and fill-in-the blank style questions (5-10), for a total of 10 points. Quizzes are untimed, and you will be allowed to attempt each quiz up to 2 times.

Each Quiz will 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. You may earn 10 points towards your final Quiz grade from each Quiz by scoring 80% or higher. You may submit a Quiz after the due date (late) within the same module and will earn 5 points by scoring 80% or higher. The lowest Quiz score will be dropped from the overall Quiz grade for the course.

Assignments (20% of Final Grade Calculation)

There are Assignments in most modules of the course. You can access the Assignments using the links provided in a given module. You are required to answer all the questions and submit your answers as a Word document or PDF. The purpose of the Assignments is to give you the opportunity to demonstrate your understanding of the course concepts.

A maximum of 100 points per Assignment can be earned, divided among the problems in each set depending on their length and/or difficulty. Each Assignment will be **due by 11:59 pm** on the day listed on the Course Schedule and Calendar unless specified otherwise.

Refer to the **Assignment Guidelines** for more information about Assignment grading.

Lab Reports (25% of Final Grade Calculation)

Throughout the course, you will work on three labs and write Lab Reports for each. The labs include the following topics:

1. Human Efficiency Model (Module 2)
2. Cardiovascular System Model (Module 4)
3. Arm Model (Module 7)

A maximum of **100 points** per Lab Report can be earned. The Lab Reports will include draft submissions of Lab Plans where you will be able to submit the first sections of your Report for feedback before conducting your lab and submitting your final Lab Report.

Refer to the **Lab Guidelines** and corresponding **Lab Guides** for more information about Lab grading.

Arduino Design Project (10% of Final Grade Calculation)

In Module 5, 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, Ardunio coding, and measuring uncertainty.

Projects will include a 1-minute video demonstration of your sensor in action.

Refer to the **Arduino Project Guidelines** for more information about grading.

Transport Design Project (10% of Final Grade Calculation)

In Module 6, you will design two ping-pong mover devices, using limited supplies, which move a ping-pong 1.5 meters along a horizontal surface. This introduces you to the engineering design process in which you identify and define a need, determine constraints to the problem, brainstorm and implement a solution, and evaluate the success of the design to meet the desired need.

Projects will be presented and judged in two ways: a 1-minute video “elevator pitch” presentation and a 2-minute video demonstration of the ball moving.

Refer to the **Transport Design Project Guidelines** for more information about grading.

Final Project (15% of Final Grade Calculation)

The Final Project is a chance for you to investigate an area of biomedical engineering and design an experiment related to the topic. 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.

Refer to the **Final Project Guidelines** for more information.

Reflections (5% of Final Grade Calculation)

For each of the Labs, you will submit a Reflection which allows you to critically think about the work you did in each lab, after you have completed it.

A maximum of 100 points per Reflection can be earned and each Reflection will be **due immediately after** the corresponding Lab Peer Review is due.

Refer to the **Reflection Guidelines** for more information about Reflection grading.

Grading

Assignments are due according to the dates posted in your Blackboard course site. You may check these due dates in the **Course Schedule** and **Calendar**. We will post grades **2 days** after assignment due dates.

We generally do not directly grade spelling and grammar. However, egregious violations of the rules of the English language will be noted without comment. Consistently poor performance in either spelling or grammar is taken as an indication of poor written communication ability that may detract from your grade.

Final grades will follow a traditional ten-point scale:

- 90-100 pts: A level work
- 80-89 pts: B level work
- 60-79 pts: C level work
- 0-59 pts: D-F level work

A grade of A indicates achievement of consistent excellence and distinction throughout the course—that is, conspicuous excellence in all aspects of the course assignments.

A grade of B indicates work that meets all course requirements on a level appropriate for undergraduate academic work.

Students who earn an A or B grade in the course receive 3 credits from Johns Hopkins University.

If you are accepted to and matriculate as an undergraduate student at JHU, the credits awarded by JHU for this BMEI course are available to count towards your undergraduate degree at JHU. Credits may be applied towards your total required credits to graduate.

Final grades will be determined by the following weighting:

Item	% of Grade
Participation	10%
Quizzes	5%
Assignments	20%
Lab Reports	25%
Arduino Design Project	10%
Transport Design Project	10%
Final Project	15%
Reflections	5%

Help & Support

You should refer to **Help & Support** on the left menu for a listing of all the student services and support available.

Academic Integrity

All students are required to read, know, and comply with the **Procedures For Dealing With Issues Of Academic Misconduct,** as outlined in your Admission and Enrollment information packet and the corresponding 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 on Microsoft Teams, all work submitted must be fully your own. Lab reports, assignments, quizzes, and projects must be done on your own.

Policy on Disability Services

To receive accommodations for a disability, a student must register with the JHU Office for Student Disability Services **no later than two weeks prior to the first day of class.** Part of the registration process is the submission of documentation of the disability. Refer to the University's Documentation Guidelines for more information on documentation. You are encouraged to share this link with your child's evaluator (e.g. physician, psychologist, etc.) to help guide his or her writing, if necessary. Please know that IEPs and 504 Plans, although helpful, do not constitute comprehensive documentation. However, when combined with other documentation from a qualified evaluator, they can provide adequate support for accommodations during your child's Engineering Innovation experience.

Registration Procedure

If your child requires disability-related accommodations during his or her experience at Biomedical Engineering Innovation, please go to the Disability Services Website, and click the **Access AIM** link to begin the process.

For a detailed walk-though of the registration process, refer to the Guides for using AIM on the Student Disability Services website.

Student Disability Services Office

The Johns Hopkins University; 385 Garland Hall; 3400 N. Charles Street; Baltimore, MD 21218
Phone: 410-516-4720; FAX: 443-529-1543; https://studentaffairs.jhu.edu/disabilities/

Please direct questions to Dr. Terri Massie-Burrell, Director of Student Disability Services.

Course Outline

- **Module 1:** Introduction to Modeling
- **Module 2:** Human Efficiency Model
- **Module 3:** Oxygen Transport
- **Module 4:** Cardiovascular System
- **Module 5:** Arduino Design Project
- **Module 6:** Transport Design Project
- **Module 7:** Static Arm Model
- **Module 8:** Final Project
- **Module 9:** Final Project Presentations

For More Information

For more information, please contact: ei-biomed@jhu.edu
https://ei.jhu.edu/biomed/