BE511 Class Syllabus and Schedule - Spring, 2023
Biomedical Instrumentation

Instructor: Dr. Darash Desai
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Office Hours: by appointment

GTF: TBD
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Office Hours: TBD

Lecture: Tues, Thurs ERA 209 3:30 - 5:15 pm

Lab: Tues 12:30 - 3:15 pm ERA 209

Course Website: Blackboard Learn https://learn.bu.edu

Textbook: *None; we will use PowerPoint presentations and PDFs posted throughout the semester*

References (optional):

1. *Medical Instrumentation: Application and Design*. John G. Webster, Ed.; 4th edition, Wiley, New York, 2010
2. *The Art of Electronics* by Horowitz and Hill

Course Prerequisites:
ENG BE 491 (Biomedical Measurements I) and ENG BE 403 (Biomedical Signals and Controls)

The Big Picture:
This course presents an introduction to biomedical instrument design and will review physiological signals, biomedical sensors, analog signal amplification and filters, digital acquisition, digital filtering and processing, and several common medical instrumentation platforms. We will focus on the core concepts and skills that form the foundation of instrument design but will learn these within a larger global context where appropriate, bringing in examples from real-world problems and solutions. Hands-on implementation of key principles will be covered in the laboratory portion of the class, helping to build proficiencies in circuit design and analysis, soldering, and high-level data acquisition and hardware interface programming. The course will culminate with students designing and fabricating their own, stand-alone pulse oximeter—a need that remains critical among vulnerable populations in resource-limited areas around the world. The course will also wrap up with a group project that will be presented to the class. Specific details regarding this project will be provided later in the semester.

Additionally, the course will put a heavy emphasis on the development of lab skills and effective communication. Instrument development requires proficiencies in both in order to thoroughly and productively share your designs and ideas with teammates, colleagues, bosses, and other audiences. It is important to keep this in mind and cultivate these skills so that we may extend our learnings on design beyond the classroom and apply them as more rigorous and well-rounded engineers.

Policy on inclusion: The goal of the course is to learn, engage and understand – but we will do so in a way that is most respectful and inclusive. We want to ensure that every single student feels welcomed and is able to participate freely in a respectful manner at all times.

Course Goals: Students will understand the major design considerations in biomedical instrumentation and the range and capabilities of the most common sensors. Students will also have an understanding of basic conditioning, processing, and analysis methods needed to design and fabricate biomedical instrumentation. Students will achieve proficiency in hands-on analog circuit design and implementation as well as practical methods for signal digitization, digital signal processing, and instrument programming. Finally, students will design, build, and characterize a complete biomedical instrument and justify their design choices.

Attendance: Attendance is required for all class and lab sessions. This course is designed for much of the learning experience to occur during the class period.

Academic Honesty: Respect is a fundamental component of this course. Respect one another and respect yourselves. Do your own work. I assume we all will uphold the highest standards of academic honesty; however, any evidence of dishonesty on assignments or exams will be thoroughly examined and subject to severe disciplinary action.

HW Policy: Submit an electronic copy via Gradescope by 11:59 pm on the due date unless otherwise indicated. There are a number of free scanner apps available to convert any handwritten assignments to a digital format; a scanner is also available in ERB 407**.** In addition to the labs, there will be several homework-like problems in each lab assignment that will help to prepare for the next lab. **Each student should submit their own homework solutions.** Groups are encouraged to collaborate and discuss problems, but each group will be required to turn in their own original work and each student must submit separate homework; all work, plots, tables, etc. must be original—no sharing of any kind is allowed.

Laboratory Policy: Students will pick groups of 2-3 for the laboratory sections of the course. Each group will submit one laboratory report, due the Tuesday following their laboratory unless otherwise specified. Here are general rules for lab reports:

- Submit an electronic copy on blackboard. **Due at 11:59pm on due date.**
- **Format/Guidelines**
  - Five section: Abstract, Background, Materials and Methods, **Results**, Discussion
    - **Concise text**: Abstract, Background, Materials and Methods should be very short

    - Results section may be longer because of the plots and figures you include
- Single-spaced with 1-inch margins
- Calibri 12 pt for text and 10 pt for figure/table captions
- **All axes should be labeled, and the plots should be properly titled**
- Answer all questions from lab manual **in paragraph form**
- Do not leave plots in standard MATLAB form – make them readable
- Data lines/markers must be thicker than MATLAB default

Late assignments: Assignments should be taken seriously and submitted on time or will lose 25% of their value each day unless specifically discussed with me prior to the due date**.** This course heavily relies on homework and lab reports as a means to practice and better understand core concepts taught throughout the course.

Grading: Grades will be available throughout the semester via Gradescope and the Blackboard Learn site. These posted grades do not necessarily reflect your final course grades as adjustments may be applied. Grades will be evaluated as follows:

Lab Reports	40%
Homework	10%
Midterm Exam	15%
Final Exam	15%
Final Project	15%
Participation	5%