Dr. J Schesser   Summer 2024

BME 301
Biomedical Computing

The Department of
Biomedical Engineering

CLASS HOURS
Monday, Wednesday and Thursday
9 am - 12pm (Fenster 640)
1 pm - 2pm (Fenster 640)

OFFICE HOURS (Fenster 610)
M, W, R 2pm – 3pm
Or by appointment
(973) 596 3193   joelsd@njit.edu

TEXT   Webb, Andrew G. Principles of Biomedical Instrumentation. Cambridge University Press, 2018.

Supplemental handouts are found on http://web.njit.edu/~joelsd

COURSE DESCRIPTION
Prerequisites: Grade of C or higher in PHYs 121 and MATH 112
This course introduces the general principles of developing a bioinstrumentation device. We will comprehensively cover basic acquisition concepts for bio-electric signals. Moreover, laboratories will provide hands-on experience with circuit fundamentals.

LEARNING GOALS
To provide students with:
1. Complete understanding of the nature of basic electric circuits and their applications in engineering systems.
2. Knowledge of the terminology and concepts of interfacing with living systems for acquisition of bio-electric signals.
3. Experience in the collection, analysis and interpretation of bio-electric signals.
4. Understanding of common clinical bioinstrumentation devices.
5. Familiarity with tools to understand and design biomedical instruments.

LEARNING OUTCOMES

As an outcome of completing this course, students should be able to:

1. Design and analyze basic electric circuits of resistors and capacitors.
2. Interpret signal characteristics from core bioinstrumentation equipment, such as oscilloscope, operational amplifier, signal generator, multimeter, etc.

3. Appropriately apply common biosensors and transducers to design simple recording systems.
4. Summarize origins of bio-potentials and their characteristics in time and frequency.

COURSE OUTLINE*

Class	Date	Lecture	Material	Homework
1	5/20	1	Introduction	See handouts
			Introduction to the Kits and Measurement Equipment	
2	5/22	2 & 3	Electrical Basics & Circuit Elements	See handouts
			Lab 1 Lab Equipment	
3	5/23	4	Simple Circuits	See handouts
			Lab 2 Taking Measurements	
4	5/29	4	Simple Circuits	See handouts
			Lab 2 Taking Measurements	
5	5/30	5	RC Circuits and Complex Numbers	See handouts
			RC Circuits and Complex Numbers	
6	6/03	5	Prep for Exam	See handouts
			Signals and Systems, Sampling, Digital vs Analog Systems, ICs	
7	6/05	6	Exam 1	
		7	Arduino	See handouts
8	6/06	8 & 9	Filters & Plotting Filters	See handouts
			Lab 3 Arduino lab	
9	6/10	9	Plotting Filters	See handouts
			Lab 4 Arduino Lab	
10	6/12	10 & 11	Feedback & OpAmps	
			Lab 5 RC Filter Lab	See handouts
11	6/13	11	OpAmps	
			Prep for Exam	
12	6/17		Exam 2	See handouts
			Lab 5 RC Filter Lab	
13	6/19	11	OpAmps	See handouts
			Lab 6 op amps	
14	6/20	12 & 13	Sensors & FDA and Standards	See handouts
			Prep for Final + Lab 6 op amps	
15	6/24		Final	

==*The Course Outline may be modified at the discretion of the instructor or in the event of extenuating circumstances. Students will be notified in class of any changes to the Course outline and schedule of laboratory sessions.==

GRADING
Homework: 15%
Class attendance/participation: 10%
Laboratory Exercises (including Lab reports): 15%
Exam 1: 15%
Exam 2: 15%
Final Exam 30%

Attendance is mandatory. Failure to attend class regularly will result in a failing grade.
No makeup examinations will be administered. If a valid, documented excuse for a missed
exam is provided, the weight of the Final Exam will increase to compensate for the missed
grade.

LABORATORY EXERCISES
BME 301 uses a laboratory exercises to supplement to the conventional lecture and
recitation format. In general, each session will begin with a mini-lecture, followed by the
laboratory exercise. These exercises are challenge-driven and require that you are fully
engaged in the learning process. The laboratory exercise will be individually oriented and
the individual will be responsible form maintaining a laboratory notebook. The lab
notebook will contain the initial solution, measurements, interpret the data, validate the
results, and write the lab report in the laboratory notebook.

Guidelines for Laboratory Reports
You are expected to maintain a laboratory notebook which will track the progress of each
laboratory exercise. For each laboratory exercise, the lab notebook must contain
   1. (prior to class) the lab exercise
   2. (prior to class) a solution to the problem posed (e.g., the design of your program in
      terms of a block diagram),
   3. (in class) the working program (Labview block diagrams) and collect results (e.g.,
      Labview screens demonstrating that their program works),
   4. interpretation and validation that the results are correct using the material discussed
      in class,
   5. what was learned in the exercise (e.g., use of Labview, troubleshooting, etc.)

Written lab reports must be submitted one-week after the laboratory exercise, unless
otherwise specified[#]. Please note: *reports that are submitted without evidence of
participation in the laboratory exercise will be considered plagiarism* and will result in
dismissal from the course. You cannot copy the experimental results of others and claim
credit.

Honor Code Violations/Disruptive Behavior:

NJIT has a zero-tolerance policy regarding cheating of any kind and student behavior that is disruptive to a
learning environment. Any incidents will be immediately reported to the Dean of Students. In the cases the
Honor Code violations are detected, the punishments range from a minimum of failure in the course plus

disciplinary probation up to expulsion from NJIT with notations on students' permanent record. Avoid situations where honorable behavior could be misinterpreted.

No eating or drinking is allowed at the lectures, recitations, workshops, and laboratories. Cellular phones must be turned off during the class hours.

BME 310: Learning Outcome Summary

Strategies and Actions	Student Learning Outcomes	Outcomes (a-m)	Prog. Object.	Assessment Methods/Metrics
Course Objective 1: Digital Signal Processing: Understand the fundamental principles of digital signal processing. In particular, gain knowledge in Fourier Series, Fourier Transforms, FIR, Frequency Response, and Sampling. Apply knowledge of math, engineering and science to identify, formulate, and solve problems in these areas.				
Biomedical signal processing with applications are covered in class lectures, homework, and laboratory assignments.	Understand the fundamental principles of signal processing and system analysis.	A,B,D,E,G,K	1, 2	Tests, homework, studio exercises, and laboratory reports are graded.
Course Objective 2: Data Interpretation: Learn to utilize Labview software to design and analyze data. Apply knowledge of math, engineering and science to interpret data. Develop an understanding of and develop the skills necessary to communicate findings and interpretations in an effective laboratory report.				
Background into use of Labview is provided in class discussion and instructor and online-developed manuals. Laboratory assignments will challenge students to process biomedical signals.	Analyze data collected in the studio utilizing Labview and signal processing techniques. Findings and interpretations are reported in laboratory reports.	A,B,D,E,G,K,N	1, 2	Laboratory reports and lab teamwork.
Course Objective 3: Biomedical Signal Processing: Apply knowledge of math, engineering and science to understand the principle of biomedical signal processing. Understand how to apply specific mathematical techniques to solve problems in the areas of biomedical signals.				
Lectures, discussions, laboratory and studio exercises will cover theoretical models.	Understand and apply signal processing and system analysis and how they apply to biomedical signal processing.	A,B,D,E,G,K		Tests, Homework, and laboratory reports.
CoCourse Objective 4: Work in Multi-disciplinary teams: Learn to work and communicate effectively with peers on multi-disciplinary teams to attain a common goal				
Laboratory assignments will be conducted by teams of approximately 3 students.	Each team member is expected to participate in the development of problem-solving strategies and to assume a specific role in accomplishing the team's goals.	A,B,D,E,G,K,N		Laboratory reports, Rubrics for instructor and students on oral presentations and lab teamwork.

ABET Outcomes expected of graduates of BME BS program by the time that they graduate:

(A) an ability to apply knowledge of mathematics, science, and engineering
(B) an ability to design and conduct experiments, as well as to analyze and interpret data
(C) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(D) an ability to function on multi-disciplinary teams
(E) an ability to identify, formulate, and solve engineering problems
(F) an understanding of professional and ethical responsibility

(G) an ability to communicate effectively
(H) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(I) a recognition of the need for, and an ability to engage in life-long learning
(J) a knowledge of contemporary issues
(K) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
(L) an understanding of biology and physiology
(M) the capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve problems at the interface of engineering and biology
(N) an ability to make measurements on and interpret data from living systems
(O) an ability to address problems associated with the interaction between living and non-living materials and systems