BME 310
Biomedical Computing

The Department of Biomedical Engineering

CLASS HOURS
Tuesday 11:30am -12:55am (Fenster 640)
Friday 10:00am – 11:25am (Fenster 640)

OFFICE HOURS (Fenster 610)
M, W, R, F 1:00pm – 2:00pm
Or by appointment
(973) 596 3193 joelsd@njit.edu

TEXT
Signal Processing First, McClellan, Schafer & Yoder
ISBN: 0130909998
Supplemental handouts are found on http://web.njit.edu/~joelsd

COURSE DESCRIPTION
Prerequisites: BME 301 and Math 112. This course covers the application of digital signal processing to biomedical problems. Labview, a graphical programming language common in engineering, is used for both signal acquisition and processing. Applications include analysis of the electrocardiogram and other electrical signals generated by the body.

LEARNING OUTCOMES
By the end of the course you should be able to do the following:

- **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.
- **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.
- **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.
- **Work in Multi-disciplinary teams:** Learn to work and communicate effectively with peers on multi-disciplinary teams to attain a common goal.

COURSE OUTLINE*

Date	Topic	Material	Class work	Reading/Problem Assignment
9/5/06	Introduction to Signal and Systems	Chapters 1	In-class discussion;	See Notes
9/8/06	Sinusoids - Chapter 2	Chapter 2	In-class discussion; Review exercises	Ex: 2-1~5 Probs: 2-1~4
9/12/06	Sinusoids - Chapter 2	Chapter 2	In-class discussion; Review exercises	Ex: 2.5 – 2.10 Probs:2.5, 2.6, 2.7, 2.9, 2.10, 2.11, 2.15, 2.17, 2.18
9/15/06	Labview Introduction	http://www.ni.com/academic/lv_training/how_learn_lv.htm	In-class discussion; Review exercises	Review Lab 1
9/19/06	Spectrum	Chapter 3	In-class discussion; Review exercises	Ex: 3-1~3 Probs: 3-1,2,3
9/22/06	Lab #1	Handout	Simple calculations in Labview	
9/26/06	Spectrum	Chapter 3	In-class discussion; Review exercises	Ex: 3-4~8 Probs: 3.5, 3.8, 3.9, 3.10, 3.12,3.13, 3.14, 3.17
9/29/06	Lab #2	Handout	Array calculations in Labview	
10/03/06	Review		Review exercises and Homework	
10/06/06	Exam #1			
10/10/06	Sampling and Aliasing	Chapter 4	In-class discussion; Review exercises	Ex: 4-1~5 Probs: 4-1,2,3,5,11,19
10/13/06	Lab #3	Handout	Signal Generation	
10/17/06	Sampling and Aliasing Homework Review	Chapter 4	In-class discussion; Review exercises	
10/20/06	FIR Filters	Chapter 5	In-class discussion; Review exercises	Ex: 5-1~4 Probs: 5-1,2,3,6

10/24/06	FIR Filters	Chapter 5	In-class discussion; Review exercises	Ex: 5-6~11 Probs: 5-7-9,11-12,14
10/27/06	Lab #4	Handout	Spectrum Generation	
10/31/06	Projects	Handouts	Biomedical Signals	
11/03/06	Frequency Response of FIR Filters	Chapter 6	In-class discussion; Review exercises	Ex: 6-1 Probs: 6-1,3,4,7,9,12,13
11/07/06	Frequency Response of FIR Filters	Chapter 6	In-class discussion; Review exercises	Ex: 6-2~6 Probs: 6-14,15,17,19,20,21
11/10/06	Review		Review exercises	
11/14/06	Exam #2			
11/17/06	Frequency Response	Chapter 10	In-class discussion; Review exercises	Ex: 10.1~3 Probs: 10-1,2,3, See Notes
11/22/06	Frequency Response	Chapter 10	In-class discussion; Review exercises	Ex: 10.4~7 Probs: 10-5,6.7
11/28/06	Homework Review		Review exercises	
12/01/06	Lab #5	Handouts	Real world measurement of Biomedical Signals	
12/05/06	Computing	– Chapter 13	In-class discussion; Review exercises	Ex: 13.2~4,6~8 Probs: 13-1,4,5,6
12/08/06	Computing	– Chapter 13	In-class discussion; Review exercises	
12/12/06	Review		Review exercises	
TBA	Final Exam			

***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: 10%
Class participation: 10%
Laboratory Exercises (including Lab reports): 20%
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 310 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 team oriented (maximum of 3 people per team) and the team will be responsible form maintaining a laboratory notebook. Each of the team members will be expected to design the initial solution, laboratory exercise coordinator (the person who coordinates the team for the laboratory exercise), take measurements, interpret the data, validate the results, and write the lab report in the laboratory notebook. The responsibilities of the team members will be different for each exercise, e.g., each team member must have the opportunity to write the lab report, to construct the initial design, etc.

Guidelines for Laboratory Reports
Your team is 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.)
6. note the team members and their responsibilities:
    a. initial solution designer
    b. laboratory coordinator
    c. measurement taker
    d. data interpreter
    e. results validation person
    f. lab report writer

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
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BME 320: Learning Outcome Summary

Outcome # 1. Students will understand the fundamental principles and examples of digital signal processing.		
Strategies & Actions	**Program Outcomes**	**Assessment Methods**
Biomedical signal processing with applications are covered in class lectures, homework, and laboratory assignments.	A,B,C,D,E,G,K,M	Tests, homework, and laboratory reports are graded.
Outcome # 2. Students will have the ability to use software applications (LABVIEW) for biomedical signal processing; students will be able to interpret data analyzed.		
Strategies & Actions	**Program Outcomes**	**Assessment Methods**
Background into signal processing and use of Labview is provided in class discussion and instructor-developed manuals. Students will utilize these applications in the development of laboratory reports.	A,B,C,D,E,G,K	Specific assignments and laboratory reports.
Outcome # 3. Students will be develop an understanding for biomedical signal processing techniques and learn to apply them for problem-solving.		
Strategies & Actions	**Program Outcomes**	**Assessment Methods**
Lectures, discussions and laboratories will cover theoretical models; laboratory assignments will challenge students to process biomedical signals.	A,B,C,D,E,G,K,M	Tests, Homework, and laboratory reports.
Outcome # 4. Students will learn to work and communicate effectively with peers on multi-disciplinary teams.		
Strategies & Actions	**Program Outcomes**	**Assessment Methods**
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,C,D,E,G,K	.Laboratory reports, Rubrics for instructor and students

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