Dr. J Schesser Spring 2020

BME 373
Biomedical Electronics II

CLASS HOURS
Tuesday/Friday 8:30am-10:00am (Fenster 640)

OFFICE HOURS (Fenster 610)
By appointment
(973) 596 3193 joelsd@njit.edu

TEXT
Electronics, 2nd Edition, Hambley
ISBN: 0136919820
Supplemental handouts are found on http://web.njit.edu/~joelsd

COURSE DESCRIPTION
Prerequisite: BME 372. The second of a two-semester sequence. It covers the design of electronic circuits for Biomedical applications. This course includes amplifier circuits using MOSFETs and JFETs; frequency response of amplifiers; feedback; oscillators; Schmidt Triggers; and other wave shaping circuits using operational amplifiers. Hands-on breadboarding of electronic circuits are used throughout the course to supplement the lectures.

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

- **Electronics:** Understand the fundamental principles electronics**.** In particular, gain knowledge in circuit analysis, amplifiers, frequency response, and field effect transistors. Apply knowledge of engineering and science to identify, formulate, and solve problems in these areas.
- **Data Interpretation:** Learn to design, test, and analyze electronic circuits using oscilloscopes and other electronics test equipment. Apply knowledge of 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.
- **Electronic circuits for Biomedical Applications:** Apply knowledge of engineering and science to understand the principle of biomedical electronic circuits. Understand how to apply, measure circuit performance, and 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/Lecture		Material	Class work	Reading/Problem Assignment
01/21/20	Circuit Analysis & Amplifiers Solid State Circuitry Diodes & Transistors MOSFETS	1,2, 3	Chapters 1 – 2 Chapter 3 - 4 Sections 5.1-3	In-class discussion;	Special Homework 5.3~4,6,14-19,21,23
01/24/20	Lab #2		Handouts	Transistor Amplifiers	
01/28/20	MOSFET EQUIVALENT CIRCUITS	4	Sections 5.4-6	In-class discussion; Review exercises	5.28~29,31~33,36~38 ,40,45,47
01/31/20	Junction FETs	5	-Section 5.7	In-class discussion; Review exercises	5.56, 5.57, 5.65
02/04/20	Boolean Algebra and Basic Logic Gates Logic Gate Design Specifications	6,7	Section 6.1 Section 6.2	In-class discussion; Review exercises	6.3, 6.5-11 6.12-20
02/07/20	Lab #3		Handout	Op Amps	
02/11/20	FET Gates	8	Sections 6.3-9	In-class discussion; Review exercises	6.32,40,48~50,58,69~ 73
02/14/20	Review			Review exercises and homework	
02/18/20	Exam #1				
02/21/20	Frequency Response	9	Section 8.1	In-class discussion; Review exercises	8.7-9
02/25/20	Frequency Response	9	Section 8.1	In-class discussion; Review exercises	8.7-9
02/28/20	Frequency Response	10	Sections 8.2	In-class discussion; Review exercises	8.12 (*rd=40kW*), 13,14,16,17
03/03/20	Miller Effect	11	Section 8.3	In-class discussion; Review exercises	8.20~24,27
03/06/20	Small Signal Equivalent Circuits for the BJT	12	Sections 8.4-8.8	Review exercises and homework	8.28,31,40~41,56~57, 60~62
03/10/20	Feedback	13	Sections 9.1-2		9.1~3,9,11,16,18~20
03/13/20	Review			Review exercises and homework	
Spring Recess 3/18 – 3/22					
03/24/20	Exam #2			In-class discussion; Review exercises	
03/27/20	Impedances	14	Sections 9.3-5	In-class discussion; Review exercises	9.22, 27~36,38
03/31/20	Transient and Frequency Response	15	Sections 9.6-11	In-class discussion; Review exercises	9.58~59,63~66,72~73

04/03/20	Oscillators Comparators and Schmitt Triggers	16,17, 18,	Section 9.11-12	In-class discussion; Review exercises	9.83~89,91
04/07/20	Lab # 4		Section 12.1 Section 12.2 Section 12.3	In-class discussion; Review exercises	12.8~9 12.14 12.18-20
4/10/20	Good Friday No Class				
04/14/20	Astable Multivibrators Timers	19	Handout	Timers	
04/17/20	Lab #5			In-class discussion; Review exercises Wein Bridge	
04/21/20	Review			Review exercises and homework	
04/24/20	Exam #3				
04/28/20	Rectifiers, Peak Detectors, SampleandHold Circuits, Clamp Circuits D/A and A/D Converters Lab #5 cont.	20, 21	Sections 12.4-7 Sections 12.8-11		12.23,27~28,30,32 12.34-36
05/01/20	Labs				
05/05/20	Review			Review exercises and homework	
TBD	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: 11%
Class participation: 5%
Laboratory Exercises (including Lab reports): 11%
Exam 1: 15%
Exam 2: 15%
Exam 3: 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 373 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 circuit in terms of a block diagram),
3. (in class) the working circuit (circuit diagrams) and collect results (e.g., oscilloscope screens demonstrating that the circuit 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 circuit design and operation, measurement equipment, 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 373: Learning Outcome Summary

Outcome # 1. Students will understand the fundamental principles and examples of electronics		
Strategies & Actions	**Program Outcomes**	**Assessment Methods**
Biomedical electronics 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 laboratory measurements for biomedical electronic circuit design and analysis; students will be able to interpret data analyzed.		
Strategies & Actions	**Program Outcomes**	**Assessment Methods**
Background into electronics and use of electronic test equipment 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 electronic circuit 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 analyze and design biomedical electronics circuits.	A,B,C,D,E,G,K	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