

**BIOENGINEERING 370: BIOINSTRUMENTATION
FALL 2014**

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Lecture: M W 12:20p - 1:10p
Lab: M 3:30p - 6:00p
T 3:30p - 6:00p
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Prerequisites: ECE 2020 or ECE 3070 and MATH 2080

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1. OVERVIEW

Bioinstrumentation is an interdisciplinary subject of applying physical principles and mechanical, electronic and chemical engineering technologies to acquire, analysis and display information from cells, tissues, organs and entire organisms including the human body. It has emerged from research conducted at the interface of the physical and biological sciences, engineering and medicine. This course is designed for junior and senior undergraduates, aiming to introduce fundamentals and frontier topics of bioinstrumentation to familiarize students with basic principles of acquire and analyze physiological signals. Through the course work, students will learn how to explore the connections between different fields and the ways of integrating those fields together to select and properly use the optimal instrument for solving biomedical problems.

An emphasis will be placed on the physics behind various phenomena that is employed to transduce physiological events into electronic signals. Through the lectures, the students will be provided with a basic knowledge of a broad range of topics in bioinstrumentation so that each of them in different engineering or other related disciplines can rapidly acquire the minimal necessary background for the operation and development of bioinstrumentation.

1.1. Critical Thinking (CT²). As part of Clemson University's accreditation with the Southeastern Association of Colleges and Schools Council on Colleges (SACS-COC) accreditation we have undertaken an initiative to promote critical thinking within our student population. This initiative helps improve Clemson University by providing our students with skills essential to real world problem solving and evaluation. By participating in this type of course you will learn new study skills while helping Clemson. *Be aware, the teaching methods, testing strategies, and overall interaction in this class may differ from other courses. Some methods may be experimental. BUT all CT² methods will be for the benefit of the student, and may change to improve the student experience.*

For more information on the CT² initiative please visit: <http://www.clemson.edu/assessment/thinks2>.

1.1.1. *The California Critical Thinking Test.* You will be asked to take an online test at the beginning and end of the course as a homework assignment called the California Critical Thinking Test, this test will assess your strengths in a number of areas of critical thinking. Your scores have no impact on your grade, your standing at Clemson, or anything else. Taking these exams helps Clemson University and myself improve teaching methods to improve the quality of our student progress. These exams typically take 45-50 minutes, and do not involve any studying, preparing, or outside work.

My Offer: If you complete the exam, you will receive one dropped homework score for each the pre-test and post-test

2. LEARNING OBJECTIVES

- (1) State the fundamentals of bioinstrumentation and bioimaging
- (2) Understand physics behind various phenomena that are employed to convert physiological events into electronic signals
- (3) Appreciate frontier topics in bioinstrumentation and bioimaging
- (4) Develop the ability to acquire and analyze physiological signals including images
- (5) Select and operate optimal instrument for solving biomedical problems
- (6) Design, in a team-based setting, an experiment to measure and analyze biological/physiological sample properties

NOTE: Students may vary in their competency levels on these abilities. You can expect to acquire these abilities only if you honor all course policies, attend classes regularly, complete all assigned work in good faith and on time, and meet all other course expectations of you as a student.

3. GRADING

Exams		55%
	Exam 1:	15%
	Exam 2:	20%
	Exam 3:	20%
Final Lab Project		20%
	Written Proposal:	14%
	Group Final Poster:	6%
Midterm Lab		15%
Weekly Lab Reports		5%
Homework		5%

4. GRADING SCHEMA

A	≥ 90
B	80 - 89.9
C	70 - 79.9
D	65 - 69.9
F	< 65

5. GRADING POLICIES

Completing the required work for this course is an important part of successfully learning the material being covered. It is therefore important that students complete and submit work in a timely manner. Therefore as a policy, to achieve an A in this course, a student must submit at least 90% of the required assignments in each category (Homework, Labs, Exams) in addition to scoring a grade of 90 or above. Students will receive a letter grade reduction for each category that has less than 90% completion. Students who have less than 50% completion in any given category will automatically fail the course.

5.1. Attendance Grading.

- If you have 2 unexcused absences your grade will be lowered by 1/2 letter grade (i.e. A becomes A-)
- If you have 3 unexcused absences your grade will be lowered by 1 letter grade (i.e. A becomes B)
- If you have 4 unexcused absences your grade will be lowered by 2 letter grades (i.e. A becomes C)
- If you have over 5 unexcused absences your grade will fail the course

6. RECOMMENDED TEXTBOOKS (GOOD REFERENCES)

Webster, JG, *Bioinstrumentation*, John Wiley & Sons, Inc., 2004, Out of Print

Webster, JG, *Medical Instrumentation: Application and Design*, 4th Ed., John Wiley & Sons, Inc., 2010, ISBN: 0471676004

7. ATTENDANCE POLICY

Since this is a lab class, students are expected to attend all classes (lectures and labs). Students are allowed 1 unexcused absence; all other absences will be reflected in the final grade (see Grading Section). Absences are excused only with a valid, written, medical or university excuse. Non-medical excuses need to be cleared more than 24 hours before class and will only be granted for a valid university excuse. **The Blackboard “Notification of Absence” form does not serve as a valid written excuse, nor valid notification of absence.**

Students are also expected to be on time to class and labs; 2 tardies is equivalent to one unexcused absence. If the professor or guest lecturer does not come to class within the first fifteen minutes, students are authorized to leave.

Cell phones should be turned off during class. Laptops should be off and put away unless they are being used for specific class purposes. Students caught using laptops for nonclass related activities during lectures will be counted as having an unexcused absence for that class.

8. CANCELLED CLASSES

Classes cancelled due to university, state, or national emergency may be made up at the discretion of the instructor upon agreement with the students in the class. In the rare event that a makeup class is needed the instructor will poll the students to determine an acceptable time to schedule such a class.

9. DUE DATES AND ASSIGNMENTS

The use of simulations and models will be an important part of the learning experience in this course, and thus assignments will be an important component of this class's process. You will therefore be expected to complete all assignments on time and submit them. Some assignments will be able to be submitted electronically while others will need to be on paper. In the case of a paper assignment, it is due at the beginning of the classroom period in which the assignment is due. In the case of electronic submission, a specific deadline will be set per assignment. This deadline will be absolute, and no assignments will be accepted beyond this deadline.

Extenuating circumstances do occur and thus with prior approval assignments may be accepted late. Requests for approval must be submitted in writing a minimum of 24 hours before the nominal deadline of an assignment. You will be informed promptly as to the status of your request.

10. HONOR CODE AND ACADEMIC DISHONESTY

Academic dishonesty has no place in any academic environment, especially not at a great institution such as Clemson. Seeing as this, cheating or academic dishonesty will not be tolerated, and will be reported to seek disciplinary action per the College of Engineering and Science's Honor Code. A copy of this honor code can be found at:

<http://www.ces.clemson.edu/ge/Hono%20Code.htm>

You are encouraged to collaborate on assignments and projects; however, ultimately, you are responsible for submitting your own work. Make sure you cite all sources, including class members. It will be acceptable to give a blanket citation for classmates with whom you worked.

If you have any questions as to how I define academic dishonesty, please contact the instructor.

Students violating the honor code or spirit of the honor code on any assignment, quiz, or exam will automatically fail the item. Incidents of academic dishonesty will be documented and referred to the appropriate department, college, and university administrators.

11. ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

Student Disability Services coordinates the provision of reasonable accommodations for students with physical, emotional, or learning disabilities. Accommodations are individualized, flexible, and confidential based on the nature of the disability and the academic environment in compliance with Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990.

Students are encouraged to consult with the Disability Services staff early in the semester, preferably prior to the first day of class. Current documentation of a specific disability from a licensed professional is needed. Additional information or appointments are available from Student Disability Services, G-23 Redfern Health Center, 656-6848. Details on policies and procedures are available at <http://www.clemson.edu/asc>

12. TITLE IX

Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity (e.g., opposition to prohibited discrimination or participation in any complaint process, etc.) in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. This policy is located at <http://www.clemson.edu/campus-life/campus-services/access/title-ix/>. Mr. Jerry Knighton is the Clemson University Title

IX Coordinator. He also is the Director of Access and Equity. His office is located at 111 Holtzendorff Hall, 864.656.3181 (voice) or 864.565.0899 (TDD).

13. MISSED QUIZZES AND EXAMS

Quizzes or exams which are missed as a result of an unexcused absence will not be able to be made up under any circumstances. Should a missed exam be the result of a valid excused absence, arrangements will be made for a makeup exam or other makeup at the discretion of the instructor. Students are requested to inform the instructor about missing exams as early as possible.

14. EXTRA CREDIT ASSIGNMENTS

The instructor reserves the right to provide additional assignments or projects for extra credit. In the unlikely event an extra credit assignment is offered, it will be available to all students at their request.

15. CURVING AND NORMALIZING

Grades will be curved and normalized at the end of the semester, this process will always be used to the benefit of the students. The letter grade divisions may be lowered, but will not be raised. This means a 90 will always be an A, an 80 will always be at least a B, and so on. If you have concerns about your grade please contact the instructor.

16. CLASSROOM DECORUM

You are expected to come to class on time, and prepared for lecture. Students should not talk amongst themselves during lecture, as this distracts student's learning. Those disrupting teaching or other student's learning will be asked to leave and will be given an unexcused absence for the lecture. Students should not use their cellphones nor laptops during class unless they are specifically required for classwork. Students caught using phones or laptops for non-course related material, will receive an automatic unexcused absence for the lecture.

17. GRADING DISPUTES

As all grading information is considered time critical, disputes on grades will only be permitted within one week of the return of graded material. Additionally, disputes must be made in writing along with the original copy of the graded material, and an explanation of the dispute. Disputes will be carefully considered and may result in either an increase or decrease in the grade on a given assignment.

PLEASE NOTE: The schedule, policies, procedures, and assignments set out in this syllabus are subject to change in the case of extenuating circumstances, by mutual agreement, and/or to ensure better student learning.

18. CALENDAR

This calendar is **tentative** and may change depending on class interests, feedback, or any other reason beneficial to the student learning process.

Lecture	Date	Description
Lecture 0.0	August 20	Introduction and CT2 / Homework 1
Lecture 0.1	August 25	Introduction to Critical Thinking / California Test
Lecture 1	August 27	Circuit Review
Lecture 2	September 1	2 nd Order Circuits, Transforms
Lecture 3	September 3	Nonlinear Circuits and Amplification
Lecture 4	September 8	A/D Conversion
Lecture 5	September 10	Hearing
Exam 1	September 15	
Lecture 6	September 17	Electrically excitable cells
Lecture 7	September 22	Patch clamp and cardiac conduction
Lecture 8	September 24	EKG / ECG
Lecture 9	September 29	Noise and electrodes
Lecture 10	October 1	EEG
Lecture 11	October 6	Pressure
Lecture 12	October 8	Chemical biosensors
Lecture 13	October 13	Glucose Sensing
Lecture 14	October 15	Optical Microscopy
Exam 2	October 20	
Lecture 15	October 22	Lasers
Lecture 16	October 27	Electron Microscopy
Lecture 17	October 29	Ultrasound
Fall Break	November 3 - 4	
Lecture 18	November 10	X-Ray
Lecture 19	November 12	Computed Tomography (CT)
Lecture 20	November 17	NMR and MRI
Lecture 21	November 19	AFM
Lecture 23	November 24	Image Guided Surgery
Thanksgiving	November 26 - 28	
Lecture 24	December 1	Wrap Up and Review
Exam 3	December 3	

19. KEY DATES

Date	Description
September 15, 2014	Exam 1
October 8, 2014	Exam 2
October 10, 2014	Midterm Lab Write-Up Due
October 24, 2014	Last Day to Drop a Course Without a Final Grade
November 3-4, 2014	Fall Break
November 7, 2014 (11:55p)	Final Lab Proposal Deadline
November 27-29, 2014	Thanksgiving Break
December 3, 2014	Exam 3
December 13, 2014 (8:00a - 10:30a)	Final Poster Presentation (Final Exam Time)