UNIVERSITY OF CALIFORNIA at MERCED
SCHOOL of ENGINEERING

BIOE 113: Bioinstrumentation
Spring, 2017

INSTRUCTOR:

Dr. Changqing Li
Office: SE1 336
Office phone: (209)228-4777, cli32@ucmerced.edu

OFFICE HOURS:

9:30-10:30AM, T, SE1 RM 336

LECTURE AND LABORATORY:

Lecture: 12:00-1:15PM, MW, SSM 104
Lab 02L: 8:00AM-10:50AM, M, SE2 150; TA: Zhao, Yue
Lab 03L: 10:30AM-1:20PM, T, SE2 150; TA: Zhao, Yue
Attendance and regular participation are mandatory.

FINAL EXAM SCHEDULE

11:30AM-2:30PM, SSM 104, May 11, 2017

COURSE DESCRIPTION

This course has been designed to introduce fundamental principles of biomedical instrumentation commonly used in biomedical engineering research labs and hospitals. Techniques and principles of bioinstrumentation include biosignal and noise, biosensors, electrodes, electrocardiogram (ECG), defibrillators, pacemakers, electroencephalography (EEG), electromyogram (EMG), respiratory instruments, and optical microscopy. Biomedical circuit and electronics will be reviewed.

TEXTBOOKS and other REQUIRED MATERIALS

Required: Biomedical Instrumentation Systems, Jerry L. Shakti Chatterjee, Aubert Miller, 2010. Inc., ISBN-13 978-1-4180-1866-5

Recommended: Principles of Bioinstrumentation, Richard A. Normann, 1988, ISBN 0-471-60514-X.

COURSE OBJECTIVES / STUDENT LEARNING OUTCOMES

After successful completion of this class, students will be able to:

- Demonstrate an understanding of physics and engineering in biosensor, electrodes;
- Demonstrate an understanding of the biomedical instrumentation principles in

aspects of device design and applications.
- Apply these principles in the context of bioinstrumentation interactions with tissues, organs and human body to explain the measurement results and to develop the instrumentations.

Students will demonstrate these abilities – and hone the appropriate information gathering, computational and data-handling skills – in homework and lab exercises. They will demonstrate their proficiency formally in examinations.

LEARNING OUTCOMES: By the end of the course, students will demonstrate:

1. An understanding of physics in biosensor, electrode.
2. An understanding of biomedical instrumentation principles in aspects of device design and applications.
3. An understanding of the techniques, skills and modern engineering tools necessary for engineering practice.
4. An ability to analyze contemporary bioinstrumentation studies to make connections and decisions based on their scientific merit.
5. An ability to communicate and function effectively on a multi-disciplinary team.
6. An ability to strengthen self-learning methods and organizational skills to enhance problem-solving abilities and efficiency.

Relationship to Program Learning Outcomes:
BIOE 113 maps directly to the following Program Learning Outcomes for Bioengineering undergraduate students:

PLO (a) an ability to apply knowledge of mathematics, science, and engineering.
PLO (d) an ability to function on multidisciplinary teams.
PLO (i) a recognition of the need for, and an ability to engage in life-long learning.
PLO (j) a knowledge of contemporary issues.
PLO (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

PREREQUISITES by TOPIC

MATH 022, PHYS 009, Bio 001; and Engr 166 or BIOE 166; Or permission by instructor

COURSE POLICIES
LECTURE AND LAB SECTIONS

- Lecture and lab section attendance is mandatory. Your lab sections are designed to support your efforts to learn the course material by practicing with it in as many ways as possible.
- Attendance will be recorded.

HOMEWORK AND LAB REPORT

- Homework and lab report are critical components of this course and are designed

to help you learn, understand and practice the material. Homework and lab report will be due on the dates indicated in the detailed schedule provided to course participants via UCMCROPS.

- Late homework and lab report will not be accepted.
- You are encouraged to work with your peers when doing homework. However, each student must turn in his/her own homework assignment and it must reflect his/her own work. You must explicitly identify all peers with whom you worked.

PRESENTATIONS

- Students will be teamed and select a project topic from a topic list for their presentation.
- Each team will present 30 minutes followed with a 5 minutes question section.
- A report for each team will be required.

EXAMS AND QUIZZES

- There will be 1 in-class midterm exam and two in-class quizzes as indicated on the detailed schedule.
- There will also be a comprehensive final exam.
- There will be no make-up exams and quizzes. If you are sick during a regularly scheduled exam, please bring a note from the university clinic or your own doctor verifying your illness. Your course grade will then be determined by the rest of your work.
- Crib sheets will not be allowed during any of the exams. However, calculators will be allowed when necessary, provided that they are not used to store data or formulae pertaining to the course.

DROPPING THE COURSE

- Please see the UC Merced General Catalog and the Registrar's / Student First website for details.

UCMCROPS

- The UCMCROPS site will be used for periodic course announcements, and for the distribution of class notes, discussion exercises, homework sets, and (some) solutions.
- You can check the scores that you have received on your homework assignments and exams.
- Warning: pay no attention to any letter grade that is reported on UCMCROPS, except for the final grade.

CONDUCT

- Students are expected to complete their own work and to abide by the UC Merced academic honesty policy, which can be found on the Student Life website http://studentlife.ucmerced.edu/ under the "Student Judicial Affairs" link.
- Note that most of the handouts provided in this course are protected by copyright, and are flagged accordingly on UCMCROPS. They are for your personal use only. Re-posting the files or their contents on sites such as (for example) "Course

Hero" is an explicit violation of this copyright.

- Students and instructors are expected to honor UC Merced's Founding Principles of Community: http://www.ucmerced.edu/about-uc-merced/principles-community.

SPECIAL ACCOMMODATIONS

- The instructor will make every effort to accommodate all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance.
- Please speak with the lead instructor during the first week of class regarding any potential academic adjustments or accommodations that may arise due to religious beliefs.

ACADEMIC DISHONESTY STATEMENT

- Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy. Any work submitted by a student in this course for academic credit will be the student's own work.
- You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an email, an email attachment file, a diskette, or a hard copy. Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Policy can also be extended to include failure of the course and University disciplinary action.
- During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

DISABILITY STATEMENT

Accommodations for Students with Disabilities: The University of California Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design and diversity. I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances. Students are encouraged to register with Disability Services Center to verify their eligibility for appropriate accommodations.

GRADING

Lecture attendance and participation: 5%

Quiz:	10%
Presentation and report:	10%
Lab attendance and reports:	15%
Homework:	10%
Midterm:	20%
Final exam:	30%

TOPICS

1. Biosignals and noises
2. Review of biomedical electronics
3. Review of low pass filter design
4. Review of linear system theory
5. Biosensors, electrodes and transducers
6. Electrocardiogram (ECG)
7. Defibrillators and pacemakers
8. Instrumentation in blood flow
9. Instrumentation in respiration
10. Electroencephalography (EEG) and electromyogram (EMG).
11. Optical microscopy
12. X-ray imaging
13. Nuclear medicine imaging
14. Ultrasound Imaging (if have time)

Note: Topics will be slightly adjusted according to class progress.

CLASS / LABORATORY SCHEDULE

Lectures

Jan 18 (W): Lecture 1 Introduction to Syllabus and Complex Number Review
Jan 23 (M): Lecture 2 Analog Electronic 1
Jan 25 (W): Lecture 3 Analog Electronic 2
Jan 30 (M): Lecture 4 Filter Design
Feb 1 (W): Lecture 5 Digital Electronics 1
Feb 6 (M): Lecture 6 Digital Electronics 2
Feb 8 (W): Lecture 7 Biosignals
Feb 13 (M): Lecture 8 Linear System theory (Quiz 1)
Feb 15 (W): Lecture 9 electrode and sensor
Feb 20 (M): Holiday
Feb 22 (W): Lecture 10 electrode and sensor
Feb 27 (M): Lecture 11 EEG and EMG
Mar 1 (W): Lecture 12 EEG and EMG
Mar 6 (M): Lecture 13 Instrumentation in respiratory
Mar 8 (W): Lecture 14 Blood flow
Mar 13 (M): Lecture 15 Mid-term exam review
Mar 15 (W): Lecture 16 (Mid-term exam)
Mar 20 (M): Lecture 17 ECG
Mar 22 (W): Lecture 18 ECG, Defibrillators and Pacemaker
Mar 27 (M): Spring recess (No class)

Mar 29 (W): Spring recess (No class)
Apr 3 (M): Lecture 19 Medical safety
Apr 5 (W): Lecture 20 Design of optical systems
Apr 10 (M): Lecture 21 Microscopy and spectroscopy
Apr 12 (W): Lecture 22 Introduction to CT (Quiz 2)
Apr 17 (M): Lecture 23 Introduction to Nuclear medicine
Apr 19 (W): Lecture 24 Research topic
Apr 24 (M): Lecture 25 Research topic
Apr 26 (W): Lecture 26 Project presentation
May 1 (M): Lecture 27 Project presentation
May 3 (W): lecture 28 (Final exam review)

Labs

Jan 17: No lab
Jan 23 and Jan 24: Lab 1
Jan 30 and Jan 31: Lab 2
Feb 6 and Feb 7: Lab 3
Feb 13 and Feb 14: Lab 4
Feb 20 and Feb 21: No lab
Feb 27 and Feb 28: Lab 5
Mar 6 and Mar 7: Lab 6
Mar 13 and Mar 14: Lab 7
Mar 20 and Mar 21: Lab 8
Mar 27 and Mar 28: Spring recess (No lab)
Apr 3 and Apr 4: Lab 9
Apr 10 and Apr 11: Lab 10
Apr 17 and Apr 18: Lab 11
Apr 24 and Apr 25: Lab 12
May 1 and May 2: Lab 13
May 8 and May 9: Lab 14