

**Electrical Engineering Department  
San José State University**

**EE262 Acquisition and Analysis of Biosignals  
Fall Semester, 2009**

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| <b>Instructor:</b>      | Dr. Mallika Keralapura   |
| <b>Office Location:</b> | Engineering E365   |
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| <b>Office Hours:</b>    | Tuesdays 1-3pm, Thursdays 1-4pm  |
| <b>Class Days/Time:</b> | Sat 9-12   |
| <b>Classroom:</b>       | ENGR 301   |
| <b>Credits</b>          | 3  |
| <b>Prerequisite</b>     | EE210 or Equivalent  |

**Course Description:**

This course is for students with interest in Biomedical Engineering, Biomedical Instrumentation and Biomedical Devices. In this course, you will first understand different biomedical signals and their physiological sources. You will then learn to design analog instrumentation to extract such signals along with instrument system response characterization addressing challenges associated with measuring such signals. In the latter part of the course you will learn biomedical signal analysis with focus on removal of artifacts, event detection and frequency domain characterization in the context of disease diagnosis, management, and treatment. Numerous case studies throughout the course will be used to explain concepts.

**Faculty Web Page and MYSJSU Messaging**

Copies of the course materials such as the syllabus, major assignment handouts, etc. may be found on my faculty web page accessible through the Quick Links>Faculty Web Page links on the SJSU home page. You are responsible for regularly checking with the messaging system through MySJSU. A WebCT may be set-up for this class. Students will be informed of it in the class.

## **Required Texts:**

1. Medical Instrumentation: Application and Design by John G. Webster (Editor), Wiley publishers, 3<sup>rd</sup> edition or 4<sup>th</sup> edition
2. Biomedical Signal Analysis: A Case-Study Approach by Rangaraj Rangayyan, Wiley – IEEE Press, 1<sup>st</sup> edition (December 2001), **ISBN-10:** 0471208116, **ISBN-13:** 978-0471208112

## **References:**

1. Discrete-Time Signal Processing by Alan V. Oppenheim and Ronald W. Schaffer, Prentice-Hall Signal Processing Series, 2<sup>nd</sup> edition (Jan 1999), ISBN-10: 0137549202, ISBN-13: 978-0137549207
2. Biomedical Signal Processing and Signal Modeling by Eugene Bruce, Wiley-Interscience; 1<sup>st</sup> edition (November, 2000), ISBN-10: 0471345407, ISBN-13: 978-0471345404

## **Assessment/Grading System**

Grades will be determined by the following criteria.

- Midterm exam (1<sup>st</sup> half of course): 15%
- Final exam (2<sup>nd</sup> half of course): 15%
- Homework (2 HWs – 5% each): 10%
- Quizzes (2 Quizzes – 5% each): 10%
- MATLAB Labs (3 Labs – 5% each): 15%
- Project: 35%

## **Grading Scheme:**

**A:** 90-100; **B:** 80-89; **C:** 70-79; **D:** 60-69; **F:** below 60

## **Description of assignments, Late-policy and Make-up policy**

### **Quizzes:**

There will be 2 quizzes on DSP review topics. There will be no opportunity to re-take these quizzes unless a serious and compelling reason exists and written proof can be provided.

### **Homework:**

2 sets of HW will be assigned – primarily for instrumentation systems. Due date will be 2 weeks after assignment.

**MATLAB Labs:** 3 Lab assignments will be assigned over the semester. Portion of some classes will be used towards introduction of the Labs and illustration of techniques. The Labs will be done in groups of 2. Instructor will post deadlines for these.

### **Project:**

This is an individual project and involves extensive signal analysis using MATLAB. Students will develop a 1 page proposal describing what they would like to do in this project, work on the project individually and present the project in a poster session at the

end of the semester. The instructor will be an extensive resource for project ideas to help students. Note this project could be a stepping-stone to a MS thesis or MS project and novel projects could be written up to be presented at international conferences.

### **Late and Make-up Policy:**

- a) 10% will be deducted for each homework or Matlab lab if submitted past the due-date.
- b) Students who come in after the quiz has been completed will not get an opportunity to take the quiz unless special permission has been taken from the instructor in the previous class. Such students will receive no credit on the quiz.
- c) If you miss the midterm, there will be a make-up exam scheduled on a specific day in the semester to make-up these exams. However, please note that you will be allowed to make up this exam ONLY IF the instructor believes that you had a serious and compelling reason (medical or personal) for which you can provide written proof for missing the exam and you have discussed this with the instructor. The instructor will decide this on a case-by-case basis. You will receive no credit if you had no reason to miss these exams. If you miss the FINAL EXAM, there is an opportunity to receive an 'I' grade again if serious and compelling reasons exists and approval has been taken from the instructor and chair of EE department. Other students who fail to appear at the FINAL EXAM will receive an 'F' grade in the course.

### **Office Hours:**

The office hours are for questions about lectures, assignments, projects and discussion of grades assigned. If you need the help of the instructor, please use the listed office hours. You can also email her regarding other minor issues if you cannot make it to the office hour. Individual appointments other than the office hours can be arranged especially if you work outside the university and the office hour is inconvenient to you.

### **Classroom Protocol**

Students are expected to attend every class. No attendance will be taken, however missing classes may result in missed quizzes resulting in loss of points. Students are requested to silence their cell phones during class.

### **Other Notes:**

MATLAB will be used to demonstrate some of the concepts discussed in class and also to solve some homework problems. Students are responsible for self-learning and purchasing the software if necessary. The Student Version of MATLAB and the Signal Processing Toolbox are available from the bookstore or directly from the Mathworks,

Inc. ([www.mathworks.com](http://www.mathworks.com)). MATLAB and many toolboxes are also available on many PCs in rooms ENG387 and ENG405. You may wish to purchase the Signal Processing Toolbox (~\$30). Check the web site: <http://www.mathworks.com/academia/> regarding how to order the DSP Toolbox. Matlab has a good help facility that you should invoke to learn more about specific commands or functions.

## ***University Policies***

### **Academic integrity**

Students should know that the University's [Academic Integrity Policy is available at \[http://www.sa.sjsu.edu/download/judicial\\\_affairs/Academic\\\_Integrity\\\_Policy\\\_S07-2.pdf\]\(http://www.sa.sjsu.edu/download/judicial\_affairs/Academic\_Integrity\_Policy\_S07-2.pdf\)](http://www.sa.sjsu.edu/download/judicial_affairs/Academic_Integrity_Policy_S07-2.pdf). Your own commitment to learning, as evidenced by your enrollment at San Jose State University and the University's integrity policy, require you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The website for [Student Conduct and Ethical Development is available at \[http://www.sa.sjsu.edu/judicial\\\_affairs/index.html\]\(http://www.sa.sjsu.edu/judicial\_affairs/index.html\)](http://www.sa.sjsu.edu/judicial_affairs/index.html).

Instances of academic dishonesty will not be tolerated. Cheating on exams or plagiarism (presenting the work of another as your own, or the use of another person's ideas without giving proper credit) will result in a failing grade and sanctions by the University. For this class, all assignments are to be completed by the individual student unless otherwise specified. If you would like to include in your assignment any material you have submitted, or plan to submit for another class, please note that SJSU's Academic Policy F06-1 requires approval of instructors.

### **Campus Policy in Compliance with the American Disabilities Act**

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 requires that students with disabilities requesting accommodations must register with the DRC (Disability Resource Center) to establish a record of their disability.

### ***EE Department Policies and Honor Code***

*The Electrical Engineering Department will enforce the following Honor Code that must be read and accepted by all students.*

*"I have read the Honor Code and agree with its provisions. My continued enrollment in this course constitutes full acceptance of this code. I will NOT:*

- *Take an exam in place of someone else, or have someone take an exam in my place*
- *Give information or receive information from another person during an exam*
- *Use more reference material during an exam than is allowed by the instructor*
- *Obtain a copy of an exam prior to the time it is given*

- *Alter an exam after it has been graded and then return it to the instructor for re-grading*
- *Leave the exam room without returning the exam to the instructor.”*

***Measures Dealing with Occurrences of Cheating***

- *Department policy mandates that the student or students involved in cheating will receive an “F” on that evaluation instrument (paper, exam, project, homework, etc.) and will be reported to the Department and the University.*
- *A student’s second offense in any course will result in a Department recommendation of suspension from the University.*

## Tentative Course Outline

| Week       | Date          | Topics, Readings, Assignments, Deadlines  |
|------------|---------------|---|
| 1          | 08/29         | Physiology [Webster Ch.4 and Rangayyan Ch. 1]   |
| 2          | 09/05         | NO CLASS  |
| 3          | 09/12         | <b>HW#1 DUE</b> , <b>09/12 QUIZ #1 = Physiology [20 mins]</b> DSP Review - Review: Oppenheim Chs. 2, 3, 5 and 7   |
| 4          | 09/19         | DSP Review Cont. - Review: Oppenheim Chs. 2, 3, 5 and 7   |
| 5          | 09/26         | <b>09/26 QUIZ #2: DSP Review (30 mins)</b> , Removal of Artifacts [Rangayyan Ch. 3]   |
| 6          | 10/03         | Removal of Artifacts Cont. [Rangayyan Ch. 3] <b>1 hour Lab Session</b>  |
| 7          | 10/10         | Frequency domain analysis [Rangayyan Ch. 6]   |
| 8          | 10/17         | Frequency domain analysis Cont [Rangayyan Ch. 6] <b>1 hour Lab Session</b><br><b>10/17 Project Proposal Due to Instructor for approval</b>  |
| 9          | 10/24         | <b>10/24 MIDTERM [Analysis] (1 hour 15 mins)</b> Event Detection [Rangayyan Ch. 4]  |
| 10         | 10/31         | Event Detection Cont. [Rangayyan Ch. 4] <b>1 hour Lab Session</b>   |
| 11         | 11/07         | <b>Start Final Project</b><br>Instrumentation Design for biological signals<br>Biopotential amplifiers – detailed analysis of ECG, EMG, plethysmography instrumentation [Webster Ch 1, 3, 5, 8] |
| 12         | 11/14         | Instrumentation Design for biological signals Cont. [Webster Ch 1, 3, 5, 8]   |
| 13         | 11/21         | Instrumentation Design for biological signals Cont. [Webster Ch 1, 3, 5, 8], <b>HW#2 DUE</b>  |
| 14         | 11/28         | THANKS GIVING HOLIDAY   |
| 15         | 12/05         | <b>End Final Project</b><br><b>Poster Presentation and Discussion of Final Projects</b>   |
| Final Exam | Week Of 12/12 | <b>Final [Instrumentation]</b>  |