San José State University
College of Engineering
Department of Biomedical Engineering
BME 115, Foundations of Biomedical Engineering

Course and Contact Information

Instructor:	Folarin Erogbogbo (Prof.Eros)
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Office Hours:	Wednesday: 11:00am - 12:00 PM Thursday: 5:30 – 6:30 PM
Class Days/Time:	Tuesday: 3:00 – 4:15 PM Thursday: 3:00 – 4:15 PM
Classroom:	CL222
Prerequisites:	**Engr 10, Biol 30, Chem 001B, Math 032, Phys 050**

Course Format

The course adopts a combination of traditional and flipped lectures as a primary teaching method, combined with in-class problem solving sessions. Short quizzes (either in class, via iClicker, or online, via Canvas) will be assigned in review of the course material. Materials from the textbook or provided by the instructor will be reinforced with homework assignments. A term paper and presentation will also be completed covering a topic of the student's choosing within the field of Biomedical Engineering. In class each student is required to have an internet-connected device (e.g. smartphone, tablet, laptop computer) to be used exclusively for learning-related activities, including the iClicker technology available at SJSU.

This course incorporates a required lab component (BME 115L), for which a separate syllabus is provided.

Faculty Web Page and MYSJSU Messaging

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on the Canvas learning management system course website. All communications relevant to the course will be sent out using the Canvas messaging system (Canvas email and announcement board). You are responsible for regularly checking with the messaging system through Canvas to learn of any updates.

Course Description

Introduction to the fundamental principles of biomedical engineering. Core conservation equations are applied to mass, energy, charge, and momentum transfer in biomedical systems. Additional topics provide a breadth of exposure in cell and molecular biology, diagnostics and analytical techniques, statistical analysis of biomedical data, bioinformatics, bioinstrumentation, FDA regulations, and biomedical ethics. Prerequisite: BIOL 30, CHEM 001B, ENGR 010, MATH 032 and PHYS 050. Misc/Lab: Lecture 3 hours / Lab 3 hours

BME 115 is the first BME course in the suggested sequence for the BS major, and required prerequisite for the MS BME degree. The purpose of this course is two-fold: introduce students to the breadth of the field and establish core engineering and problem solving skills applicable across biomedical engineering disciplines.

Course Goals

Course Learning Outcomes

Upon successful completion of this course, students will be able to:

- **Identify** basic components of biological systems and their function
- **Apply** engineering approaches and prescribed problem solving techniques to modeling biological systems
- **Apply** accounting and conservation equations to mass, energy, and charge.
- **Perform** laboratory experiments and obtain measurements from living systems.
- **Analyze** ethical issues surrounding biomedical engineering practice
- **Describe** recent advances in biomedical engineering within the context of existing knowledge and technology
- **Investigate** novel biomedical engineering techniques by doing an in-depth research paper and presentation
- **Work** in teams to complete specified course assignments; namely laboratory work and term paper/presentations
- **Apply** quantitative skills learned in class to evaluate advances in biomedical engineering (via term paper/presentation)

Required Texts/Readings

Required textbook

Madihally S.V., Principles of Biomedical Engineering, Artech House; 1st Edition (2010), electronic version (.pdf) **available free of charge** to SJSU students via the MLK library.

Recommended textbooks

- Ann Saterbak, Ka-Yiu San, Larry V McIntire, Bioengineering Fundamentals, Prentice Hall, 2nd Edition, (2017).
- Enderle J.D., Bronzino J.D., Introduction to Biomedical Engineering, 3rd Edition, Elsevier (2011).

Other Readings

- Alberts B., *et al.*, Essential Cell Biology, Taylor & Francis, 4th Edition, 2013.

Other technology requirements

Paperpile referencing software : https://paperpile.com/app $35

iClicker (formerly REEF Polling)

You will have several options available to participate in clicker sessions:

iClicker REEF app (iOS, Android, web app): Allows you to use your smartphone, tablet, or even laptop in class as a clicker to participate.

Clicker Remote: You can request to borrow a Clicker remote from eCampus (eCampus@sjsu.edu) for free. Remotes are to be returned to eCampus at the end of the semester.

How to set up an iClicker account and add a course

Follow the instructions available on the dedicated eCampus webpage (Student Resources section) at http://www.sjsu.edu/ecampus/teaching-tools/reef/index.html.

Library Liaison

Anamika Megwalu
Phone: (408) 808-2089
Email: anamika.megwalu@sjsu.edu

Course Requirements and Assignments

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practice. Other course structures will have equivalent workload expectations as described in the syllabus. More details about student workload can be found in University Syllabus Policy S16-9 at http://www.sjsu.edu/senate/docs/S16-9.pdf.

Attainment of the learning objectives (as listed above) will be assessed via homework, quizzes (via iClicker, or in Canvas), two midterm examinations, the final examination, the term paper and presentation, and the assignments for the lab component (BME 115L).

Homework

Students are expected and encouraged to work together on assignments. However, submitted homework should be individual work. Homework must be turned in at the **beginning of class** on the due date. **Late assignments** will be assessed 10%/day off of the maximum possible score.

In-class quiz (iClicker)

There will be regular in-class quizzes based on multiple-answer questions. iClicker will be used as a student response system in class. iClicker helps the instructor to understand what you know and gives everyone a chance to participate in class. iClicker will NOT be used to keep track of attendance. Refer to the Grading Policy and Student Technology Resources section for additional details on iClicker.

Midterm examinations

There will be two mid-semester examinations. Each examination will cover the entire course material covered until the time of the examination. Examinations may include multiple-choice questions, open-ended questions, and problems. During the exam, students can have only a non-programmable scientific calculator. Internet-connected devices, books and notes are not allowed. The dates of the midterms are indicated in the Lecture Schedule.

Final Examination

The final examination will be held on the date and time stipulated by SJSU's Final Examination Schedule. The final examination will cover the entire course material covered during the semester. The final examination may include multiple-choice questions, open-ended questions, and problems. During the exam, students can have only a non-programmable scientific calculator. Internet-connected devices, books and notes are not allowed.

Laboratory

Students will work in team to complete the laboratory activities. After each laboratory, student teams will submit a lab worksheet or report. See BME 115L syllabus for details.

In addition, students will keep individual laboratory notebooks. Students should write down all preliminary calculations, procedures, notes on results, and errors made during the experiment.

Term paper and presentation

All students are required to prepare a term paper on a subject relevant to the biomedical engineering, and present it in class during a dedicated session. The requirements for the term paper and the evaluation criteria will be posted on Canvas. Teams of two students will collaborate on a subject of their choice. The term paper must include an Acknowledgments section indicating the specific contributions of each student. Students with no contribution will receive no credit for the term paper.

The term paper must be prepared in accordance with the Biomedical Engineering Department's Thesis Guidelines (posted on Canvas). One electronic copy of the term paper must be submitted to Canvas in one of the accepted formats (.doc, .docx, .pdf, .pages) by the assigned deadline.

Students must cite any and every source of data or information used in the term paper. Quoting *verbatim* (i.e. "copy and paste") from papers, textbooks, websites or other is strongly discouraged. **Very limited use** of verbatim quotes is acceptable **only if** (1) the quoted text is short, (2) quote marks are used to delimit the quoted text, and (3) an appropriate reference is provided, with a citation number added immediately after the quoted text. Failure to comply with this requirement may be interpreted as plagiarism, which constitutes a violation of academic integrity. All term paper submissions will be automatically scanned in Turnitin to locate matching or similar text within the paper. The instructor will decide whether there is plagiarism case-by-case, in which case academic and administrative sanctions will be assigned according to the [University Academic Integrity Policy S07-2](http://www.sjsu.edu/senate/docs/S07-2.pdf) (http://www.sjsu.edu/senate/docs/S07-2.pdf).

Late submissions of the term paper are strongly discouraged. However, under exceptional circumstances and pending instructor approval, in case of late submission of the term paper, points will be deducted as follows:

- One day late: -10%
- Two days late: -25%
- Three days late: -50%

No submission will be accepted later than three days after the deadline. Please note that this late submission policy only applies to the term paper assignment.

NOTE that [University policy F69-24](http://www.sjsu.edu/senate/docs/F69-24.pdf) at http://www.sjsu.edu/senate/docs/F69-24.pdf states that "Students should attend all meetings of their classes, not only because they are responsible for material discussed therein, but because active participation is frequently essential to insure maximum benefit for all members of the class. Attendance per se shall not be used as a criterion for grading."

Grading Information

Letter Grades:

A+ > 97%
A   > 93% – 97%
A-   > 90% – 93%
B+   > 87% – 90%
B   > 83% – 87%
B-   > 80% – 83%
C+   > 77% – 80%
C   > 74% – 77%

C-   > 70% – 73%
D+   > 67% – 70%
D   > 64% – 67%
D-   > 60% – 63%
F   < 60%

Determination of Grades

Grades will be determined based on all the assignments and examinations, weighted as reported in the table below:

Homework and Quizzes	5%
Midterm 1	15%
Midterm 2	15%
Final Exam	30%
Term Paper	10%
Presentation	10%
Laboratory	15%
Extra-credit (iClicker)	1%

Participation with iClicker will be the only extra credit assignment. Participating in at least 75% of the iClicker quizzes over the semester is necessary to obtain the extra credit.

Absence during examinations, without prior approval, will result in a zero. Prior approval will be given only under exceptional circumstances. Please contact the instructor as soon as possible if you have such a situation.

Note that "All students have the right, within a reasonable time, to know their academic scores, to review their grade-dependent work, and to be provided with explanations for the determination of their course grades." See University Policy F13-1 at http://www.sjsu.edu/senate/docs/F13-1.pdf for more details.

Classroom Protocol

Attendance and arrival times

Students are expected to be set up for lecture by the time the class begins. Attendance in class is not mandatory and shall not be used per se as a criterion for grading. However class attendance and participation are highly recommended.

Behavior

Students should remain respectful of each other at all times. Students will respect a diversity of opinions, ethnicities, cultures, and religious backgrounds. Interruptive or disruptive attitudes are discouraged. While in the classroom, the use of electronic devices (laptops, tablets, smartphones) MUST be limited to activities closely related to the learning objectives. While in the classroom, electronic devices should not be used for personal communication, included messaging and use of social media. All cell phones must be silenced prior to entering the classroom.

Safety

Students should familiarize themselves with all emergency exits and evacuation plans. In particular, if the class meeting ends in the evening, students should be aware of their surroundings when exiting the building, and are encouraged to carry a cell phone for emergency communications.

University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' [Syllabus Information web page](http://www.sjsu.edu/gup/syllabusinfo/) at http://www.sjsu.edu/gup/syllabusinfo/. Make sure to review these policies and resources.

BME 115, Foundations of Biomedical Engineering, Spring 2019

Tentative Course Schedule
(subject to change with fair notice)

Week		Topics, Readings, Assignments	Term paper deadlines
1	1/29	Introduction - General information - Syllabus.	
1	1/31	Engineering Calculations.	
2	2/5	Conservation principles. Accounting equations.	Select partner, two tentative topics
2	2/7	Conservation of mass.	Topic assigned by instructor
3	2/12	Open non-reacting steady-state systems.	
3	2/14	More problem on non-reacting steady-state systems.	
4	2/19	Systems with chemical reactions.	
4	2/21	Dynamic systems.	1. Introduction: the problem
5	2/26	**Midterm 1 review**	
5	2/28	**Midterm 1 exam**	
6	3/5	Conservation of Energy. Basic Concepts.	Bibliography
6	3/7	Conservation of Energy. Changes in Enthalpy.	
7	3/12	Conservation of Energy. Dynamic systems	
7	3/14	DNA Replication and PCR	2. Lit review: current solutions
8	3/19	*Guest Lecture: Bioinformatics*	
8	3/21	Biomedical optics. Light-tissue interactions	
9	3/26	Biomedical optics. Spectroscopic Measurements	3. One promising new technology
9	3/28	*Guest Lecture: Ethics in BME*	
10	4/9	Biomedical optics. Photothermal therapeutics	4. Pros, cons, alternative solutions
10	4/11	**Midterm 2 review**	
11	4/16	**Midterm 2 exam**	
11	4/18	Bioinstrumentation. Conservation principles	5. Future perspectives
12	4/23	Bioinstrumentation. Electric circuits	
12	4/25	Bioinstrumentation. Amplifiers and filters	Final draft submission
13	4/30	Biomedical sensors. Electrophysiology of the heart	
13	5/2	Biomedical sensors. ECG and PPG. Wearables	Term paper submission
14	5/7	Biomedical sensors. Spirometry and VO2	
14	5/9	Biomedical sensors. Kidney function monitoring	Term paper presentation
		Final exam review	
	5/21	**FINAL EXAM (14:45 – 17:00)**	