San José State University, College of Engineering
BME 207, Experimental Methods in Biomedical Engineering, Fall 2022

Course and Contact Information

Instructor:	Dr. Patrick Jurney
Office Location:	E 233L
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Professor Jurney AMA:	ENGR 233L: Tuesdays 14:00 – 15:00 Zoom: Mondays 10:30 – 11:30
Class Days/Time:	Lecture: Thursdays 18:00 – 19:40 Lab Sections: Saturday 9:00-11:45 – TA: Gabriela Acevedo Munares Fridays 12:00 – 14:45 – TA: Brendan Heap ~~Saturdays 12:00-14:45~~
Classroom:	Lecture: Clark 202 Lab: ENGR 335
Prerequisites:	**BME 115, graduate standing**

Course Format

This is a lecture-lab course. The class format is *blended*, meaning that we will meet every week in Clark 202, but that some weeks lectures will be pre-recorded and posted on the course website (Canvas), and others students will be expected to watch and/or read other background material before lecture, but that we will cover course material in-class. Students are expected to view the pre-recorded lectures for each week that we are engaged in a "flipped" classroom before the live class session. 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.

The lab will consist of wet-lab, hands-on experiments. The lab will typically start with a brief explanation of safety and background material to help students understand the concepts of a particular experiment. Following this, students will work in teams to set up and perform the necessary tasks.

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). **Students are responsible for regularly checking with the messaging system through Canvas to learn of any updates.**

Course Description

The main objective in this class is to familiarize students with experimental methods and techniques used in Biomedical Engineering: how to design experiments, how to recognize the various factors that can affect the outcome (results) of experimental work, and how to analyze experimental data so that they are meaningful.

This is a hands-on course. During the semester, the students will operate the equipment in the department's laboratories. They will also design, conduct, analyze and report on one full-length experiment.
This course will cover the principles of data representation, analysis, and experimental designs in bioreactors, biomaterials, and medical devices. Topics include error analyses, modeling, normality testing, hypothesis testing. **This course satisfies graduate-level GWAR.**

Development of team work skills is another important aspect of this course. Students will be divided into groups by the instructor for the term project (laboratory project). All team members in a team will receive the same grade for a particular assignment, based on their performance as a team.

Course Learning Outcomes (CLO)

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

1. **recognize and operate** commonly used lab equipment and their functions
2. **perform** experiments to characterize material, mechanical, chemical, biological, and electrical properties of application in biomedical engineering
3. **identify** sources and types of error in measurement and data analysis
4. **predict** the effects of potential sources of error on a physical measurement
5. **understand** and **identify** a significant hypothesis
6. **design** experiments to measure physical variables of biomedical relevance
7. **design** data acquisition systems for biomedical applications
8. **identify** and **describe** the various types of mechanical measurements
9. **interpret** results in context of assumptions and limitations of the model
10. **perform** data analysis
11. **apply** the acquired knowledge to improve presentation and writing skills as well as overall professional development.
12. **communicate** effectively, in written form and in oral presentations, information relating to the design and/or results of an engineering experiment.
13. **work** in teams to complete specified course assignments

Required Texts/Readings

Textbook

Required

- G.R. Norman, Biostatistics: the bare essentials, 3rd Edition, B.C. Decker (2008), available online for free through the SJSU library
- Antony Jiju, Design of Experiments for Engineers and Scientists, 2nd edition, Elsevier (2014), available for free online through the SJSU library
- Other required reading will be posted to Canvas. No textbook purchase is required for this course.

Other technology requirements: iClicker

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
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Email: anamika.megwalu@sjsu.edu

Course Requirements and Assignments

SJSU classes are designed such that in order to be successful, it is expected that students will spend a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on. More details about student workload can be found in University Policy S12-3 at http://www.sjsu.edu/senate/docs/S12-3.pdf.

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

This is a three-unit course, letter-graded. This course can be used to satisfy the Graduate Writing Assessment Requirement (GWAR) if the student passes this course.

Homework assignments

Students are expected and encouraged to work together on assignments. However, submitted homework should be individual work.

Laboratory assignments

Students will prepare laboratory reports, based on post-lab assignments, **working in groups**. The report must include an Acknowledgments section indicating the specific contributions of each student. Students with no contribution will receive no credit for the report.

Class participation

There will be regular in-class participation problems that you will work on individually or in groups. Some problems will request a response with iClicker and others will require a short submission via Canvas. I will not use iClicker to keep track of attendance. Refer to the Grading Policy and Student Technology Resources section for additional details on iClicker. **If you cannot attend class synchronously (i.e. at the scheduled time), please email the instructor within the first week of class to make alternate arrangements.**

Midterm Examinations

Midterm examinations will be held online (via Canvas)**.** These midterms will cover the **entire course material** covered until that point in the semester (i.e. it will be comprehensive). The examinations may include multiple-choice questions, open-ended questions, and problems. Details about the format and administration of the exam will be given closer to the date of the exams.

Final Examination

In lieu of a traditional final examination for the course, you will complete a class project. Your assignment will be to design, execute, and report on a project involving calibration of equipment, validation of equipment or a process, comparison of processes or methods, etc. You will work in a small group to design the experiments, write a project proposal, carry out the experimental work, and record a JoVE-style video of your work. You will submit a final report on the results of your project. Full instructions for these assignments (the proposal, video and final report), as well as rubrics for these assignments can be found on Canvas.

Term paper

Each student is required to prepare and submit a term paper on a subject relevant to experimental methods in biomedical engineering (in consultation with the course instructor), and present it in class during a dedicated session.

The topic of the paper may cover (for example):

- measurement techniques or instrumentation systems for a particular application in biomedical engineering
- characterization and assessment strategies to evaluate suitability of a material, device, or system for use in biomedical engineering practice
- critical evaluation of performance and safety of an FDA-approved biomedical device, based on evidence provided in peer-reviewed journal articles and medical case studies

The term paper is an individual assignment. No collaboration with other students is allowed in the preparation and revision of this report. This report will be used to assess the student's competency in technical writing. **The competency demonstrated in technical writing accounts for 30% of the grade for this course.**

The paper must follow a minimum-length requirement of 3,000 words of text, **not including figures, tables, front and back materials**. *Front materials* should include a title page, abstract, table of contents, list of figures, list of tables, and list of symbols (when applicable). *Back materials* should include appendices (when applicable), acknowledgments (when applicable), and a list of all the references cited in the report. Page margins should be 1" on all sides and the font size should be 12 point. The term paper must be prepared in accordance with the Biomedical Engineering Department's Thesis Guidelines (posted on Canvas). **Citations and bibliography should follow the *Annals of Biomedical Engineering* referencing style**. In particular, references in the Bibliography section must list all sources that were used in preparing the report. They should be double-spaced, arranged alphabetically by author, and numbered serially, with only one reference per number. When using a citation manager software, such as EndNote, Mendeley, Zotero, PaperPile, etc., the proper citation format should be selected. **A minimum of 15 references from appropriate sources, such as books and peer-reviewed journal articles will be required.**

Students will complete the project report in three stages, with three deliverables. The first two deliverables will be graded for participation and completeness and are intended to identify major issues early so that they can be corrected before the final draft. These reviews are not intended to be comprehensive, and students are encouraged to review their work with peers and/or with Writing Center tutors to improve their writing further. **The final, complete draft will be graded with a detailed rubric that will be posted to Canvas prior to the submission of the final paper.** The purpose of the two early drafts is to provide students with adequate opportunity to receive instructor feedback and revise their paper accordingly. Each draft of the term paper must be submitted electronically to Canvas by the indicated deadline, and it will be scanned for plagiarism according to SJSU policy. Additional, specific requirements for the term paper and the evaluation criteria will be posted on Canvas.

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 there is no feasible way to paraphrase the information, *and* 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. If you have questions about this policy, please ask the instructor. 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). For additional information, students are encouraged to review the video on plagiarism at http://libguides.sjsu.edu/plagiarism.

Late Submission Policy: Assignments are due by the date and time indicated on Canvas and/or in-class discussions. If an assignment is submitted after the due date but before the assignment has been graded then a penalty of 50% will be assessed. If an assignment is submitted after it has been graded for the rest of the class then the instructor will provide feedback on the work if requested, but a grade of zero will be assessed for the assignment.

If something truly exceptional has taken place in a student's life, or a student feels that they need a one-time break, they are encouraged to reach out directly to Dr. Jurney to discuss a grade on a particular assignment as well as strategies for improving future submissions.

NOTE that University policy F69-24 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 Policy

Letter Grades:

A+	> 97%
A	> 93% – 97%
A-	> 90% – 93%
B+	> 87% – 90%
B	> 83% – 87%
B-	> 80% – 83%
C+	> 77% – 80%
C	> 73% – 77%
C-	> 70% – 73%
D	> 60% – 70%
F	< 60%

Weight of class assignments and examinations:

Homework	5%
Class participation via iClicker	5%
Midterm Exam I	15%
Term Paper	30%
Laboratory Project	30%
Laboratory	15%

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. Interruptive or disruptive attitudes are discouraged. While in the classroom, the use of electronic devices (laptops, tablets, smartphones) should 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.
Students will respect a diversity of opinions, ethnicities, cultures, and religious backgrounds. Students will treat online discussions with their peers as if they were in-class, face-to-face interactions.

Safety

Students should familiarize themselves with all emergency exits and evacuation plans. Especially since class concludes in the evening, when departing the building, students should be aware of their surroundings, and carry a cell phone.

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 at http://www.sjsu.edu/gup/syllabusinfo/

Recording Zoom Classes

This course or portions of this course (i.e., lectures, discussions, student presentations) will be recorded for instructional or educational purposes. The recordings will only be shared with students enrolled in the class through Canvas. If, you would prefer to remain anonymous during these recordings, then please speak with the instructor about possible accommodations (e.g., temporarily turning off identifying information from the Zoom session, including student name and picture, prior to recording). Students are not allowed to record without instructor permission. Students are prohibited from recording class activities (including class lectures, office hours, advising sessions, etc.), distributing class recordings, or posting class recordings.

Copyrighted Material

Materials created by the instructor for the course (syllabi, lectures and lecture notes, presentations, etc.) are copyrighted by the instructor. This university policy (S12-7) is in place to protect the privacy of students in the course, as well as to maintain academic integrity through reducing the instances of cheating. ***Students who record, distribute, or post these materials will be referred to the Student Conduct and Ethical Development***

office. Unauthorized recording may violate university and state law. It is the responsibility of students that require special accommodations or assistive technology due to a disability to notify the instructor.

Academic Dishonesty

Students who are suspected of cheating during an exam will be referred to the Student Conduct and Ethical Development office and depending on the severity of the conduct, will receive a zero on the assignment or a grade of F in the course. Grade Forgiveness does not apply to courses for which the original grade was the result of a finding of academic dishonesty.

BME 207, Experimental Methods in Biomedical Engineering, Fall 2022 Course Schedule

(subject to change with fair notice)

Week	Date	Lecture	Readings/Deadlines	Lab
1	8/25	Introductions	BME 207 – Syllabus/ **Term Paper Topic Choice**	No lab meeting
2	9/1	Intro to data types in BME, Error analysis, propagation – accuracy, precision, calibration, sensitivity	Ch. 1 The Basics	Lab 0 - Intro to Lab Section/**DoE Project Topic Choice**
3	9/8	Review of basic statistics concepts – Central Tendency, Statistical distributions, probability	Ch. 3 Describing the Data with Numbers/ **Term Paper – 1st Progress Report due**	
4	9/15	Review of basic statistics concepts – Probability from Gaussian distributions, Confidence intervals, Student's t-test and distribution	Ch. 4 The Normal Distribution	Lab 1 - Material Testing (T-test)
5	9/22	Statistics – One and Two-Way ANOVA, Post hoc tests, and Gage R&R	Ch. 6 Elements of Statistical Inference, Ch. 7 Comparing Two Groups, Ch. 8 One Way ANOVA/**Term Paper – 2nd Progress Report due**	**DoE Project Proposal**
6	9/29	Statistics – linear and multiple regression	Ch. 13 Simple Regression and Correlation	Lab 2 - Gage R&R (2-way ANOVA)
7	10/6	**Term Paper Presentations**		
8	10/13	**Midterm Exam I**		
9	10/20	Introduction to Design of Experiments (DoE) –Guest lecture from Ryu Thenuwara	NIST Handbook on DoE, Ch. 5 **Term Paper – Due**	Lab 3 - Motion Tracking
10	10/27	DoE – Types of Experimental Designs		Spectrophotometry lab

Week	Date	Lecture	Readings/**Deadlines**	Lab
11	11/3	DoE – Screening Designs		Lab 4 - Calibration Curve (linear regression)
12	11/10	DoE – Full factorial Designs		
13	11/17	DoE – Fractional factorial Designs		Lab 5 - Microscopy and Image Processing
14	11/24	Thanksgiving Week – No Class		
15	12/1	DoE – Analysis of DoE results; DoE case study from industry		
Final Exam	12/8	The class project will take the place of the final exam for this class. The project report is due by the end of the scheduled final exam time: 7:30 pm		**Final DoE Project Video and Report due**