San José State University
Biomedical Engineering
BME 130, Numerical Methods in Biomedical Engineering, Fall 2020

Course and Contact Information

Instructor(s):	Matthew Leineweber
Office Location:	ENG 233G Zoom Office Link: https://sjsu.zoom.us/j/97353038941
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Email:	matthew.leineweber@sjsu.edu
Office Hours:	MW 16:30-17:30
Class Days/Time:	MW 12:00-12:50
Classroom:	Zoom: https://sjsu.zoom.us/j/91066461852?pwd=Y0JZU1JGMjBQdUJYY2prL1l5emZ5Zz09
Prerequisites:	Math 32, BIOL 30, Chem 1B all with C- or better

Course Description

Course applies computational and numerical analysis techniques to myriad Engineering problems. The course focus is on application of numerical analysis to BME topics ranging from image analysis to nonlinear systems. We will employ various computational tools, including MATLAB/Simulink and ImageJ.

Course Format

Online Course

The course will be held in a synchronous online manner. Lecture videos and reading materials are posted to Canvas for students to review prior to the online lectures each week. Synchronous meetings each week will consist of 50-minute Zoom lecture session and one 3-hour Zoom lab session every week. The lab session will focus on hands on execution and analysis of code in MATLAB and Simulink that applies the numerical techniques discussed in lecture.

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 by logging into https://sjsu.instructure.com/.

Course Piazza Site

A link to the course Piazza site is provided on Canvas, or the site can be accessed directly at the URL piazza.com/sjsu/fall2020/bme130/home. Piazza is the fastest way for you to ask technical questions to the professor and TA while allowing them to share their response to all students at once. You may post questions anonymous to other students (professor and TA will see who you are). Students may also answer your questions, endorse responses made by other students, and mark duplicate questions.

To ensure fair treatment of all students and to provide students with the most rapid and consistent instructional information, **the professor and TA will not answer technical and policy questions by email.** Technical and policy questions include those regarding homework content, exam content, assignment deadlines, etc. Students should instead post to the class discussion board on Piazza.

Email Policy
Please send **emails regarding personal issues** (academic integrity issues, personal grades, medical issues, etc.) to the professor and/or TA. To receive the most rapid response to your email message, please start the subject line with the characters "**BME130**". Out of fairness to all students, email communications related to technical questions or course policy will *not* be returned (please post these types of questions to the course Piazza site).

Course Learning Outcomes (CLO)

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

1. **identify** relevant features of a biomedical system and,
2. **analyze** such components to determine the appropriate numerical analysis technique and,
3. **apply** engineering tools to the solution of complex problems in biomedical systems.
4. **analyze** the physical, chemical, and biological aspects of a system at multiple scales and multiple levels of complexity and detail.
5. **apply** computational approaches to the analysis of biomedical systems and data.
6. **work** in the MATLAB and Simulink environments to create functional programs for modeling, analyzing, and reporting on scientific and engineering data sets.

Required Texts/Readings

A complete list of course readings is available through the *Leganto* link on Canvas.

Textbooks

Chapra, S.C., Canale, R.P. "Numerical Methods for Engineers", Seventh Edition, McGraw-Hill (2015).

Attaway, S. "MATLAB: a practical introduction to programming and problem solving", Second Edition, Butterworth-Heinemann (2012).

Other Readings

Dunn S.M., Constantinides A., and Moghe P.V. "Numerical Methods in Biomedical Engineering", First Edition, Elsevier Academic Press (2006).

Other technology requirements / equipment / material

MATLAB software is required for the course and can be accessed remotely through the SJSU College of Engineering Desktop as a Service site: https://one.sjsu.edu/task/all/desktop-as-a-service

The iClicker Reef application will also be used throughout the semester to facilitate student participation in the course. The software for laptops, smartphones, and tablets can be accessed here: https://www.iclicker.com/students/

Library Liaison

Anamika Megwalu
Phone: (408) 808-2089
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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 practica. Other course structures will have equivalent workload expectations as described in the syllabus."

Final Examination or Evaluation

The final exam for this course will be held in an online format at the regularly scheduled time, as set by San Jose State University.

"Faculty members are required to have a culminating activity for their courses, which can include a final examination, a final research paper or project, a final creative work or performance, a final portfolio of work, or other appropriate assignment."

Grading Information

Homework

Homework assignments will include questions and problems related to the materials covered in the lectures, as well as assignments that require the use of MATLAB/Simulink. Students are expected and encouraged to work together on assignments. However, submitted homework should be individual work. Homework must be turned into the Canvas submission link before the beginning of class (12:00PM) on the due date. ***Late assignments will not be accepted. The lowest homework score at the end of the semester will be dropped.***

Pre-Lecture Quizzes

Weekly quizzes will be administered online through Canvas, and will cover assigned reading and video lectures assigned for the week. Quizzes should be completed before the beginning of class, as specified in the quiz due date. Missed quizzes cannot be re-taken or made-up and will be scored as zero, unless prior approval has been given. Prior approval will only be given under exceptional circumstances, or if the instructor is informed at the beginning of the semester. The lowest quiz score of the semester will be dropped.

Lab Assignments

To be completed and handed in to Canvas on **Fridays**. Lab assignments will consist of two components. (1) A set of in-class activities and questions is to be completed and submitted as a *lab group*. These assignments must include copies of all MATLAB scripts and/or functions used, unless otherwise stated. The group assignments are due each week, as specified in Canvas. ***Late lab assignments will not be accepted. The lowest lab score at the end of the semester will be dropped.*** **ALL** Reports must be submitted to Canvas, with each Report consisting of a **SINGLE PDF FILE.** (2) A set of Post-Lab questions is to be *individually* completed online through the MATLAB Grader system. The MATLAB Grader problems can submitted as many times as needed, and are automatically graded, with feedback provided to the student. All MATLAB Grader problems must be completed by December 9, 2020. However, to receive full credit, students must submit at least one attempt by the posted due date for each assignment.

Determination of Grades

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

Homework	10%
Pre-Lecture Quizzes	10%
Lab Assignments	15%
Lab Quizzes	5%
Midterm 1	20%
Midterm 2	20%
Final Exam	20%

Absence during online 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.

Grade	*Percentage*
A plus	*96 to 100%*
A	*93 to 95%*
A minus	*90 to 92%*
B plus	*86 to 89 %*
B	*83 to 85%*
B minus	*80 to 82%*
C plus	*76 to 79%*
C	*73 to 75%*
C minus	*70 to 72%*
D plus	*66 to 69%*
D	*63 to 65%*
D minus	*60 to 62%*

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

Students are expected to attend all Zoom lectures and labs throughout the semester. It is the student's responsibility to log in to the online session on time. Questions during these sessions are to be entered into the chat window, or asked verbally when prompted by the instructor. Students should keep their microphones muted at all times when not actively engaging in group work or asking questions to the instructor as to minimize distractions to their classmates. Attendance is not mandatory and shall not be used as a grading criterion. However, class attendance and participation are highly recommended.

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.

University Policies

Per University Policy S16-9 *(http://www.sjsu.edu/senate/docs/S16-9.pdf)*, relevant university policy concerning all courses, such as student responsibilities, academic integrity, accommodations, dropping and adding, consent for recording of class, etc. and available student services (e.g. learning assistance, counseling, and other resources) are listed on Syllabus Information web page (http://www.sjsu.edu/gup/syllabusinfo), which is hosted by the Office of Undergraduate Education. Make sure to visit this page to review and be aware of these university policies and resources.

BME 130, Num. Methods in BME, Fall 2020 Course Schedule

Course Schedule is tentative to change with fair notice

Week	Dates	Session	Topics, Exams, Labs	Assigned Reading	Due
0	8/19	Lecture	Course Overview & Introduction	Syllabus	
		Lab 1	MATLAB Review & Introduction	*Attaway Ch. 1.1-1.4, 2.2-2.5*	
1	8/24-8/28	Lecture	Modeling Errors & Approximations	PT1.1-1.3, Ch. 3.1-3.3	HW 0
		Lab 2	Array Operations & Flow Control	*Attaway Ch. 1.6, 3.1-3.5*	Lab 1
2	8/31-9/4		Floating Point Number Representation	Ch. 3.4.1	HW 1
		Lab 3	Loops and Indexing	*Attaway Ch. 4.1-4.3*	Lab 2
3	**9/7**	***Labor Day - No Class or Lab***			
	9/9-9/11	Lecture	Roundoff Error & Truncation Error	Ch. 3.4.1	HW 2
		Lab 4	Reading and Writing Data, Data Types	*Attaway Ch. 8, 9*	Lab 3
4	9/14-9/18	Lecture	Error Propagation & Linear Algebra	Ch. 4.1-4.2, PT3.1-3.3	HW 3
		Lab R1	Review of Basic MATLAB	*Attaway Ch. 6.5*	N/A
5	9/21-9/25	Lecture	Solving Systems of Equations	Ch. 9.1-9.2, 9.7	HW 4
		Lab 5	Indexing and Gaussian Elimination	*Attaway Ch. 5.1-5.4, 12.1*	Lab 4
MT1	9/28	Lecture	Midterm Review		
	9/30	**Lecture**	**Midterm Exam 1**		N/A
		No Lab			N/A
6	10/5 10/9	Lecture	Gauss-Seidel & Least Squares Regression	Ch. 11.2, PT5.1-5.3	HW 5
		Lab 6	Gauss-Jordan & Gauss-Seidel	*Attaway Ch. 12.2*	Lab 5
7	10/12-10/16	Lecture	Least Squares Regression	Ch. 17.1-17.2	HW 6
		Lab 7	Least Squares & Curve Fitting	*Attaway Ch. 15.1*	Lab 6
8	10/19-10/23	Lecture	Root Finding: Bracketing Methods	PT.2.1-2.3, Ch. 5.1-5.3	HW 7
		Lab 8	Curve Fitting & Polyfit		Lab 7
9	10/26-10/30	Lecture	Root Finding: Newton Raphson;	Ch. 6.2	HW 8
		Lab 9	Root Finding 1	*Attaway Ch. 10.1-10.2*	Lab 8
10	11/2-11/6	Lecture	Numerical Integration Midterm Review	PT. 6.1-6.3, Ch. 21.1	HW 9
		Lab 10	Root Finding 2 & Anonymous Functions	*Attaway Ch. 10.1-10.2*	Lab 9
MT2	**11/9**	**Lecture**	**Midterm Exam 2**		N/A
	11/11	***Veteran's Day - No Class or Lab***			
11	11/16-11/20	Lecture	Numerical Differentiation	Ch. 23.1, 23.6.1	HW 10
		Lab 11	Numerical Differentiation	*Attaway Ch. 15.4*	Lab 10
12	11/23		ODEs & Runge-Kutta Methods	PT7.1-7.3, Ch. 25.1-25.2	N/A
	11/25	***Thanksgiving - No Class or Lab***			
	11/25	Bonus Lab	Numerical Integration (Optional)		
13			ODEs & Runge-Kutta Methods	Ch. 25.3-25.4	HW 11

	11/30-12/4	Lab 12	Solving ODEs in MATLAB		Lab 11 Bonus Lab
14	12/7	Last Lecture	Final Exam Review		Lab 12
	12/9		**FINAL EXAM: 9:45 – 12:00**		