San José State University
Department of Biomedical Engineering
BME 130, Numerical Methods in Biomedical Engineering, Fall 2022

Course and Contact Information

Instructor(s):	Prof. Abdulmelik Mohammed
Office Location:	ENGR 233H
Email:	abdulmelik.mohammed@sjsu.edu
Office Hours:	Thursdays 3:00pm-5:00pm
Class Days/Time:	Mondays and Wednesdays 4:30pm-5:20pm
Classroom:	ENGR 343
Prerequisites:	Math 32, BIOL 30, Chem 1B all with C- or better

Lab Section 02

Teaching Assistant:	Ronal Basil
Email:	ronaldvictor.basil@sjsu.edu
Office Hours:	Mondays 12:00pm-1:00pm on Zoom
Lab Days/Time:	Wednesdays 1:30pm-4:15pm
Classroom:	ENGR 339

Lab Section 03

Teaching Assistant:	Cheng Qiu
Email:	cheng.qiu@sjsu.edu
Office Hours:	Tuesdays 1:00-3:00pm on Zoom
Lab Days/Time:	Wednesdays 9:00am-11:25am
Classroom:	ENGR 407

Grading

ISA:	Eyerusalem Abiy
Email:	eyerusalem.abiy@sjsu.edu

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

The course will be held in a synchronous in-person manner. Videos and reading materials are posted to Canvas for students to review prior to the lectures each week. Synchronous meetings each week will consist of two 50-minute in person lecture sessions and one 2 hour and 45 minutes in-person 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 in 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/.

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 Canvas).

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

MATLAB software is required for the course and can be accessed online through Matlab online at https://www.mathworks.com/products/matlab-online.html, or downloaded and installed from the Matlab for SJSU website at https://www.mathworks.com/academia/tah-portal/san-jose-state-university-31511582.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.

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 by **11:59pm on the due date**. ***Late assignments will be deducted by 20% for each day late and no submissions later than five days will 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. 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 **Wednesdays by 11:59pm**. 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 be deducted by 20% for each day late and no submissions later than five days will 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 14, 2022. However, to receive full credit, students must submit at least one attempt by the posted due date for each assignment.

Grading Information

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%

Failure to complete examinations as scheduled, 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.

Letter Grades

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%*

Classroom Protocol

Attendance and Arrival Times

Students are expected to be set up for lectures 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, including 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, 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 (https://www.sjsu.edu/curriculum/courses/syllabus-info.php). Make sure to visit this page to review and be aware of these university policies and resources.

Academic Integrity

Your commitment, as a student, to learning is evidenced by your enrollment at San Jose State University. The University Academic Integrity Policy F15-7 requires you to be honest in all your academic coursework. Any incident of academic dishonesty during an exam will result in an F in the course and the incident will be reported to the Office of Academic Affairs for additional review and possible sanctioning. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. Visit the Student Conduct and Ethical Development website for more information.

BME 130, Numerical Methods in Biomedical Engineering, Fall 2022, Course Schedule

Tentative Course Schedule (subject to change with fair notice)

Week	Dates	Session	Topics, Exams, Labs	Assigned Reading	Due
0	8/22	Lecture	Course Overview & Introduction	Syllabus	
	8/24	Lecture	Modeling Errors & Approximations	PT1.1-1.3, Ch. 3.1-3.3	
	8/24	Lab 1	MATLAB Review & Introduction	*Attaway Ch. 1.1-1.4, 2.2-2.5*	
1	8/29	Lecture	Modeling Errors & Approximations	PT1.1-1.3, Ch. 3.1-3.3	HW 0
	8/31	Lecture	Floating Point Number Representation		
	8/31	Lab 2	Array Operations & Flow Control	*Attaway Ch. 1.6, 3.1-3.5*	Lab 1
2	**9/5**	**Labor day (No class)**			
	9/7	Lecture	Floating Point Number Representation	Ch. 3.4.1	HW 1
	9/7	Lab 3	Loops and Indexing	*Attaway Ch. 4.1-4.3*	Lab 2
3	9/12, 9/14	Lecture	Round-off Error & Truncation Error	Ch. 3.4.1	HW 2
	9/14	Lab 4	Reading and Writing Data, Data Types	*Attaway Ch. 8, 9*	Lab 3
4	9/19, 9/21	Lecture	Error Propagation & Linear Algebra	Ch. 4.1-4.2, PT3.1-3.3	HW 3
	9/21	Lab R1	Review of Basic MATLAB	*Attaway Ch. 6.5*	N/A
5	9/26, 9/28	Lecture	Solving Systems of Equations	Ch. 9.1-9.2, 9.7	HW 4
	9/28	Lab 5	Indexing and Gaussian Elimination	*Attaway Ch. 5.1-5.4, 12.1*	Lab 4
MT1	10/3	Lecture	Midterm Review		
	10/5	**Lecture**	**Midterm Exam 1 (ENGR 343)**		
	10/5	No Lab			
6	10/10, 10/12	Lecture	Gauss-Seidel & Least Squares Regression	Ch. 11.2, PT5.1-5.3	HW 5
	10/12	Lab 6	Gauss-Jordan & Gauss-Seidel	*Attaway Ch. 12.2*	Lab 5
7	10/17, 10/19	Lecture	Least Squares Regression	Ch. 17.1-17.2	HW 6
	10/19	Lab 7	Least Squares & Curve Fitting	*Attaway Ch. 15.1*	Lab 6
8	10/24, 10/26	Lecture	Root Finding: Bracketing Methods	PT.2.1-2.3, Ch. 5.1-5.3	HW 7
	10/26	Lab 8	Curve Fitting & Polyfit		Lab 7
9	10/31, 11/2	Lecture	Root Finding: Newton Raphson;	Ch. 6.2	HW 8
	11/2	Lab 9	Root Finding 1	*Attaway Ch. 10.1-10.2*	Lab 8

Week	Dates	Session	Topics, Exams, Labs	Assigned Reading	Due
10	11/7, 11/9	Lecture	Numerical Integration Midterm Review	PT. 6.1-6.3, Ch. 21.1	HW 9
	11/9	Lab 10	Root Finding 2 & Anonymous Functions	*Attaway Ch. 10.1-10.2*	Lab 9
MT2	**11/14**	**Lecture**	**Midterm Exam 2 (ENGR 343)**		
	11/16	Lecture	Numerical Differentiation	Ch. 23.1, 23.6.1	HW 10
	11/16	Lab 11	Numerical Differentiation	*Attaway Ch. 15.4*	Lab 10
11	11/21	Lecture	Numerical Differentiation	Ch. 23.1, 23.6.1	
	11/23	**Non Instructional Day (No Class or Lab)**			
12	11/28, 11/30	Lecture	ODEs & Runge-Kutta Methods	PT7.1-7.3, Ch. 25.1-25.2,Ch. 25.3-25.4	HW 11
	11/30	Lab 12	Solving ODEs in MATLAB		Lab 11
13	12/5	Last Lecture	Final Exam Review		
	12/7	**Study/Conference Day (No Class or Lab)**			Lab 12
14	**12/14**	**FINAL EXAM: 2:45pm–5:00pm (ENGR 343)**			