San Jose State University,
Mechanical Engineering Department,
ME-230, Advanced Mechanical Engineering Analysis, Section 02,
Fall 2022

1 Course and Contact Information

Instructor: Dr. Ali Tohidi
Email: ali.tohidi@sjsu.edu
Class days and time: Tuesdays and Thursdays, 04:30 PM - 05:45 PM (PT)
Class location: ENG Building, Room 232
Office hours: Wednesdays, 01:30 - 02:30 PM (PT); Most preferably virtual with appointment and via Zoom (https://sjsu.zoom.us/j/3072404720)
Office Locaion: Engineering Building, Room 310
Prerequisite(s): (BSME or BSAE) OR (ME 130 or equivalent) OR (Instructor's Consent)

2 Proof of Prerequisites

As part of the requirements, you must submit proof of prerequisites to your instructor **before the second day** of the class in order to remain enrolled. A survey on Canvas is designated to this part where you upload an unofficial copy of your transcripts with prerequisite courses highlighted. If your courses are being transferred or evaluated, please attach a course description to your unofficial transcripts.

3 Course Description

- Designed to supplement and enrich students with advanced mathematical methods in treating problems selected from various areas of mechanical engineering.
- 3 units

4 Course Goal(s)

- The goal of this course is to educate students on advanced techniques which are used to solve mathematical equations that describe engineering problems.

5 Learning Objectives

- To learn different analytical and numerical techniques used to solve ordinary and partial differential equations that arise in modeling engineering problems.

- To be able to create mathematical models for engineering problems using differential equations and appropriate boundary conditions.

6 Course Format

The course format will be *in-person* however due to developing conditions in response to COVID-19 some modifications may apply that will be discussed in class.

7 Resources

- If you need special accommodations throughout the course please contact me personally. Also, you can find support and useful information in Accessible Education Center (AEC)'s page at https://www.sjsu.edu/aec/index.php
- The Learning Assistance Resource Center (LARC) is located at Room 600 in the Student Services Center. It is designed to assist students in the development of their full academic potential and to motivate them to become self-directed learners. The center provides support services, such as skills assessment, individual or group tutorials, subject advising, learning assistance, summer academic preparation, and basic skills development. The LARC web-site is https://peerconnections.sjsu.edu/. Additional tutoring may be available through the engineering honor societies.
- In case you need help with purchasing the textbook or obtaining the required technologies that are essential for being successful in this class, please visit Affordable Learning Solutions available at https://library.sjsu.edu/affordable-learning-solutions/affordable-learning-solutions.
- If you need assistance with basic equipment needs please visit the Learn Anywhere's Technology page at https://www.sjsu.edu/learnanywhere/equipment/index.php

8 Canvas, Communication, and Connect

- Copies of the course materials such as the *syllabus*, *assignments*, *exam review materials*, *eclectic presentations*, and etc. may be found on the **Canvas** site for the class. Canvas, also, shows you your grades and allows for discussion forums within the class. This feature may be helpful if you or your group need assistance on understanding a concept, a homework problem, or a project.
- To log in, go to the Canvas URL at https://www.canvas.net. Log in with your 9-digit *SJSU ID* and *Password*. For questions on how to use Canvas, please visit http://www.sjsu.edu/at/ec/canvas/student_resources/index.html
- You are responsible for regularly checking with the messaging system through Canvas. You can set up your account to forward all emails sent to your Canvas account to any other email address you regularly use.

9 Classroom Protocols

9.1 University Policies

Students are responsible for understanding the policies and procedures about academic integrity, accommodations, **DROPPING AND ADDING A COURSE**, consent for recording of classes, and, etc. Per University Policy

S16-9, available at https://www.sjsu.edu/senate/docs/S16-9.pdf, refer to the Office of Graduate and Undergraduate Programs' syllabus information page at https://www.sjsu.edu/gup/syllabusinfo/ in order to access all related policies and procedures. Please, **make sure to review these policies**.

9.2 General Attendance Policies

- You should attend every class session. However, extenuating circumstances may arise that can affect your schedule. In case, you cannot attend a session, please let me know in advance.
- Please do not use cell-phones during sessions.
- In virtual sessions use your full name.
- Discussion forums/boards and chat sections are designed for enriching the course content and enhancing your learning experience. Please follow the **Netiquette** expectations available on Canvas and avoid out of the course context material.

9.3 The Instructional Team Code of Conduct

The instructional team affirms and commits to the following and encourages you to,

- Promote the diversity of opinions, ideas, and backgrounds which are crucial for academic pursuits
- Practice personal and academic integrity
- Respect the dignity and work of others
- Promote a culture of respect within and outside of the class and through discussion forums and/or other online platforms
- Respect the privacy, property, and freedom of others
- Reject bigotry, discrimination, and violence or intimidation of any kind

9.4 Zoom Classroom Etiquette

- This course or portions of this course (i.e., lectures, discussions, student presentations) may be recorded by the instructor for instructional or educational purposes. The recordings will only be shared with students enrolled in the class through Canvas. The recordings will be deleted at the end of the semester. If, however, 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).
- Please keep your camera on as long as it is possible for you and you can follow these guidelines,
  - **Mute Your Microphone:** To help keep background noise to a minimum, make sure you mute your microphone when you are not speaking.
  - **Be Mindful of Background Noise & Distractions:** Find a quiet place to "attend" class, to the greatest extent possible.
  - **Position Your Camera Properly:** Be sure your webcam is in a stable position and focused at eye level.
  - **Limit Your Distractions/Avoid Multitasking:** You can make it easier to focus on the meeting by turning off notifications, closing or minimizing running applications, and putting your smartphone away (unless you are using it to access Zoom).
  - **Use Appropriate Virtual Backgrounds:** If using a virtual background, it should be appropriate and professional and should NOT suggest or include content that is objectively offensive or demeaning.
- Students are prohibited from recording class activities (including class lectures, office hours, advising sessions, etc.), distributing class recordings, or posting class recordings. 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), available at https://www.sjsu.edu/senate/docs/S12-7.pdf,

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.

10 Required Texts/Readings

10.1 Textbook

There is no requirement for purchasing a textbook for this course. The content of this class however is inspired by the following item:

- Zill, Dennis G.. "**Advanced Engineering Mathematics**", 6 or 7^{th} edition, Jones & Bartlett Learning, 2020.

10.2 Technology requirements

- For some of the assignments you may need to use a computer that can comfortably run **Python** and/or **Matlab** scripts.
- Due to the format of the course, you may need a reliable Internet connection as well as access to a computer to attend synchronous parts of the sessions and collaboration with your group members.
- In case for any reason, you are unable to access such resources please contact the department or your instructor. Please see the section 7 for more information.

11 Expected Time Commitment

- According to university rules *"Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of forty-five hours over the length of the course (normally* 3 *hours per unit per week with* 1 *of the hours used for lecture) for instruction or preparation/studying or course related activities including but not limited to internships, labs, clinical practice. Other course structures will have equivalent workload expectations as described in the syllabus"*.

- You should plan to spend $2-3$ hours outside of class for every hour in class. This time should be spent reviewing notes, reading the book, doing homework problems, and studying for exams. Some student may need to spend more time.

12 Course Requirements

12.1 Homework

The purpose of the homework is to instill important concepts as well as exposing you to different methods of solving problems.

1. Homework will be assigned at the end of each chapter or when a significant portion of a chapter is covered in class. Your submission must be made before the designated due date for full consideration. Submission will be done on Canvas. Late submissions will be accepted but with 10% reduction per day to the maximum possible points. It is strongly recommended to attempt the homework assignments on your own and allocate time to solve them and understand the underlying concepts.

2. In-class assignments will be given during the class. For these problems, the class will be divided into small groups (maximum 3-4 individuals per group) so you can work with your classmates on the questions. Each person will turn in (upload on Canvas) a copy of the completed worksheet at the end of the class. I expect everyone to participate in the class and leverage the learning opportunities in the group discussions.

12.2 Exams

There will be two (2) midterm exams, all cumulative. The first midterm exam also includes the material in the self-study module on Canvas. Please see the section 13 for more details.

12.3 Seminar

A term project on a phenomenon of interest or a problem–that can be explained using the principles we learn in this class–is required. You will work with your instructor to decide on the project topic after the first midterm exam. The project should be delivered through a presentation that will be uploaded to the corresponding Canvas assignment and a report that will be due on the final exam date and time.

12.4 Grade policy and distribution

Class activity	G.D.
In-class Assignments	15%
Homework	15%
Midterm Exam 1	25%
Midterm Exam 2	25%
Seminar	20%

Grade	Distribution
A+ (plus)	[96.00 – 100.0]
A	[93.00 – 95.99)
A- (minus)	[90.00 – 92.99)
B+ (plus)	[86.00 – 89.99)
B	[83.00 – 85.99)
B- (minus)	[80.00 – 82.99)
C+ (plus)	[76.00 – 79.99)
C	[73.00 – 75.99)
C- (minus)	[70.00 – 72.99)
D+ (plus)	[66.00 – 69.99)
D	[63.00 – 65.99)
D- (minus)	[60.00 – 62.99)

12.4.1 Grading scheme

In engineering, even a small error–outside the acceptable range–in the final answer can lead to catastrophic outcomes. However, at the moment we are engineers under training and as part of this process we need to master problem-solving. Therefore, in this course the problem-solving part will be weighted more than just the final answer itself. For all exams, the approximate grading scheme (subject to change depending on the exam, and not applicable to multiple-choice/true-false problems!) is as follows:

- Correct answer 10%
- Correct units [if applicable] 10%
- Utilizing correct equations and/or expressions 40%
- Using the correct problem solving method (explained below) 40%
  - If applicable, a drawing or illustration of the problem such as the system, its boundaries, and etc.
  - A list of all assumptions.
  - Write symbolic form of equations before plugging in the numbers.

- Details of the solution procedure (the way to get to the final answer and/or expression)
- The final answer indicated clearly along with the units.

If you follow the above problem-solving method, I will do my best to give you partial credit. The more clearly you write your solutions and elaborate on them, in a legible format, the easier it is for instruction team to follow this grading scheme.

13 Tentative Schedule

Please visit the Fall 2022's academic calendar –available at https://www.sjsu.edu/registrar/calendar/fall-2022.php– for a detailed schedule of the events, deadlines, and due dates. A tentative schedule of the course is available in Table 1; see next page.

Table 1: Tentative Topics and Schedule.

Date	Topics/Activity	Textbook chapter
08/23	Introduction	
	Syllabus review	
	Mathematical modeling	1
	Ordinary Differential Equations (ODE)	
08/25	Review of the 1st-order ODEs	2
	- Qualitative behavior of simple ODEs	
09/01	- Separable equations, linear equations, Exact equations	
	- Solution by substitution	
	- Linear models	
09/06	Review of the high-order ODEs	3
	- IVPs, BVPs	
	- Homogeneous and nonhomogeneous equations	
09/08	- Reduction of order	
	- Homogeneous linear equations with constant coefficients	
09/13	***High-order ODEs***	3
	- Method of undetermined coefficients	
	- Variation of parameters	
09/15	- Cauchy-Euler equations	
	- Linear IVP and BVP problems	
09/20	- System of linear differential equations	8 & 10
09/22	**Midterm Exam 1**	
Online	Laplace transform and applications in solving ODEs	4
09/27	Series solution of Linear Differential Equations	5
	- Solutions about ordinary points	
09/29	- Solutions about singular points	
10/04	Series solution of Linear Differential Equations	5
	- Bessel and Legendre functions	
10/06	Orthogonal Functions and Fourier Series	12
	- Fourier series, Fourier sine and cosine series	
10/11	- Complex Fourier series	
	- Sturm-Liouville problem	
	Partial Differential Equations (PDE)	
10/13	Boundary value problems in rectangular coordinates	13
	- Separation of variables	
10/18	- Classic PDEs	
	- Heat equation	
10/20	Boundary value problems in rectangular coordinates	13
	- Wave equations	
10/25	**Midterm Exam 2**	
10/27	- Laplace's equations	
	- Nonhomogeneous BVPs	
11/01	Boundary value problems in rectangular coordinates	13
	- Orthogonal series expansions	
11/03	- Other coordinates	
11/08	Laplace transform and solving PDEs	15
	- Error function	
11/10	- Application of Laplace Transform in solving PDEs	
11/15	Fourier Transform and solving PDEs	15
11/17	- Fourier Integral	
	- Fourier Transform	
11/22	Numerical solution of PDEs	16
11/24	- Introduction to Finite Difference Method	
11/29	- Implications of the integration methods	
12/01-06	Review and problem solving	
12/08	**Project report submission deadline** Thursday, December 08, 5:00 PM PT	