Differential Equations Sec 1 Course Syllabus

Fall 2023

Course Description

Differential equations are an important branch of mathematics. They have a rich mathematical formalization, as well as a very successful history of being applied to important problems in engineering, physics, chemistry, and biology. This course will introduce primarily linear, first and second order differential equations. Solution techniques for separable equations, homogeneous and inhomogeneous equations, as well as an intuition for modeling-based applications will be presented. The application of Laplace transforms to differential equations, systems of linear differential equations, linearization of nonlinear systems, and phase plane methods will be introduced. Fourier series and their application to simple partial differential equations will be treated. MATLAB based numerical solution and visualization will be briefly covered.

Schedule

Lecture/Studio

Section 01:	Mondays	13:50 – 16:25	Room 3-104

Instructor

Prof. Tony Ho zh_ho01@scupi.cn

Teaching Assistant:

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When emailing the instructors, include “MATH” in the subject field of your message. Use your university email account (student_number@stu.scu.edu.cn); mail from other accounts such as qq.com and 163.com will be stopped by the SCU spam filter.

Textbook

Differential Equations with Boundary Value Problems, 2nd Edition, by John Polking, Al Boggess, and David Arnold (published by Pearson).

We will cover approximately two or three sections per week. Textbook reading assignments will be posted to the class website. Read the assigned chapter BEFORE class.

Software

We will use a powerful software tool, MATLAB, to perform calculations and draw graphs. MATLAB is installed on the class computers, and you will also need a copy for your own computer.

MATLAB is a potent tool, used worldwide by engineering and science professionals in many fields. The effort you put in to master it will repay you many times over in this class and others. To make learning it easier, there is a wealth of information, examples, and documentation available within the program and on the web. Learn to tap into these resources so you can make the best use of the program.

Web Site

This course uses the Blackboard system; the web site is

https://pibb.scu.edu.cn//

(Note: https is important, otherwise it may not load.) There you will find the course syllabus, studio and homework assignments, and other materials. Current announcements and assignments will be posted on the home page. All assignments will be uploaded through the Blackboard system. Please check the class page frequently.

Class Format and Studio Assignments

We will be doing math problems during class. Integrations are the solutions to differential equations, so please review all integration techniques from the calculus courses and read the materials from the sections we will cover before coming to class.

Class Participation

As members of an academic community, all students are expected to actively participate in and contribute to class discussions. You are expected to engage with the class during the lecture/studio time, and to be prepared to think and answer questions on your feet. There is no penalty for not knowing the answer to a question, but you need to be able to "think out loud" and demonstrate the procedure you will follow to arrive at a solution. So, if you're asked a question in class, be prepared to figure out the answer.

You are also expected to follow and critique the presentations of your classmates and provide useful feedback to them so they can learn from the experience.

It is imperative that you spend the class time finding out what you do not understand. My expectation is that you will ask questions once you find out that you do not understand something. Since there is no way for me to tell whether you are spending time finding out what you do not understand, or whether you even ask questions about what you do not understand, I will, occasionally, give a 10-minute quiz. These quiz scores will count as studio assignments and class participation.

Homework Assignments

Working on homework assignment is the key to get a good grade. Please compare your solutions with others in class to see carefully whether there are any differences. Make a note of the differences and ask questions, so that you will understand how to do your homework assignments. This is a very important learning technique as a correct answer does not imply that its solving steps are correct. At most one point will be given grading your exams when giving the wrong steps to get a correct answer. So, DO NOT simply copy other students' solutions. You will not learn the material this way.

If you believe an error has been made in the grading of an assignment, bring it to either my or your TA's attention within ONE WEEK of its submission.

Exams and Grading

There will, tentatively, be two 135-minute major exams tentative scheduled during the weeks of October 23rd and November 27th, and a comprehensive final examination at the end of the semester. Each major exam will be cumulative with more emphasis on the material since the previous test.

There will be **no makeup exams or quizzes**. We will replace your lowest major exam score with the final exam score, but your lowest score does **not** include any 0-score due to simply not taking any major exam(s). You may provide a doctor's note or a legitimate reason, like attending a university competition, to replace a 0-score.

Your grade will be based on studio assignments and class participation, homework (15%), quizzes (10%), major exams (20% each), final examination (35%), and playing games during class (-10 points every time). Here is an example. If a student's scores are homework (80), quizzes (60), exams (60, 80), final (80), and played games during class twice, then the student grade determination is 80 × 15% + 60 × 10% + 60 × 20% + 80 × 20% + 80 × 35% - 2(10) = 54. There is NO makeup for all the quizzes and exams.

The final letter grade is determined from the following table:

A: [90 , 100]	A−: [85 , 90)	B+: [80 , 85)	B: [76 , 80)	B−: [73 , 76)
C+: [70 , 73)	C: [66 , 70)	C−: [63 , 66)	D: [60 , 63)	F: < 60

You must retrieve your own exam and quiz papers. For any exam or quiz, you only have one week to request for a score correction. No score corrections will be made one week after the test papers have been returned in class.

Office Hours

If you do not understand something, and talking to your classmates does not help, then you should be seeking help from me or your TA. My office is 3-317A.

Office hours are times we have specifically set aside to be available to students. During office hours, you can come to my office; you do not need an appointment. I am usually in my office after lunch on Tuesdays, Wednesdays, Thursdays, and Fridays. I am also available at other times; please email me to schedule a time.

If you do not do well on exams, I will also ask you to come to my office during office hour.

Plagiarism and Academic Misconduct

Collaboration on studio problems and homework assignments is permitted and encouraged until an agreement on how to solve a problem is established. You will still have to write your own solutions. Collaboration on exams is not permitted.

Plagiarism, copying, and any other form of academic misconduct or dishonesty will not be tolerated. Cite all references, including books, technical reports, and web sites you have used. You may discuss the homework with other people currently taking this class, the instructors, and the teaching assistants.

Examples of disallowed sources include websites that offer homework help; course documents from previous semesters; people or agencies that do your work for you.

You are not to share materials distributed in class with people outside the University. Uploading of course materials, including homework, handouts, homework and test solutions, etc. to the web is prohibited.
To reiterate: use of homework or test solutions from previous semesters or the web is not allowed. Getting homework help from the instructors and fellow students in the class is okay; looking up things on the Google, Baidu, and the Wikipedia is okay; getting help from websites offering homework help and problem solutions is NOT okay.

If you have any questions about referencing material, or the boundaries of acceptable collaboration, please talk to me.

Phones and Laptops

Out of respect for your fellow students, please mute and put away your phones, and close your laptops when class begins.

Web surfing, emailing, text messaging, and the like during lecture is distracting to other students and the instructor, and is likely to result in your missing some important information. Don't do it. If caught playing games on phones, we'll deduct points.

Although restroom breaks are allowed during exams, you are not allowed to take any phone(s) or laptop(s) with you.

Other Useful Information

Although there are no formal prerequisites for this class, you are expected to know how, or learn how, to do the following:

- Use your newly acquired knowledge to make calculations instead of hanging onto using your older knowledge. It is a strong indication of whether you understand the materials or not.
- Use an internet browser to find things on the web.
- Use MATLAB to evaluate numerical results, make graphs, and do multiple-step calculations.
- Open, read, and print Acrobat pdf files.
- Be proficient in basic pre-calculus mathematics, including plane geometry, trigonometry, and algebra.

For most of you, this will be your first introduction to calculus with analytic geometry where I ask you to take a more active role in learning. You are not going to have an instructor showing you how to make mathematical calculations all your life. At times, you might not even be able to find a textbook showing you how to solve your problems.

By virtue of your being admitted to SCUPI, we know that you are smart, capable, and hardworking. You may find this course challenging and demanding and might even wonder if you've made a mistake coming here. Fear not! You will do okay if keep a few things in mind:

- This and other classes at SCUPI are being taught using a Western-style approach. This involves a lot of questioning and interaction with the instructor, probably much more than you are used to.
- It's okay to be frustrated. You will be learning a lot of new things, at a fast pace, in a language you're still getting comfortable with. The best way to learn is to ask lots of questions. If you don't understand something in class, ASK! Remember that if you're unsure about something, there is a good chance that many of the people sitting around you are also unsure.
- Develop a good studying habit. Don't fall behind on your course material.
- When working with equations, use variables to denote the quantities and parameters specific to the problem. Delay substituting numerical values if possible; this will make it easier to check your work and find errors.

An important skill to acquire is the art of baloney detection (also known as BS detection). Statements are called baloney (or BS) when they are unsupported by facts and are often used to deceive unwary people. For example, a salesperson might make unjustified claims regarding the performance of a system or product to make a sale; as a mathematics student, you need to learn how to be skeptical about unsupported claims. To acquire this skill, you need to always be questioning: how do you know a calculation is correct? Do you understand why it is true? Are there counterexamples that show it is not true?

When you get your graded homework back, you should go over any problems you did not do well on. Homework solutions will not be distributed, but you may contact your teaching assistant if you need help in understanding where you went wrong.

Course Goals

Students will develop a good understanding of solving differential equations. Students will acquire basic skills needed to apply techniques to solve a wide range of differential equations. Students will develop a basic understanding of Laplace and Fourier transforms and their applications to solve differential equations. Evaluation of students will be determined by homework, quizzes, and tests.

Learning Outcomes for This Course

- Students will develop a basic understanding of linear first order and second-order differential equations.
- Students will learn various techniques of solving differential equations.
- Students will develop a basic understanding of Laplace and Fourier transforms and their applications to solve differential equations.

Approximate Schedule

Tentative sequence of the sections covered in this class is:

Week	Contents	Descriptions
1 (09/04)	1.1 – 1.3 & 2.1 – 2.2	Differential Equation Models, The Derivative, Integration, Differential Equations & Solutions, Solutions to Separable Equations
2 (09/11)	2.3 – 2.4	Models of Motion, Linear Equations
3 (09/18)	2.5	Mixing Problems
4 (09/25)	2.6	Exact Differential Equations
5 (10/02)	2.7 – 2.8	Existence & Uniqueness, Dependence of Solutions on Initial Conditions
6 (10/09)	2.9, 3.1	Autonomous Equations and Stability, Modeling Population Growth
7 (10/16)	3.3, 4.3	Personal Finance, Linear, Homogeneous Equations with Constant Coefficients
8 (10/23)		Exam 1
9 (10/30)	4.5 – 4.6	Inhomogeneous Equations: Method of Undetermined Coefficients, Variation of Parameters
10 (11/06)	5.1 – 5.2	The Definition of the Laplace Transform, Basic properties of the Laplace Transform
11 (11/13)	5.2 – 5.3	Basic properties of the Laplace Transform, Inverse Laplace Transform
12 (11/20)	5.4 – 5.5	Using Laplace Transform to solve Equations, Discontinuous Forcing Terms
13 (11/27)		Exam 2
14 (12/04)	5.6 – 5.7	The Delta Function, Convolution
15 (12/11)	12.1 – 12.2	Fourier Series, Convergence of Fourier Series
16 (12/18)	12.3, 13.1	Fourier Cosine and Sine Series, Derivation of the Heat Equation
17 (12/25)	13.2	Separation of Variables for the Heat Equation, Final Exam