MATH 0290: Differential Equations

Fall, 2022-2023

Instructor: Kunpeng Wang

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Office Hours: Mon./Wed. 9:00-11:00 am, Mon./Tue. 1:30-4:00 pm

Office: Room **3-317A** SCUPI Building

Course Description

A comprehensive introduction to the theory of differential equations (DEs), which is a broad field in pure and applied mathematics with numerous applications in engineering and other sciences. The topics include: special types of ODEs of 1st order, homogeneous and inhomogeneous linear ODEs with constant coefficients, Laplace transforms, Fourier series, orthogonal polynomials, Sturm-Liouville problems, the classical partial differential equations, and some applications to physics, chemistry and engineering.

Section: 01

Class Room: Room **3-103** SCUPI Building

Class Hours: Tuesday 8:15-9:00 am, 9:10-9:55 am, 10:15-11:00 am

Teaching Assistant: Guangcan Zhang

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Tutorials: TBA

Section: 02

Class Room: Room **3-106** SCUPI Building

Class Hours: Wednesday 1:50-2:35 pm, 2:45-3:30 pm, 3:40-4:25 pm

Teaching Assistant: Yuanye Dong

QQ/Wechat Group: 882500308

Email: **2019141520075@stu.scu.edu.cn**

Tutorials: TBA

Prerequisites

MATH 0240 Analytic Geometry and Calculus 3 or MATH 0280 Introduction to Matrices and Linear Algebra

Course Objectives

At the completion of this course, students will be able to:

1. Classify and analyze differential equations.
2. Use analytical methods for solving linear first/second order ordinary differential equations.

3. Employ the Laplace transform to solve ordinary differential equations.
4. Understand the qualitative analysis of (a system of) differential equations.
5. Model the problems arising in physics, chemistry and engineering with differential equations.
6. Solve second order ODEs by power series methods and Fourier series methods.
7. Solve PDEs with boundary value problems by the method of separate variables.

Course Content

We will cover most of the material from Chapters 1-5 & 11-13 in the textbook.

Class Structure

Lectures.

Tutorials

Tutorials run by our TA will start in Week 04.

Course Materials

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

Blackboard

Please regularly log on and check https://learn.scupi.cn/. We will upload there lecture notes, assignments, projects, announcements and your grades.

Course Assessment

Weekly assignments, quizzes, class activities, tests and final exams.

Schedule of Exams, Assignments and Quizzes

Exams

Date	Time	Component
Week 9	2 hours	Test 1
Week 14	2 hours	Test 2
Final exam week (Jan 2 to Jan 11)	2 hours	Final exam

Assignments

Homework assignments will be given out weekly. They will be due by the following week at the beginning of the class correspondingly in each section. Plagiarism will not be tolerated. However, discussions of the assignment problems will be permited. Please also note each student must submit his/her individual assignment.

Quizzes

Students will be asked to complete a quiz in tutorials each week. Normally, a quiz will consist of a short question.

Grading Policy

The final grade will be computed according to the following scheme:

Scheme: Total grade = 15 % Assignments + 20 % Test 1 + 20 % Test 2 + 35 % Final Exam + 10 % Quizzes, Class Activities and Attendance.
Note: All tests and final exam will be closed-book.

Conversion of Numerical Grades to Final Letter Grades Follows the SCUPI Common Grade

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+ $[61,63)$ D $[60,61)$ F $(60,0)$

Schedule and weekly learning goals

The schedule is tentative and subject to change. The listed objects below should be viewed as the key concepts you should grasp after each week, and also as a study guide before each exam, and at the end of the semester. Each test will base on material that was taught up until the second last week prior to the test, namely, Test 1 covers Weeks

02-07, Test 2 is based on Weeks 8-12. The final exam will cover all topics taught in this semester.

Week 01, 08/29-09/02

- Classes cancelled.

Week 02, 09/05-09/09

- Cover Sections 1.1-1.3 & 2.1-2.2
- Course introduction.
- Introduction to differential equations.
- Solutions to separable equations.

Week 03, 09/13-09/16

- Cover Sections 2.3-2.5.
- Scaling variables.
- Linear equations.
- Mixing problems.

Week 04, 09/19-09/23

- Cover Sections 2.6-2.7.
- Exact differential equations.
- Existence and uniqueness of solutions.

Week 05, 09/26-09/30

- Cover Section 2.8-2.9.
- Dependence of solutions on initial conditions.
- Autonomous equations and stability.

Week 06, 10/03-10/07

- National Day Holiday.

Week 07, 10/08-10/14

- Cover Sections 3.1-3.2.
- Modeling population growth.

- Personal finance.

Week 08, 10/17-10/21

- Cover Sections 4.1-4.3.
- Linear, homogeneous equations with constant coefficients.

Week 09, 10/24-10/28

- **Text 1**.
- Cover Sections 4.5-4.6.
- Inhomogeneous differential equations.

Week 10, 10/31-11/04

- Cover Section 4.4 & 4.7.
- Harmonic motion.

Week 11, 11/07-11/11

- Cover Section 5.1-5.3.
- Introduction of the Laplace transform.
- The inverse Laplace transform.

Week 12, 11/14-11/18

- Cover Sections 5.4-5.5.
- Use the Laplace transform to sovle DEs.
- Discontinuous forcing terms.

Week 13, 11/21-11/25

- Cover Sections 5.6-5.7.
- The Delta function.
- Convolutions.

Week 14, 11/28-12/02

- **Test 2**.
- Cover Section 11.1-11.2.

- Solve differential equations with variable coefficients using power series method near ordinary points.

Week 15, 12/05-12/09

- Cover Sections 12.1-12.2.
- Fourier series.

Week 16, 12/12-12/16

- Cover Sections 12.3 & 13.1.
- Fourier cosine and sine series.
- The eigenvalue and Sturm-Liouville problem.

Week 17, 12/19-12/23

- Cover Section 13.2.
- Separation of variables and the Hear equation.

Week 18, 12/26-12/30

- Cover Section 13.3.
- The wave equation.

Weeks 19 & 20, 01/02-01/11 Final Exam Week

Course Policies

There will be no special treatments for any students in this course! For example, if you have a heavy course load, you should expect a steep learning curve and be prepared for it. You will not be exempted from any assignments.

During Class

Computers may be allowed in class for the electronic recording of notes. But please refrain from using computers for any activities that are unrelated to the course. Phones are prohibited as they are rarely useful for anything in the course. Eating and drinking are allowed in class but please keep from it affecting the course.

Attendance Policy

Attendance is expected in all lectures. Valid excuses for absence will be accepted before class. In extenuating circumstances, valid excuses with proof will be accepted after class.

Policies on Late Assignments and Exams

Students should start their homework assignments immediately after the assignments are given, and DO NOT wait until the last minute to meet the deadlines. **Late assignments will be NOT accepted except for emergencies and health issues. Any other late assignments handed in will be marked but will be given 0**. At most **Two** extensions for assignments will be given in this course. All assignments will be counted in your total grade. **Late submission for previous assignments during the final exam period will NOT be accepted in any form for any excuses**.

All tests and the final exam are mandatory. There will be absolutely no makeup exam for each test. If you miss the final, a makeup exam may be given for the final exam if the student has the approval from the instructor or emergencies and health issues **with a valid proof**. I will not accept the student deceleration for absence form for the final exam.

Academic Integrity

At Sichuan University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do.

Everyone at SCUPI is expected to treat others with dignity and respect. The Code of Student Conduct allows Sichuan University to take disciplinary action if students don't follow this community expectation.