Instructor

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Lecture Time & Location

Monday, 11:30 am – 12:45 pm, COB 274
Wednesday, 11:30 am – 12:45 pm, COB 274

Discussion Section Time & Location

Friday, 10:00 am – 10:50 am, COB 203

Office hours

Wednesday 1:30 pm – 2:30 pm or by appointment.

Course Description

Theory of linear and nonlinear partial differential equations (PDEs).

Course Topics

- Modeling physical phenomena in terms of PDEs.
- Solving first-order linear and nonlinear PDEs using the method of characteristics.
- Initial and boundary value problems and their well-posedness.
- Second-order linear PDEs: solution by separation of variables, Fourier series, and Sturm-Liouville theory.

Course Goals and Objectives

My goals are that by the end of this course you will learn how PDEs arise in applications, what are some of prototypical PDEs, and some of the fundamental concepts of PDE theory.

Graduates of MATH 221 should be able to fulfill the following **Learning Outcomes**:

1. Describe real-world systems using PDEs.
2. Solve first order PDEs using the method of characteristics.
3. Determine the existence, uniqueness, and well-posedness of solution of PDEs.
4. Solve linear second order PDEs using canonical variables for initial-value problems, Separation of Variables and Fourier series for boundary value problems.

Relationship to Program Learning outcomes:
MATH 221 primarily addresses the first two Program Learning Outcomes for the M.S. and Ph.D. programs.

1. PLO #1: Solve advanced mathematical problems using analytical methods.
2. PLO #4: Model real-world problems mathematically and analyze those models using their mastery of the core concepts.:

In particular, by the end of this course you should have learned how to use analytical techniques to solve the PDEs and how PDEs are used to model real-world problems.

Prerequisites

Multi-variable calculus, Ordinary differential equations with Boundary Value Problems, Linear Algebra. *A PDEs course at the undergraduate level is strongly encouraged.*

Course Outline

- Introduction: PDEs and their solutions; initial and boundary value problems; existence, uniqueness, and well-posedness; derivation of PDEs from conservation laws.
- First order PDEs: method of characteristics, linear and quasi-linear PDEs, shock waves.
- Second order linear PDEs: classification; d'Alembert's solution to the wave equation and propagation of discontinuities; Separation of Variables: homogeneous equations, examples from the heat, wave, and Laplace equations; Fourier series and their convergence; energy and maximum principles; elements of Sturm-Liouville and spectral theories; introduction to Green's functions.

Course webpage:

MATH 221's website is part of the UCMCROPS course management system.

Primary Textbooks:

- *Partial Differential Equations: An Introduction (2^{nd} Edition)*, W. A. Strauss (copy available at the UC Merced library).
- *An Introduction to Partial Differential Equations*, Y. Pinchover and J. Rubinstein (copy available at the University of California library).

Additional Reading

- *Partial Differential Equations of Applied Mathematics*, E. Zauderer (copy available at the University of California library).
- *Partial Differential Equations of Mathematical Physics and Integral Equations*, R. B. Guenther and J. W. Lee (copy available at the University of California library).

Homework

Homework problems will be assigned throughout the semester. However, you will not turn in solutions for these homework problems to be graded. Even though homework solutions are not graded, it is your responsibility to attempt, work through and complete these homework problems to succeed in this course. Exam questions will be based on these homework problems.

You are encouraged to work on homework problems in groups. However, *you must comprehend the material and be able to solve the problems on your own.* You homework should make use of appropriate literature resources, such as books (available through the UC Merced library) and journal articles (available online via the California Digital Library).

Exams

There will be three exams during this course. The exams are with closed books. The exams will take place at the Lecture time and place on the following dates:

· Exam 1: **Wednesday, October 1**.
· Exam 2: **Wednesday, November 19**.
· Exam 3: **Wednesday, December 10**.

You must show up for these exams. There will be no early or make-up exams.

Grade Determination

The final grades in the course will be based entirely on the performance on the three exams.

Dropping the Course

Please see the UC Merced General Catalog for more details.

Special accommodations

Student Affairs determines accommodations based on documented disabilities. If you qualify, please submit a letter from Disability Services to the instructor; every effort will be made to accommodate your needs.

I will also make every effort to accommodate students whose religious beliefs/obligations lead to scheduling conflicts with exams, assignments, or attendance. Please speak with me during the first two weeks of this course regarding any potential accommodations.

Academic integrity

Academic integrity is the foundation of an academic community and without it none of the educational or research goals of the university can be achieved. All members of the university community are responsible for its academic integrity. Existing policies forbid cheating on examinations, plagiarism and other forms of academic dishonesty. The current policies for UC Merced are described in the Academic Honesty Policy. See http://studentlife.ucmerced.edu/ $\rightarrow$ "Student Judicial Affairs"