King Fahd University of Petroleum and Minerals
Department of Mathematics and Statistics
SYLLABUS
Semester II: 2024-2025 **(242)**

Coordinator:	Dr. Nasser-eddine Tatar
Course #:	MATH 568
Title:	Advanced Partial Differential Equations I

Textbook: A basic course in Partial Differential Equations by Y. Qing Han, First Edition.

References: 1. Beginning Partial Differential Equation. by P. O'Neil. (Second Edition, 2008)

Objectives: The course aims to reinforce students' knowledge on concepts of existence, uniqueness and properties of solutions to first and second-order linear and quasilinear PDEs. Energy methods to solve nonlinear PDEs will be introduced. Applications to the wave equation, the heat equation and the Laplace equation are considered.

Course description: First order linear and nonlinear equations. Classification of Second order equations. The wave equation, heat equation and Laplace's equation. Green's functions, conformal mapping. Separation of variables, Sturm-Liouville theory. Maximum principles and regularity theorems.

MATH 437

Prerequisites:

Learning outcomes: Upon successful completion of this course, a student should be able to:
- Solve quasilinear first order equation by the method of characteristics.
- Classify and solve 2nd order PDE's by the method of characteristics.
- Solve the wave equation and analyze the well-posedness.
- Solve IBVP heat equation by using the maximum principle.
- Know the proofs of the representation theorems, MVP, and maximum principles for Laplace equation.
- Apply Green's function method and method of images to solve the Dirichlet and Neumann problems for the Laplace equation.
- Apply Energy methods to solve 2nd order linear and nonlinear PDEs.

Week #	MATERIAL
1	**Definitions & Notation**: Preliminaries, classification, Initial conditions, Boundary conditions, simple examples
2-4	**First-Order Equations**: Linear Equations, Quasilinear Equations, Characteristic method, Examples of Characteristic method, General nonlinear Equations, A Priori estimates, weak solutions
5	**Second-Order Equations in Two Variables**: Classification, energy estimates
6-8	**The Laplace Equation:** Fundamental solutions, Mean Value Property, Maximum Principle, Poisson Equations

9-11	**The Heat equation:** Fourier transform**,** Fundamental solutions, Maximum Principle
12-14	**The Wave Equation**: The 1-D wave equation, Higher-order wave equations, Energy estimates
15	Review and catch up

Grading:

Midterm	30%
Homework assignments	30%
Presentation of Projects	10%
Final Exam	30%

Missing an Exam: In case a student misses an exam (Exam I, Exam II, or the Final Exam) for a legitimate reason (such as medical emergencies), he/she must bring an official excuse from Students Affairs. Otherwise, he/she will get a score of zero in the missed exam.

Attendance: Students are expected to attend all classes.
  ➢ If a student misses a class, he/she is responsible for any announcement made in that class.
  ➢ After warned **twice** by the instructor, a DN grade will be awarded to any student who accumulates
    • 9 unexcused absences. (20%)
    • 15 excused and unexcused absences. (33.3%)

The Usage of Mobiles in Class: Students are not allowed to use mobiles for any purpose during class time. Students who want to use electronic devices to take notes must take permission from their instructor. Violations of these rules will result in a penalty decided by the instructor.

Academic Integrity: All KFUPM policies regarding ethics apply to this course. See the Undergraduate Bulletin in the Registrar's website.