King Fahd University of Petroleum and Minerals
Department of Mathematics
SYLLABUS COMPREHENSIVE EXAM
Semester I: 2025-2026 **(251)**

Course #: MATH 568
Title: Advanced Partial Differential Equations I

Textbooks: 1. Beginning Partial Differential Equation. by P. O'Neil. (Second Edition, 2008)
2. A basic course in Partial Differential Equations by Y. Qing Han, First Edition.

Topics to be covered
The linear first-order equation
The significance of characteristics
The Quasilinear equations
Linear second order equations in two independent variables: classification
The hyperbolic canonical form
The parabolic canonical form
The elliptic canonical form
The second-order Cauchy problem
Characteristics and the Cauchy problem
The wave equation: d'Alembert solution of the Cauchy problem
d'Alembert solution as a sum of waves
The characteristic triangle
The wave equation in 1-d
A nonhomogeneous wave equation in 1-d
A wave equation in 2-d
The Kirchhoff-Poisson solution of the wave equation in 3-d
The heat equation: IBVP
The weak maximum principle
The heat equation in 1-d
The nonhomogeneous heat equation in 1-d
The heat equation in 2-d
The setting of Dirichlet and Neumann problems
Some harmonic functions
Representation theorems
Maximum principle, Mean value property
Dirichlet problem in 2-d
Poisson's integral representation for a disk
Green's function for a Dirichlet problem in 3d
The Neumann problem in 2-d
Energy methods for nonlinear IBVPs