King Fahd University of Petroleum and Minerals
Department of Mathematics
SYLLABUS
Semester I: 2024-2025 **(241)**

Instructor: Dr. A. Bonfoh
Course: **MATH 569:** Elliptic Partial Differential Equations

Objectives: This course aims to introduce some essential methods to solve linear and nonlinear elliptic PDEs using functional analysis tools. In particular, the Lax-Milgram theorem and the Galerkin approximations appoach will be applied. Then, an introduction to the resolution of time evolution linear and nonlinear PDEs will be given.

Course Description: Sobolev spaces, Mollifiers, Dual spaces, Poincare's inequality, Lax-Milgram Theorem, Linear elliptic problems, Weak formulation, Weak derivatives, Weak solutions, Existence uniqueness and regularity, Maximum principle.

Prerequisite: Graduate Standing

Credit: 3 credit hours

References: 1. J.C. Robinson, *Infinite-dimensional Dynamical systems*, Cambridge University Press, Cambridge, 2001.

Week		Topics	
1-11		Sobolev spaces The Laplace eigenvalue problem The Poisson equation A nonlinear elliptic equation The steady state nonlinear reaction diffusion equation The steady state Navier Stokes equation Linear evolution equations Nonlinear evolution reaction diffusion equation: both semigroup theory and Galerkin method	
12-15		Presentations of mini research projects	

Grading:

Midterm Exam	35%
Homework assignments	20%
Presentation	10%
Final Exam	35%