

King Fahd University of Petroleum and Minerals  
 Department of Mathematics  
**SYLLABUS**  
 Semester I: 2023-2024(231)

**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 approach 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%