Department of Mathematics, KFUPM

**Math 572 Syllabus (Tentative)**

**2025-2026, first semester (251)**

**Instructor: Khaled M. Furati**

**Course Title:** Numerical Analysis of Partial Differential Equations

**Course Description:** Theory and implementation of numerical methods for boundary value problems in partial differential equations (elliptic, parabolic, and hyperbolic). Finite difference and finite element methods: convergence, stability, and error estimates. Projection methods and fundamentals of variational methods. Ritz-Galerkin and weighted residual methods.

**Prerequisite:** Graduate Standing

**Textbook:** PDEs with numerical methods, Larsson and Thomee, Springer, 2009.

**References:**
1. Applied numerical methods, lecture notes, McLean and Mustapha, 2023.
2. Numerical solution of PDEs: finite difference methods, Smith, 1985

**Learning Outcomes:**
1. Use finite difference method for solving PDEs.
2. Apply Galerkin method to solve elliptic PDEs.
3. Evaluate the impact of elements types and number on the approximate solution.
4. Analyze numerical methods based on their accuracy and stability.
5. Estimate the a priori error and stability of the approximate solution.
6. Implement algorithms for solving PDEs using suitable software.

**Assessment:** Assignments 30%, Project 10%, Midterm Exam 30%, Final Exam 30%

| WK | Date | Ch | Topics |
|---|---|---|---|
| 1 | 24-Aug | 1 | Introdcution |
| 2 | 31-Aug | 2 | FDM for two-point BVP |
| 3 | 07-Sep | 4 | FDMs for elliptic equations |
| 4 | 14-Sep | | |
| 5 | 21-Sep | 9 | FDMs for parabolic equations |
| 6 | 28-Sep | | |
| 7 | 05-Oct | 12 | FDMs for hyperbolic equations |
| 8 | 12-Oct | | |
| 9 | 19-Oct | 5 | FEMs for elliptic equations |
| Midterm break | | | |
| 10 | 02-Nov | 5 | FEMs for elliptic equations |
| 11 | 09-Nov | … | Project proposals |
| 12 | 16-Nov | 10 | FEM for parabolic equations |
| 13 | 23-Nov | 13 | FEM for hyperbolic equations |
| 14 | 30-Nov | … | Project preparation |
| 15 | 07-Dec | … | Review and project presentations |