**Course Title:** Partial Differential Equations

**Course Code**: MATH-304

**Course Type**: Major Math

**Prerequisites:** Ordinary Differential Equations

**Credit Hours:** 3 (3 + 0)

**Course Objectives:** Partial Differential Equations (PDEs) are at the heart of applied mathematics and many other scientific disciplines. After the completion of the course, students will be able to:

- Understand fundamental concepts of PDEs, identification and classification of their different types.
- Learn technique of separation of variables to solve partial differential equations and analyze the behavior of solutions in terms of eigen function expansions.
- Apply elementary solution techniques and be able to interpret the results and solve specific problems in major area of studies.

**Course Contents:**

**First Order Partial Differential Equations:** Introduction, Formation of PDEs, Linear PDEs of the first order, Cauchy's problem for quasilinear first-order PDEs, First order nonlinear equations, Special types of first order equations.

**Second order Partial Differential Equations:** PDEs of second order in two independent variables with variable coefficients, Linear transformation from one equation to another, normal form, Cauchy's problem for second order PDEs in two independent variables.

**Adjoint Equations:** Adjoint operator, Self-adjoint equation and operator, Linear PDEs in $n$ independent variables, Lagrange's identity, Green's theorem for self-adjoint operator.

**Boundary Value Problems:** Laplace equation, Dirichlet problem for a circle, Poisson's integral for a circle, solution of Laplace equation in cartesian, Cylindrical, and spherical coordinates, The wave equation in one dimension, Wave equation in higher dimensions, The heat equation.

**Recommended Books:**

1. Dennemyer, R., *Introduction to Partial Differential Equations and Boundary Value Problems*, McGraw Hill, 1st edition, 1968.

2. Haberman, R., *Elementary Applied Partial Differential Equations*, Prentice Hall, 1997.

3. Pinsky, M. A., *Partial differential equations and boundary-value problems with applications*, Amer Mathematical Society, 3rd edition, 2011.

4. Sneddon, I. N., *Elements of Partial Differential Equations*, Dover Publishing, 2006.

5. Zauderer, E., *Partial Differential Equations of Applied Mathematics*, Wiley-Interscience, 2nd edition, 1998.

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _