**Course Title: Differential Equations & Complex Variables**
**Course Code: MATH 207**
**Credit Hours: 4**

**Course Description:**
The course aims to impart a basic understanding of differential equations (D.E.) with solving techniques as well as foundation knowledge of complex variables. The course includes First order ODEs, Second order and Higher order Linear ODEs, Laplace transforms, Partial Differential Equations and Complex variables.

**Course Contents:**

**Unit 1: First Order Differential Equations**
Introduction, Separable equations, exact differential equations, integrating factors and Bernoulli's equations, linear first order differential equations with some physical & geometrical applications, Initial and boundary value problems, orthogonal trajectories of curves

**Unit 2: Linear Second Order Differential Equations**
Introduction, The fundamental theorem, Homogeneous second order linear D.E. with constant coefficients, Euler-Cauchy Equation, damped and undamped motions, Wronskians and general solution, Non-homogeneous second order D.E., Solution by undetermined coefficients and variation of parameters, General solution of higher order homogeneous linear differential equations.

**Unit 3: Series Solutions of Differential Equations**
Introduction, Power series solution of D.E, Legendre's equation and functions, Bessels' equations and functions, (Derivation not required), Associated properties and its verifications.

**Unit 4: Laplace Transforms**
Introduction, Definition of Laplace transform, Laplace transform of derivatives and integrals, Derivatives and integrals of Laplace transforms, Inverse Laplace transforms, Shifting Theorems, Laplace transforms of periodic functions, Partial fractions, Convolution, Laplace transform solutions of differential equations with polynomial coefficients.

**Unit 5: Partial Differential Equations (PDEs)**
Introduction, Some important forms of PDEs, Types and Normal forms of Linear PDEs, Solution Techniques: Solvable as Ordinary differential equations, Variable separations, and D'Alemberts principle, Laplacian in polar, Cylindrical and Spherical coordinates, Laplace transform solution of boundary value problems.

**Unit 6: Complex Variables**
Complex numbers, Complex functions, Domain, Range, geometry, polar forms, limits, continuity, derivatives, analytic functions, Cauchy-Riemann equations, harmonic conjugacy, conformal mappings, bi-linear transformation ( cross section formula), complex integration, Green's theorem, Cauchy's Integral Theorem, Cauchy's integral formulae, Taylors series, Laurent series, singularities, residues, Cauchy's residues theorem.

**References:**

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, 8th Edition, Wiley Eastern Ltd, 2008
2. S. S. Sastry, *Advanced Engineering Mathematics*, PHI
3. H. S. Kasana, *Complex variables: Theory and Applications*, PHI