Course No	Course Name	L-T-P-Credits
MA 406	**Partial Differential Equations**	**3-1-0: 4**

Prerequisite: nil

Course Objectives: The objective of this course is to provide different methods to solve first order linear and nonlinear partial differential equations (PDEs). The solutions methods for higher order linear PDEs are also discussed. Another important objective of this course is to present some well known second order elliptic, hyperbolic and parabolic equations with their possible applications to physics and engineering.

Course Outcomes: After successful completion of the course, students will be able to:

1. Understand method of characteristics, Lagrange, Charpit's and Jacobi's methods along with their appropriate choice to solve first order PDEs.
2. Understand canonical forms and solve second order linear PDEs by computing complimentary function and particular integral.
3. Solve heat equation (parabolic) incorporating different types of initial and boundary condition using separation of variables method.
4. Understand D'Alembert's method to solve one dimensional wave equation, forced vibrations, solution of non-homogeneous equations.
5. Solve Laplace equation with homogeneous and non-homogeneous boundary conditions.
6. Identify the locations of maximum/minimum values of the solution for heat and Laplace equations.

SYLLABUS

Module	Contents	Hours
I	Partial differential equations (PDE) of first order: Cauchy problem, linear first order PDE, method of characteristics, Lagrange, Charpit's and Jacobi's methods, PDE with constant co-efficients.	9
II	PDE of second order: classification of second order equations, hyperbolic, parabolic and elliptic equations, linear second order equations with constant coefficients, reduction of second order liner PDEs into canonical forms.	6
III	Parabolic differential equations, one dimensional diffusion equation, method of separation of variables, solutions in cylindrical and spherical domains, maximum modulus principle.	7
IV	Hyperbolic differential equations, one dimensional wave equation, D'Alembert's Solution, solution of one dimensional wave equation, forced vibrations, solution of non-homogeneous equations, initial boundary value problem of two dimensional wave equation.	8

V	Elliptic differential equations, two-dimensional Laplace's equation in rectangular and polar coordinates, maximum principle, Green's function method.	6

Essential Readings:

1. I. Sneddon, “Elements of Partial Differential Equations”, Dover Publications Inc., 2006.
2. S. J. Farlow, “Partial Differential Equations for Scientists and Engineers”, Dover Publications Inc., Reprint edition, 2012.

Supplementary Readings:

1. G. B. Folland, “Introduction to Partial Differential Equations”, Overseas Press, 2nd edition, 2011.
2. D. Greenspan, “Introduction to Partial Differential Equations”, Dover Publications Inc., 1st edition, 2000.
3. R. Haberman, “Elementary Applied Partial Differential Equations: With Fourier Series and Boundary Value Problems”, Pearson, 5th edition, 2013.