20MSM506T					Theory of Partial Differential Equations					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To familiarize the students with first and higher order partial differential equations and their classification.
- To provide a broad coverage of various mathematical techniques that is widely used for solving and to get analytical solutions to partial differential equations of first and second order.
- To introduce various applications of partial differential equations in many fields of science and engineering.
- To develop an understanding of numerical methods for partial differential equations.

UNIT 1 LINEAR AND SEMILINEAR PDEs 10 Hrs.

Linear and semi-linear equations, Cauchy problem, Method of characteristics. Cauchy-Kowalewsky theorem, Holmgren's Uniqueness Theorem. Classification of second order equations, Laplace equation, fundamental solutions, maximum principles and mean value formulas, Properties of harmonic functions, Green's function, Energy methods, Perron's method.

UNIT 2 NON-LINEAR PDEs 09 Hrs.

Parabolic equations in one space dimension, fundamental solution, maximum principle, existence and uniqueness theorems. Wave equation, Solutions by spherical means, Non-Homogeneous Problems, Nonlinear first order PDE's: Complete integrals, Envelopes and singular solutions. Some special methods for finding solutions: Similarity solutions, Hopf-Cole transformation.

UNIT 3 MODELLING AND APPLICATIONS 06 Hrs.

Mathematical models leading to partial differential equations. Riemann's method and applications. Vibration of a membrane. Duhamel's principle. Solutions of equations in bounded domains and uniqueness of solutions. BVPs for Laplace's and Poisson's equations.

UNIT 4 NUMERICAL METHODS FOR PDEs 15 Hrs.

Finite difference methods for the existence and computation of Laplace, heat and wave equations, Jacobi's, Gauss-Seidel and SOR methods for solving Laplace equation, Crank-Nicolsan and Lax-Wendroff methods for solving heat equation, Explicit formula of three level difference schemes for solving wave equation.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Understand the formation and solution of PDEs of first, second and higher order.
CO2 – Solve first-order linear and nonlinear PDEs using the method of characteristics.
CO3 – Apply various analytic methods to obtain solutions to PDEs of first and second order, which occur in science and engineering.
CO4 – Use appropriate numerical methods to study phenomena modeled as PDEs.
CO5 – Analyze the method of characteristics to understand the concepts related to shocks.
CO6 – Point out real phenomena as models of partial differential equations.

TEXT/REFERENCE BOOKS

1. Sneddon, I.N. , Elements of Partial Differential Equations, Dover, 1st ed., 2006.
2. John F., Partial Differential Equations, Springer Velag, 4th Ed., 1982.
3. G. D. Smith: Numerical Solutions of Partial Differential Equations: Finite Difference Methods, Oxford University Press, U.S.A., 3rd Ed, 1986.
4. T. Amaranath: An Elementary Course in Partial Differential Equations, Narosa Publishing House, New Delhi.
5. Y. Pinchover and J. Rubinstein, An introduction to partial differential equations, Cambridge, 2005.