Transforms - Nonlinear Equations of the second order. Elliptic Equation - Occurrence of Laplace Equations in Physics - Elementary solution of Laplace equations - Families of equipotential surfaces, Boundary value problems - Separation of variables - Problems with axial symmetry. Properties of Harmonic functions, Spherical mean - Maximum-minimum principles.

The wave equation - Occurrence of wave equation in Physics - Elementary solutions of one dimensional wave equation - D'Alembert solution - Vibrating Membranes: Applications of the calculus of variations, Duhamel's principle - Three dimensional problems. The Diffusion Equations: Elementary solutions of the Diffusion Equation - Separation of variables - Maximum minimum principles - The use of Integral transforms.

Text books:

1. N. Sneddon, Elements of Partial Differential Equations, Dover, 2006.
2. Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, Birkhauser, Boston, 2007.

References:

1. Fritz John, Partial Differential Equations, Springer, 1991 .
2. Walter A. Strauss, Partial Differential Equations: An Introduction, John Wiley & Sons Inc., 2008.
3. Sandro Salsa, Partial Differential Equations in Action: From Modelling to Theory, Springer, 2nd Edition. 2015.
4. Gerald B. Folland, Introduction to Partial Differential Equations. Second Edition, Princeton University Press, 2nd Edition, 1995.
5. Garabedian P. R., Partial Differential Equations, John Wiley and Sons, 1964. 6. Prasad P and Ravindran R., Partial Differential Equations, Wiley Eastern, 1985. 7. Renardy M. and Rogers R. C., An Introduction to Partial Differential Equations, Springer- Verlag, 1992.

Code:MAT5303: Numerical Analysis Prerequisites: Basic knowledge Calculus, linear algebra, complex analysis, ordinary differential equations	L	T	P	Credit
	4	1	0	**4**

Course Category	Core
Course Type	Theory

Course Objective	Introduce the concepts of existence and uniqueness of solution of differential equations Develop analytical techniques to solve differential equations Understand the properties of solution of differential equations
Course Outcome(s)	Use knowledge of partial differential equations (PDEs), modelling, the general structure of solutions, and analytic and numerical methods for solutions. Formulate physical problems as PDEs using conservation laws. understand analogies between mathematical descriptions of different (wave) phenomena in physics and engineering. Classify PDEs, apply analytical methods, and physically interpret the solutions.

Syllabus:
Solution of Equations, Linear Systems and Algebraic Eigenvalue Problems. Solution of algebraic and transcendental equations: Fixed-point iteration method, Newton's method; Linear system (Direct methods): Gaussian elimination - Pivoting - LU Decomposition; Vector and Matrix norms - Error Analysis and Condition numbers; Linear system (Iterative methods): Gauss-Jacobi and Gauss-Seidel -Convergence considerations; Eigenvalue problem: Power method - Jacobi for a real symmetric matrix.

Interpolation, Differentiation and Integration. Interpolation: Lagrange's interpolation - Errors in Lagrange's interpolation - Newton's divided differences - Newton's finite difference interpolation - Optimal points for interpolation - Piecewise Interpolation: Piecewise linear and piecewise Cubic Spline interpolation. Numerical differentiation: Numerical differentiation based on interpolation, finite differences, method of undetermined coefficients; Numerical integration: Newton Cotes formula - Gaussian quadrature - Errors in Simpson's rule and Gaussian quadrature - method of undetermined coefficients - quadrature rules for Multiple integrals. Ordinary Differential Equations. Single-step methods - Euler's method and Modified Euler's method, Taylor series method, Runge-Kutta method of fourth order. Multi-step methods: Adams-Bashforth -Adams-Moulton methods - Stability considerations. Two point BVPs: Finite Difference method Linear problems with Dirichlet and derivative boundary conditions – Stiff equations – Eigenvalue problems.

Text books:
1. Faires J. D. and Burden R., Numerical Methods, Brooks/Cole Publishing Co., 1998. 2. Jain M. K., Iyenger S. R. K. and Jain R.K., Numerical Methods for Scientific and Engineering Computation, 3rd Edition, New Age, 1993.

References:
1. Atkinson K. E., An Introduction to Numerical Analysis, Wiley, 1989.
2 Phillips G. M and Taylor P.J., Theory and Applications of Numerical Analysis, 2nd Edition, Elsevier, New Delhi, 2006.
3. Isaacson E. and Keller H. B., Analysis of Numerical Methods, Dover, 1994. 4. Conte S. D. and Carl de Boor, Elementary Numerical Analysis, 3rd Edition, McGraw-Hill Book Company, 1983.
5. Kincaid D. and Chenney W., Numerical Analysis: Mathematics of Scientific Computing, Brooks/Cole Pub. 2nd Edition, 2002.
6. A. Quarteroni, F. Saleri and P. Gervasio, Scientific Computing with MATLAB and Octave, Springer Science & Business Media, 2010.
7. Sastry S.S, Introductory Methods of Numerical Analysis, Prentice Hall India, 5th Edition, 2012. 8. Iserlas A., First course in the numerical analysis of differential equations, Cambridge, 1996.