NUMERICAL METHODS

1.1 **Course Number**: MA 221

1.2 Contact Hours: 28 **Credits**: [2-1-0] 8 Credits

1.3 Semester-offered: 2ND Year / Even

1.4 Prerequisite: Real Analysis & Calculus, Linear Algebra, Differential Equations and Computer Programming.

1.5 **Course Instructor**(s): Dr. Sudeep Kundu, Dr. G. Rakshit, Dr. Pradeep Das (AY 2024-25)

2. Objective: To fulfill the fundamental requirements of knowledge of Mathematics for learning Science and Engineering subjects.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	**Numerical solutions of linear equations using iterative and least-squares techniques**	Error Analysis: Exact and approximate numbers, rounding-off numbers, types of errors encountered in computations, propagation of errors. Solution of system of linear equations using direct methods: Gauss elimination and LU-decomposition methods. Solutions to linear system of equations using iterative methods: Jacobi, Gauss-Seidel, and successive relaxation methods with convergence rates. Least-squares, solving least-squares problem, least-squares data fitting and validation, and nonlinear regression.	11
2	**Numerical solutions of nonlinear equations**	Solutions of non-linear equations in single variable using Bisection, Regula-Falsi and Newton-Raphson methods, convergence criteria, Newton-Raphson method for solution of system of non-linear equations.	5
3	**Polynomial Interpolations and Numerical Integrations**	Interpolation: Finite difference operator and properties, difference tables, interpolation formulae, divided differences, Lagrange and Hermite interpolations. Numerical integration: Trapezoidal and Simpsons rules with errors and their combinations, Gauss Legendre 2-points and 3-points formulae.	8
4	**Numerical solutions of ordinary differential equations**	Solution of first and second order ordinary differential equations: Picard's method, Taylor's series method, Euler, modified Euler, Runge-Kutta methods, case studies.	4
	Total		**28**

4. Readings

4.1 Textbooks:

i. Numerical Methods for Engineers by Steven C. Chapra and Raymond P. Canale
ii. Applied Numerical Analysis by C. F. Gerald and P. O. Whitely; Pearson Education India; 7 ed.; 2007
iii. Elementary Numerical Analysis: An Algorithmic Approach by S. D. Conte, Carl de Boor; Third Edition, Mc-Graw Hill Book Company

4.2 Reference books:

iv. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K.
Iyengar and R. K. Jain; New Age Pvt. Pub, New Delhi; 6 ed.; 2012.
v. Introduction to Applied Linear Algebra: Vectors, Matrices, and Least Squares by S. Boyd and L. Vandenberghe; Cambridge University Press; 1 ed.; 2018.

5. Outcome of the Course:

This course will help students to choose, develop and apply the appropriate numerical techniques for their problems, interpret the results, and assess accuracy.