Semester	**5**
Course	**Major**
Paper Code	C3MT230532T / C3MT230532P
Paper Title	**Numerical Analysis**
No. of Credits	**4**
Theory / Practical / Composite	**Composite**
Minimum No. of preparatory hours per week a student has to devote	**4**
Number of Modules	**Nil**
Syllabus	**Numerical Analysis (Theory)** 1. **Errors in Numerical Computations**:[3] Relative error, Absolute error, Percentage error, round-off rules and Round-off error, inherent errors, Significant digits and Numerical instability. Error of a sum, difference, product & quotient of two approximate numbers Operators Δ ,∇,μ , δ , E (Definitions and simple relations among them) 2. **Interpolation:**[14] Polynomial Interpolation, Weierstrass Approximation Theorem (statement only). Vandermonde's determinant. Equi-spaced arguments. Difference Table.]. Uniqueness of Interpolation formula and their Error. Deduction of Newton's Forward and Backward interpolation . Lagrange's interpolation formula .Newton divided difference formula. Newton's divided difference formula identified as a discrete version of Taylor's finite series. Deduction of Interpolation from Newton Divided Difference Formula Inverse Interpolation. Hermite interpolation formula: a combination of Function value and Derivative. Different interpolation formulae viewed as various basis choices of the vector spaceP_n[a,b].Comparative study of various Interpolation formula. 3. **Numerical Differentiation**: [1] Basic idea and deduction from Interpolation Formula. 4. **Numerical Integration**: [5] Deduction of Newton-Cotes formula. Basic Trapezoidal, Simpson's 1/3 rd, Simpson's rule 3/8 rule and their composite forms. Error estimates of

	these formulae. Deduction of Mechanical quadrature formula by Integrating Interpolation formula. Degree of precision . 5. **Numerical Solution of non-linear equations**: [8] Location of a real root by Tabular method. Bisection method. Regula-Falsi and Newton-Raphson methods. Generalized Newton Raphson method for multiple root. Fixed point iteration method.Discussion of convergence of these methods. order of convergence. 6. **Numerical solution of a system of linear equations**: [5+3] Direct method— [Gauss elimination method, Gauss- Jordan elimination method]. Idea of Partial Pivoting and Check formula. Iterative method— [Jacobi iteration method, Gauss- Seidel method] and their convergence. **Numerical Analysis (Practical)[26 classes][2 classes/week]** The following set of problems from Numerical Analysis are to be done on computer using C language: 1. Newton's Forward and Backward interpolation polynomial. 2. Lagrange's interpolation. 3. Trapezoidal, Simpson's 1/3- rule, Simpson's 3/8th rule, Weddle's rule for fixed number of Node. 4. Convergence of Trapezoidal, Simpson's 1/3- rule, Simpson's 3/8th rule, Weddle's rule. 5. Method of Tabulation, Bisection, Regula Falsi, Fixed point iteration, Newton-Raphson method. 6. Numerical solution of a system of linear equations: (Direct method) Gauss elimination and Gauss –Jordan. 7. (Iterative method) Gauss-Jacobi and Gauss- Seidel iteration method. Matrix inversion. 8. Power method for finding the extreme eigenvalues of real square matrix. 9. Numerical solution of ordinary differential equation (Single step methods) —Euler's method, Modified Euler along with iterative method, Runge-Kutta method (fourth order). 10. Multistep methods: Adam's Bash forth method. **Note: 7 ,8 ,9 are only in practical.**
Learning Outcomes	On successful completion of the course a student will be able to do the following: • Will be able to understand the concept of error in numerical computations. • Will get introduced to the idea of interpolation and understand various applications of polynomial interpolation and analyse them. • Will be able to apply numerical quadrature formula and understand the idea of degree of precision. • Will get introduced to numerical methods of solving non-linear equation and understand the order of convergence. • Will be able to understand numerical methods (both direct and iterative) for solving a system of linear equations and understanding the concept of pivoting.

Reading/Reference Lists	1. Numerical Analysis: Sinha Pradhan 2. Numerical Analysis for Scientist And Engineers: Madhumangal Pal 3. Numerical Analysis and algorithm: P.K.Niyogi 4. An Introduction to Numerical Analysis: Kendall E Atkinson 5. Elementary Numerical Analysis: An algorithmic Approach: Conte & Boor 6. An Introduction to numerical Analysis: Gupta &Bose	
Evaluation	Theory: 45 (End Semester) CIA:15 (10(MidSem)+2(Assignment)+3(Attendance)) Practical: 40 (38 (CIA)+ 2 Attendance)	
Paper Structure for Theory Semester Exam	4 questions each carrying 10 marks out of 7 questions + one 5 mark question out of 2 questions	