**Course: Discipline Specific Core [Semester-5]**

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| Semester | 5 |
| Paper Number | Paper no:11[HMTCR5112T+ HMTCR5112P] |
| Paper Title | Numerical Methods ( Theory and Practical) |
| No. of Credits | 6 |
| Theory/ Composite | Composite |
| No of periods assigned | Th: 4  Pr: 4 |
| Name of Faculty Member(s) | Prof. Diptiman Saha  Prof. Sucharita Roy |
| Course Description/ Objective | * Learning different type of error and its source and propagation. * To be acquainted with different linear operators like * To estimate value of unknown function and its derivative and corresponding error management. * To find the value of an integral whose analytical solution is not known. * To solve transcendental equation and linear system of equations and corresponding error estimation. * To be acquainted with various technique of solving ODE. * To understand the numerical method of finding eigen value and eigen vector of a matrix by Power series method. |
| Syllabus | **HMTCR5112T**  **Errors in Numerical Computations**: 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 (4)  Operators Δ , μ , δ , E (Definitions and simple relations among them) (2).  **Interpolation:** Polynomial Interpolation, Weierstrass Approximation Theorem (statement only). Vandermonde’s determinant. Equi-spaced arguments. Difference Table. Different interpolation formulae viewed as various basis choices of the vector spacePn[a,b].Deduction of Newton’s Forward and Backward interpolation and Lagrange’s interpolation formula and their error estimate. Drawback of Lagrangian Interpolation Formula and preference for divided difference formula. Newton’s divided difference formula identified as a discrete version of Taylor’s finite series. Inverse Interpolation. (14)  **Numerical Integration**: Integration of Newton’s interpolation formula. Newton-Cotes’formula. (with derivation) Basic Trapezoidal, Simpson’s 1/3 rd, Simpson’s rule 3/8 rule and their composite forms. Error estimates of these formulae. Degree of precision (definition only) (8)  **Numerical Solution of non-linear equations**: Location of a real root by Tabular method. Bisection method. Regula-Falsi and Newton-Raphson methods, their geometrical significance. Fixed point iteration method .[10]  **Numerical solution of a system of linear equations**: Direct method— [Gauss elimination method, Operation count. Gauss- Jordan elimination method]. Iterative method— [Jacobi iteration method, Gauss- Seidel method] (8)  **Solution of Ordinary Differential equations**—Euler’s method,Picard method, Runge-Kutta method fourth order). (Single step methods) Multistep methods: Adam’s Bashforth method. (6)  **HMTCR5112P**  The following set of problems from Numerical Analysis is to be done on computer using C language:  1.Polynomial Interpolation: Newton’s Forward and Backward interpolating polynomial (Equidistant nodes), Lagrange’s and Newton’s divided difference interpolating polynomial (not necessarily equidistant). (6)  2. Numerical Integration: Composite Trapezoidal, Simpson’s 1/3- rule, Simpson’s 3/8th rule, Weddle’s rule. (10)  3. Numerical solution of non-linear equations: Method of Tabulation, Bisection, Regula Falsi, Fixed point iteration, Newton-Raphson. (8)  4. Numerical solution of a system of linear equations: (Direct method) Gauss elimination and Gauss –Jordan (Iterative method) Gauss-Jacobi and Gauss- Seidel iteration method. Matrix inversion by Gauss method.LU decomposition method. (10)  5. Power method for finding the extreme eigenvalues of real symmetric matrices. (4)  6. Numerical solution of ordinary differential equation—Euler’s method, Modified Euler along with iterative method, Picard method, Runge-Kutta method (fourth order). (Single step methods) Multistep methods: Adam’s Bash forth method. (10) |
| Texts | 1. Introduction to Numerical Analysis — Devi Prasad 2. Introduction to C programming- Balaguruswamy |
| Reading/Reference Lists | (1) Elementary Numerical Analysis — Conte de Boor  (2) Elementary Numerical Analysis — Atkinson  (3) Computational Mathematics-B. P. Demidovich & I. P. Maron |
| Evaluation | CIA: 10 (HMTCR5112T) + 40 (HMTCR5112P)  End-Sem: 50(HMTCR5112T) |