Syllabus

Mathematics - II for Computer Science and Engineering Stream

Module-1 integral Calculus

Introduction to Integral Calculus in Computer Science & Engineering. Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find Area and Volume by double integral.Problems. Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Problems.

Self-Study: Center of gravity, Duplication formula.
Applications: Antenna and wave propagation, Calculation of optimum value in various geometries. Analysis of probabilistic models.

Module-2 Vector Calculus

Introduction to Vector Calculus in Computer Science & Engineering. Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems. Curvilinear coordinates:Scale factors, base vectors, Cylindrical polar coordinates, Spherical polar coordinates, transformation between cartesian and curvilinear systems, orthogonality. Problems.

Self-Study: Vector integration and Vector line integral.
Applications: Conservation of laws, Electrostatics, Analysis of streamlines.

Module-3 Vector Space and Linear Transformations

Importance of Vector Space and Linear Transformations in the field of Computer Science & Engineering. Vector spaces: Definition and examples, subspace, linear span, Linearly independent and dependent sets, Basis and dimension. Problems. Linear transformations: Definition and examples, Algebra of transformations, Matrix of a linear transformation. Change of coordinates, Rank and nullity of a linear operator, rank-nullity theorem. Inner product spaces and orthogonality. Problems.

Self-study: Angles and Projections.Rotation, Reflection, Contraction and Expansion.
Applications: Image processing, AI & ML, Graphs and networks, Computer graphics.

Module-4 Numerical Methods -1

Importance of numerical methods for discrete data in the field of computer science & engineering. Solution of algebraic and transcendental equations - Regula-Falsi and Newton-Raphson methods (only formulae). Problems. Finite differences, Interpolation using Newton's forward and backward difference formula, Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof). Problems. Numerical integration: Trapezoidal, Simpson's (1/3)rd and (3/8)th rules(without proof). Problems.

Self-Study: Bisection method, Lagrange's inverse Interpolation.

Applications: Estimating the approximate roots, extremum values, Area, volume, and surface area.

Module-5 Numerical Methods -2

Introduction to various numerical techniques for handling Computer Science & Engineering applications. Numerical Solution of Ordinary Differential Equations (ODE's): Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector formula (No derivations of formulae). Problems.

Self-Study: Adam-Bashforth method.
Applications: Estimating the approximate solutions of ODE

Laboratory experiments

Suggested software's: Mathematica/MatLab/Python/Scilab

1. Program to compute area, surface area, volume and centre of gravity
2. Evaluation of improper integrals
3. Finding gradient, divergent, curl and their geometrical interpretation
4. Computation of basis and dimension for a vector space and Graphical representation of linear transformation
5. Computing the inner product and orthogonality
6. Solution of algebraic and transcendental equations by Ramanujan's, Regula-Falsi and Newton-Raphson method
7. Interpolation/Extrapolation using Newton's forward and backward difference formula
8. Computation of area under the curve using Trapezoidal, Simpson's (1/3)rd and (3/8)th rule
9. Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method
10. Solution of ODE of first order and first degree by Runge-Kutta 4th order and Milne's predictor-corrector method