

Syllabus

Course title: Numerical Analysis

Chapter 1

Errors, different type of errors. Representation of numbers in computer, computer arithmetic, zero in floating point number.

Chapter 2

Operators –finite differences, average, differential, etc., their inter-relations. Difference of polynomials. Difference equation.

Interpolation. Lagrange's methods, error terms. Uniqueness of interpolating polynomial. Newton's fundamental interpolation. Forward, backward and central difference interpolations. Interpolation by iteration.

Spline interpolation, comparison with Newton's interpolation. Hermite's interpolation. Bivariate interpolation, Lagrange and Newton's methods. Inverse interpolation.

Chapter 3

Approximation of function. Least square method. Use of orthogonal polynomials. Approximation by Chebyshev polynomials, Max-min principle. Economization of power series.

Chapter 4

Solution of non-linear equation containing one variable. Newton's methods. Modified Newton-Raphson method. Birge-Vieta method, Bairstow method. System of non-linear equations-iteration and Newton-Raphson methods.

Chapter 5

System of linear equations. Iteration methods, rate of convergence. Matrix factorization methods. Tri-diagonal equations. Least square method for inconsistent system. Ill conditioned systems. Relaxation method.

Chapter 6

Eigenvalues and eigenvectors of matrix. Leverrier-Faddeev method. Power method. Jacobi's method, Givens method, Householder's method. Comparisons.

Chapter 7

Differentiation. Lagrange's method.

Gauss-quadrature. Degree of precision. Gauss-Legendre and Gauss-Chebyshev methods. Double integration. Monte-Carlo method.

Chapter 8

Ordinary differential equation. Euler's method. Runge-Kutta methods. Predictor-corrector method. Finite-difference method. IVP and BVP. Shooting method. Stability analysis.

Chapter 9

Partial differential equation. Finite-difference approximation. Explicit methods. Crank-Nicolson method. Parabolic, hyperbolic and elliptic equation. Stability.

Week wise Syllabus:

Week No	Module to be covered	Nature of work (Video, Text, Discussion forum, Live chat, Assignment, Assessment, Activity, Quiz)	Remarks
Week 1	<ol style="list-style-type: none"> 1. Error in Numerical Computations. 2. Propagation of Errors and Computer Arithmetic. 	Video, Text, Discussion forum	
Week 2	<ol style="list-style-type: none"> 3. Operators in Numerical Analysis. 4. Lagrange's Interpolation. 5. Newton's Interpolation Methods. 6. Central Deference Interpolation Formulae. 	Video, Text, Discussion forum,	
Week 3	<ol style="list-style-type: none"> 7. Aitken's and Hermite's Interpolation Methods. 	Video, Text, Discussion forum, Live chat	

	8. Spline Interpolation. 9. Inverse Interpolation. 10. Bivariate Interpolation.		
Week 4	11. Least Squares Method. 12. Approximation of Function by Least Squares Method. 13. Approximation of Function by Chebyshev Polynomials.	Video, Text, Assignment, Activity	Assignment for 10 Marks
Week 5	14. Newton's Method to Solve Transcendental Equation. 15. Roots of a Polynomial Equation. 16. Solution of System of Non-linear Equations.	Video, Text, Discussion forum, Activity, Quiz	
Week 6	17. Matrix Inverse Method. 18. Iteration Methods to Solve System of Linear Equations. 19. Methods of Matrix Factorization.	Video, Text, Discussion forum, Live chat	
Week 7	20. Gauss Elimination	Video, Text, Discussion forum	

	<p>Method and Tri-diagonal Equations.</p> <p>21. Generalized Inverse of Matrix.</p> <p>22. Solution of Inconsistent and Ill Conditioned Systems.</p>		
Week 8		REVISION AND ASSIGNMENT WEEK	
Week 9	<p>23. Construction of Characteristic Equation of a Matrix.</p> <p>24. Eigenvalue and Eigenvector of Arbitrary Matrices.</p> <p>25. Eigenvalues and Eigenvectors of Symmetric Matrices.</p>	Video, Text, Live chat	
Week 10	<p>26. Numerical Differentiation.</p> <p>27. Newton-Cotes Quadrature.</p>	Video, Text, Discussion forum, Quiz	
Week 11	<p>28. Gaussian Quadrature.</p> <p>29. Monte-Carlo Method and Double Integration.</p>	Video, Text, Discussion forum	
Week 12	<p>30. Runge-Kutta Methods.</p> <p>31. Predictor-Corrector</p>	Video, Text, Live chat	

	Methods.		
Week 13	32. Finite Difference Method and its Stability. 33. Shooting Method and Stability Analysis.	Video, Text, Discussion forum, Quiz	
Week 14	34. Partial Differential Equation: Parabolic. 35. Partial Differential Equations: Hyperbolic. 36. Partial Differential Equations: Elliptic	Video, Text, Discussion forum	
Week 15		REVISION, ASSESSMENT and EVALUATION WEEK	