



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

ANALYTICAL AND NUMERICAL METHODS FOR STRUCTURAL ENGINEERING								
I Semester: ST								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
BSTE03	Elective	L	T	P	C	CIA	SEE	Total
		3	0	0	3	40	60	100
Contact Classes: 45	Total Tutorials: Nil	Total Practical Classes: Nil			Total Classes: 45			
Prerequisite: Mathematical Transform Techniques								

I. COURSE OVERVIEW:

Numerical methods provide a way to solve problems quickly and easily compared to analytic solutions. Whether the goal is integration or solution of complex differential equations, there are many tools available to reduce the solution of what can be sometimes quite difficult analytical math to simple algebra. Analysis, modeling and solution of realistic engineering problems. Learning outcome looks at algebraic methods, including polynomial division, exponential, trigonometric and hyperbolic functions, arithmetic and geometric progressions in an engineering context and expressing variables as power series.

II. COURSE OBJECTIVES:

The student will try to learn:

- I. Formulation of the mathematical model of the problem to solve civil engineering problems
- II. Partial differential equations with closed form or numerical solution in structural mechanics using numerical methods.
- III. The applications of mathematical tools and statistical methods for the solution of the problems related to structures.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

- CO 1 Analyze different types of numerical errors and apply interpolation, extrapolation, and curve fitting techniques for engineering problem solving.
- CO 2 Apply numerical methods to solve nonlinear algebraic and transcendental equations with accuracy and convergence analysis.
- CO 3 Formulate and solve systems of linear equations and eigenvalue problems using concepts of matrix algebra.
- CO 4 Evaluate shear forces, bending moments, and deflections in beams using numerical differentiation and integration techniques.
- CO 5 Implement finite difference schemes for solving ordinary and partial differential equations, and assess the stability of explicit and implicit methods.
- CO 6 Design computer algorithms for structural engineering problems and explore the role of fuzzy logic and neural networks in numerical analysis.

IV. COURSE CONTENT:

MODULE - I: FUNDAMENTALS OF NUMERICAL METHODS (09)

Error Analysis, Polynomial Approximations and Interpolations, Curve Fitting; Interpolation and extrapolation
Solution of Nonlinear Algebraic and Transcendental Equations.

MODULE - II: ELEMENTS OF MATRIX ALGEBRA (09)

Solution of Systems of Linear Equations, Eigen Value Problems

MODULE - III: NUMERICAL DIFFERENTIATION & INTEGRATION (9)

Numerical integration (Trapezoidal and Simpson's rule) for determining shear, moment and deflection in beams

Gauss Quadrature formula for Numerical integration (Trapezoidal and Simpson's rule), Solution of ordinary and Partial Differential Equations.

MODULE - IV: FINITE DIFFERENCE SCHEME (9)

Implicit & Explicit scheme, solution using Explicit method, Stability analysis of Explicit and Implicit scheme

MODULE - V: COMPUTER ALGORITHMS (9)

Numerical Solutions for Different Structural Problems, Fuzzy Logic and Neural Network.

V. TEXTBOOKS:

1. Atkinson K. E., "*An Introduction to Numerical Analysis*", J. Wiley and Sons, 1989.
2. Stevan C. Chopra, Raymond P. Canal, "*Numerical Methods for Engineers*", Mc Graw Hill Book Company. April 2009.

VI. REFERENCE BOOKS:

1. Scheid F, "*Theory and Problems of Numerical Analysis*", McGraw Hill Book Company, (ShaumSeries), 1988.
2. Sastry S. S, "*Introductory Methods of Numerical Analysis*", Prentice Hall of India, 1998

VII. ELECTRONICS RESOURCES:

1. <http://nptel.ac.in/courses/105105043/>
2. <https://www.class-central.com/course/nptel-numerical-methods-finite-difference-approach-10003>
3. <https://nptel.ac.in/courses/105/105/105105043/>

VIII. MATERIALS ONLINE:

1. Course Outline Description
2. Tutorial Question Bank
3. Assignments
4. Model Question Paper – I
5. Model Question Paper - II
6. Lecture Notes
7. Early Lecture Readiness Videos
8. Power point presentation