

# **AMC-24 FINITE ELEMENTS METHOD OF CIVIL ENGINEERING**

## **UNIT-1 INTRODUCTION**

- 1.1 Introduction. Historical Background. Design Considerations. Need of Finite Element Method. The Process Of Finite Element Method,
- 1.2 Field and Boundary Conditions, Steps Involved In Fem, the Standard Discrete System, Transformation of Co-Ordinates.

## **UNIT-2 FINITE ELEMENTS OF ELASTIC CONTINUUM DISPLACEMENT APPROACH**

- 2.1 Direct Formulation Of Finite Element Characteristic, Generalized Nature Of Displacements, Strains, And Stresses, Generalization To The Whole Region
- 2.2 Internal Nodal Force Concept Abandoned, Displacement Approach As A Minimization Of Total Potential Energy, Convergence Criteria,
- 2.3 Discretization Error And Convergence Rate,
- 2.4 Displacement Functions With Discontinuity Between Elements--Non-Conforming Elements And The Patch Test,
- 2.5 Bound On Strain Energy In A Displacement Formulation, Direct Minimization.

## **UNIT-3 GENERALIZATION OF THE FINITE ELEMENT CONCEPTS WEIGHTED RESIDUAL AND VARIATIONAL APPROACHES**

- 3.1 Weighted Residual Methods, Approximation To Integral Formulations: The Weighted Residual Method, Virtual Work As The 'Weak Form' Of Equilibrium Equations For Analysis Of Solids Or Fluids,
- 3.2 Variational Principles, Establishment Of Natural Variational Principles For Linear, Self-Adjoin Differential Equations, Maximum,
- 3.3 Minimum, Or A Saddle Point, Constrained Variation Principles, Lagrange Multipliers And Adjoin Functions.

## **UNIT-4 STRAIN PLANE STRESS AND PLANE**

- 4.1 Element Characteristics, Some Practical Applications,
- 4.2 Special Treatment Of Plane Strain With An Incompressible Material.

## **UNIT-5 AXI-SYMMETRIC STRESS ANALYSIS**

- 5.1 Element Characteristics, Some Illustrative Examples.

## **UNIT-6 THREE-DIMENSIONAL STRESS ANALYSIS**

- 6.1 Tetrahedral Element Characteristics.

## **UNIT-7 ELEMENT SHAPE FUNCTIONS SOME GENERAL FAMILIES OF CONTINUITY**

- 7.1 Two-Dimensional Elements, Completeness of Polynomials, Rectangular Elements,  
7.2 Lagrange Family, Rectangular Elements, 'Serendipity' Family, Triangular Element Family,  
7.3 One-dimensional Elements, Three-Dimensional Elements, Other Simple Three-Dimensional Elements.

#### **UNIT-8 CURVED, ISOPARAMETRIC ELEMENTS AND NUMERICAL INTEGRATION**

- 8.1 Introduction, Parametric Curvilinear Co-Ordinates, Geometrical Conformability Of Elements,  
8.2 Variation Of The Unknown Function With In Distorted, Curvilinear, Elements,  
8.3 Continuity Requirements, Transformations, Element Matrices, Area and Volume Co-Ordinates, Convergence of Elements In Curvilinear Co-Ordinates, Numerical Integration.

#### **UNIT-9 SOME APPLICATIONS OF ISOPARAMETRIC ELEMENTS IN TWO- AND THREEDIMENSIONAL STRESS ANALYSIS**

- 9.1 A Computational Advantage of Numerically Integrated Finite Elements.

#### **Reference Books:**

1. Introduction to Finite Elements in Engineering by T R Chandrupatla and A D Belegundu
2. Finite Element Analysis: Theory and Programming by C S Krishnamurthy
3. Introduction to the Finite Element Method by J N Reddy

