- Chapter 1 Introduction Prologue
- Brief History
- Introduction to Matrix Notation
- Role of the Computer
- General Steps of the Finite Element of Method
- Applications of the Finite Element Methods
- Advantages of the Finite Element Method
- Computer Programs for the Finite Element Method
- References
- Problems
- Chapter 2 Introduction to the Stiffness (Displacement) Method Introduction
- Definitions of the Stiffness Matrix
- Derivation of the Stiffness Matrix for a Spring Element
- Example of a Spring Assemblage
- Assembling the Total Stiffness Matrix by Superposition (Direct Stiffness Method)
- Boundary Conditions
- Potential Energy Approach to Derive Spring Element Equations
- References
- Problems
- Chapter 3 Development of Truss Equations Introduction
- Derivation of the Stiffness Matrix for a Bar Element in Local Coordinates
- Selecting Approximation Functions for Displacements
- Transformation of Vectors in Two Dimensions
- Global Stiffness Matrix
- Computation of Stress for a Bar in the x-y Plane
- Solution of a Plane Truss
- Transformation Matrix and Stiffness Matrix for a Bar in Three-Dimensional Space
- Use of Symmetry in Structure
- Inclined, or Skewed, Supports
- Potential Energy Approach to Derive Bar Element Equations
- Comparison of Finite Element Solution to Exact Solution for Bar
- Galerkin's Residual Method and Its Application to a One-Dimensional Bar
- References
- Problems
- Chapter 4 Development of Beam Equations Introduction
- Beam Stiffness
- Example of Assemblage of Beam Stiffness Matrices
- Examples of Beam Analysis Using the Direct Stiffness Method
- Distributed Loading
- Comparison of Finite Element Solution to the Exact Solution for a Beam
- Beam Element with Nodal Hinge
- Potential Energy Approach to Derive Beam Element Equations
- Galerkin's Method for Deriving Beam Element Equations
- References
- Problems
- Chapter 5 Frame and Grid Equations Introduction

- Two-Dimensional Arbitrarily Oriented Beam Element
- Rigid Plane Frame Examples
- Inclined or Skewed Supports-Frame Element
- Grid Equations
- Beam Element Arbitrarily Oriented in Space
- Concepts of Substructure Analysis
- References
- Problems
- Chapter 6 Development of the Plane Stress and Plane Strain Stiffness Equations Introduction
- Basic Concepts of Plane Stress and Plane Strain
- Derivation of the Constant-Strain Triangular Element Stiffness Matrix and Equations
- Treatment of Body and Surface Forces
- Explicit Expression for the Constant-Strain Triangle Stiffness Matrix
- Finite Element Solution of a Plane Stress Problem
- References
- Problems
- Chapter 7 Practical Considerations in Modeling; Interpreting Results and Examples of Plane Stress/Strain Analysis
- Introduction
- Finite Element Modeling
- Equilibrium and Compatibility of Finite Element Results
- Convergence of Solution
- Interpretation of Stresses
- Static Condensation
- Flowchart for the Solution of Plane Stress Problems
- Computer Program Results for Some Plane Stress/Strain Problems
- References
- Problems
- Chapter 8 Development of the Linear-Strain Triangle Equations Introduction
- Derivation of the Linear-Strain Triangular Element Stiffness Matrix and Equations
- Example LST Stiffness Determination
- Comparison of Elements
- References
- Problems
- Chapter 9 Axisymmetric Elements Introduction
- Derivation of the Stiffness Matrix
- Solutions of an Axisymmetric Pressure Vessel
- Applications of Axisymmetric Elements
- References
- Problems
- Chapter 10 Isoparametric Formulation
- Introduction
- Isoparametric Formulation of the Bar Element Stiffness Matrix
- Rectangular Plane Stress Element
- Isoparametric Formulation of the Plane Element Stiffness Matrix

- Gaussian Quadrature (Numerical Integration)
- Evaluation of the Stiffness Matrix and Stress Matrix by Gaussian Quadrature
- Higher-Order Shape Functions
- References
- Problems
- Chapter 11 Three-Dimensional Stress Analysis
- Introduction
- Three Dimensional Stress and Strain
- Tetrahedral Element
- Isoparametric Formulation
- References
- Problems
- Chapter 12 Plate Be