

- Preface
- Notation
- 1 Getting Started and Beyond
 - 1.1 When Not to Model
 - Example 1.1 The Challenger Space Shuttle Disaster
 - Example 1.2 Loss of Blood Vessel Patency
 - 1.2 Some Initial Tools and Steps
 - 1.3 Closure
 - Example 1.3 Discharge of Plant Effluent into a River
 - Example 1.4 Electrical Field Due to a Dipole
 - Example 1.5 Design of a Thermocouple
 - Example 1.6 Newton's Law for Systems of Variable Mass: A False Start and the Remedy
 - Example 1.7 Release of a Substance into a Flowing Fluid: Determination of a Mass Transfer Coefficient
 - Practice Problems
- 2 Some Mathematical Tools
 - 2.1 Vector Algebra
 - 2.1.1 Definition of a Vector
 - 2.1.2 Vector Equality
 - 2.1.3 Vector Addition and Subtraction
 - 2.1.4 Multiplication by a Scalar m
 - 2.1.5 The Scalar or Dot Product
 - 2.1.6 The Vector or Cross Product
 - Example 2.1 Distance of a Point from a Plane
 - Example 2.2 Shortest Distance Between Two Lines
 - Example 2.3 Work as an Application of the Scalar Product
 - Example 2.4 Extension of the Scalar Product to n Dimensions: A Sale of Stocks
 - Example 2.5 A Simple Model Economy
 - 2.2 Matrices
 - 2.2.1 Types of Matrix
 - 2.2.2 The Echelon Form, Rank r
 - 2.2.3 Matrix Equality
 - 2.2.4 Matrix Addition
 - Example 2.6 Acquisition Costs
 - 2.2.5 Multiplication by a Scalar
 - 2.2.6 Matrix Multiplication
 - Example 2.7 The Product of Two Matrices
 - Example 2.8 Matrix-Vector Representation of Linear Algebraic Equations
 - 2.2.7 Elementary Row Operations
 - Example 2.9 Application of Elementary Row Operations: Algebraic Equivalence
 - 2.2.8 Solution of Sets of Linear Algebraic Equations: Gaussian Elimination
 - Example 2.10 An Overspecified System of Equations with a Unique Solution
 - Example 2.11 A Normal System of Equations with no Solutions
 - 2.3 Ordinary Differential Equations (ODEs)
 - Example 2.12 A Population Model

- Example 2.13 Newton's Law of Cooling
- 2.3.1 Order of an ODE
- 2.3.2 Linear and Nonlinear ODEs
- 2.3.3 Boundary and Initial Conditions
- Example 2.14 Classification of ODEs and Boundary Conditions
- 2.3.4 Equivalent Systems
- Example 2.15
- 2.3.5 Analytical Solution Methods
- Example 2.16 Solution of NonLinear ODEs by Separation of Variables
- Example 2.17 Mass on a Spring Subjected to a Sinusoidal Forcing Function
- Example 2.18 Application of Inversion Procedures
- Example 2.19 The Mass-Spring System Revisited: Resonance
- Practice Problems
- 3 Geometrical Concepts
- Example 3.1 A Simple Geometry Problem: Crossing of a River
- Example 3.2 The Formation of Quasi Crystals and Tilings from Two Quadrilateral Polygons
- Example 3.3 Charting of Market Price Dynamics: The Japanese Candlestick Method
- Example 3.4 Surveying: The Join Calculation and the Triangulation Intersection
- Example 3.5 The Global Positioning System (GPS)
- Example 3.6 The Orthocenter of a Triangle
- Example 3.7 Relative Velocity and the Wind Triangle
- Example 3.8 Interception of an Airplane
- Example 3.9 Path of Pursuit
- Example 3.10 Trilinear Coordinates: The Three-Jug Problem
- Example 3.11 Inflecting Production Rates and Multiple Steady States: The van Heerden Diagram
- Example 3.12 Linear Programming: A Geometrical Construction
- Example 3.13 Stagewise Adsorption Purification of Liquids: The Operating Diagram
- Example 3.14 Supercoiled DNA Practice Problems
- 4 The Effect of Forces
- 4.1 Introduction
- Example 4.1 The Stress-Strain Relation: Stored Strain Energy and Stress Due to the Impact of a Falling Mass
- Example 4.2 Bending of Beams: Euler's Formula for the Buckling of a Strut
- Example 4.3 Electrical and Magnetic Forces: Thomson's Determination of e/m
- Example 4.4 Pressure of a Gas in Terms of Its Molecular Properties: Boyle's Law and the Ideal Gas Law, Velocity of Gas Molecules
- Example 4.5 Path of a Projectile
- Example 4.6 The Law of Universal Gravitation: Escape Velocity and Geosynchronous Satellites
- Example 4.7 Fluid Forces: Bernoulli's Equation and the Continuity Equation
- Example 4.8 Lift Capacity of a Hot Air Balloon
- Example 4.9 Work and Energy: Compression of a Gas and Power Output of a Bumblebee
- Practice Problems

- 5 Compa