

Contents

CHAPTER

1

Introduction

1

- 1.1 Engineering Mechanics 2
- 1.2 The Primitives 2
- 1.3 Basic Laws 3
- 1.4 Units and Dimensions 5
- 1.5 Problem Solving and Accuracy of Solutions 8

CHAPTER

2

Forces and Moments

11

- 2.1 Forces and Lines of Action 12
- 2.2 Moment of a Force about a Point 26
- 2.3 Moment of a Force about a Line 33
- 2.4 The Couple 44
- 2.5 Laws of Equilibrium; Relationship of Sums of Moments 50
- 2.6 Equipollence of Force Systems 52
- 2.7 The Force-and-Couple Resultant of a System of Forces 60
- 2.8 The Simplest Resultant of a Force System 67
- 2.9 Distributed Force Systems 92

CHAPTER

3

Analysis of Equilibrium Problems

112

- 3.1 Introduction 113
- 3.2 The Free-Body Diagram 115

CHAPTER

4

- 3.3** Fundamental Applications of the Equilibrium Equations 127
3.4 Applications of the Equations of Equilibrium to Interacting Bodies or Parts of a Structure 176

Structural Applications**228****I TRUSSES** 229

- 4.1** Introduction 229
4.2 The Method of Joints (or Pins) 235
4.3 Shortcuts and Rigidity/Determinacy Results 246
4.4 The Method of Sections 254
4.5 Space Trusses 272

II SYSTEMS CONTAINING MULTIFORCE MEMBERS 281

- 4.6** Axial and Shear Forces and Bending Moments 281
4.7 Beams; Shear and Moment Distributions 291
4.8 Differential Relationships Between $q(x)$, $V(x)$, and $M(x)$ in a Beam; Shear and Bending Moment Diagrams 305

III CABLES 321

- 4.9** Parabolic and Catenary Cables 321
4.10 Cables Under Concentrated Loads 333

CHAPTER

5

Friction**347**

- 5.1** Laws, Coefficients, and Basic Applications of Coulomb Friction 348
5.2 Special Applications of Coulomb Friction 385
- Wedges 385
 - Flexible Flat Belts and V-Belts 388
 - Screws 394
 - Disk Friction 399

CHAPTER

6

Centroids and Mass Centers**411**

- 6.1** Centroids of Lines, Areas, and Volumes; The Recurring Integral 412
6.2 The Method of Composite Parts 428
6.3 Center of Mass 443
6.4 The Theorems of Pappus 451

CHAPTER

7

Inertia Properties of Plane Areas**460**

- 7.1** Moments of Inertia of a Plane Area 461
7.2 The Polar Moment of Inertia of a Plane Area 466

7.3	The Parallel-Axis Theorem (or Transfer Theorem) for Moments of Inertia; The Radius of Gyration	469
7.4	The Method of Composite Areas	476
7.5	Products of Inertia of Plane Areas	488
7.6	The Parallel-Axis Theorem for Products of Inertia	493
7.7	Moments and Products of Inertia with Respect to Rotated Axes Through a Point; Mohr's Circle	496

CHAPTER

8

Special Topics**509**

8.1	The Principle of Virtual Work	510
8.2	Hydrostatic Pressure on Submerged Bodies	533

Appendices**561****Appendix A** Vectors **562**

A.1	Vectors: Addition, Subtraction, and Multiplication by a Scalar	562
A.2	Unit Vectors and Orthogonal Components	563
A.3	Scalar (Dot) Product	565
A.4	Vector (Cross) Product	567
A.5	Scalar and Vector Triple Products	570
	Problems/Appendix A	574

Appendix B Tables Relating to Units **576****Appendix C** Moments of Inertia of Areas **579****Appendix D** Using the Newton-Raphson Method and Programmable Calculators
to Solve Two Equations Occurring in the Book **583****Appendix E** Answers to Odd-Numbered Problems **587****Index** **597**