Contents

Preface x
Guided Tour xiii
Digital Resources xv
Acknowledgments xvi
List of Symbols xvii

1 Introduction 1

1.1 What is Mechanics? 2
1.2 Fundamental Concepts and Principles 3
1.3 Systems of Units 5
1.4 Converting between Two Systems of Units 10
1.5 Method of Solving Problems 12
1.6 Numerical Accuracy 14

2 Statics of Particles 15

2.1 Addition of Planar Forces 16
2.2 Adding Forces by Components 29
2.3 Forces and Equilibrium in a Plane 39
2.4 Adding Forces in Space 52
2.5 Forces and Equilibrium in Space 66
Review and Summary 75
Review Problems 79

3 Rigid Bodies: Equivalent Systems of Forces 82

3.1 Forces and Moments 84
3.2 Moment of a Force about an Axis 105
3.3 Couples and Force-Couple Systems 120
3.4 Simplifying Systems of Forces 136
Review and Summary 161
Review Problems 166

bee60730_fm_i-xviii.indd vii 07/22/15 02:39 PM

4 Equilibrium of Rigid Bodies 169

4.1 Equilibrium in Two Dimensions 172
4.2 Two Special Cases 195
4.3 Equilibrium in Three Dimensions 204
Review and Summary 225
Review Problems 227

5 Distributed Forces: Centroids and Centers of Gravity 230

5.1 Planar Centers of Gravity and Centroids 232
5.2 Further Considerations of Centroids 249
5.3 Additional Applications of Centroids 262
5.4 Centers of Gravity and Centroids of Volumes 273
Review and Summary 291
Review Problems 295

6 Analysis of Structures 297

6.1 Analysis of Trusses 299
6.2 Other Truss Analyses 317
6.3 Frames 330
6.4 Machines 348
Review and Summary 361
Review Problems 364

7 Internal Forces and Moments 367

7.1 Internal Forces in Members 368
7.2 Beams 378
7.3 Relations among Load, Shear, and Bending Moment 391
*7.4 Cables 403
*7.5 Catenary Cables 416
Review and Summary 424
Review Problems 427

8 Friction 429

8.1 The Laws of Dry Friction 431
8.2 Wedges and Screws 450
*8.3 Friction on Axles, Disks, and Wheels 459
8.4 Belt Friction 469
Review and Summary 479
Review Problems 482

9 Distributed Forces: Moments of Inertia 485

9.1 Moments of Inertia of Areas 487
9.2 Parallel-Axis Theorem and Composite Areas 498
*9.3 Transformation of Moments of Inertia 513
*9.4 Mohr's Circle for Moments of Inertia 523
9.5 Mass Moments of Inertia 529
*9.6 Additional Concepts of Mass Moments of Inertia 549
Review and Summary 564
Review Problems 570

10 Method of Virtual Work 573

*10.1 The Basic Method 574
*10.2 Work, Potential Energy, and Stability 595
Review and Summary 609
Review Problems 612

Appendix: Fundamentals of Engineering Examination A-1
Answers to Problems AN-1
Photo Credits C-1
Index I-1

*Advanced or specialty topics