

CONTENTS

LIST OF SYMBOLS xix	3 STATICS OF PARTICLES 61
1 GENERAL PRINCIPLES 1	3-1 INTRODUCTION 62 3-2 FREE-BODY DIAGRAMS 62
1-1 INTRODUCTION TO MECHANICS 2 1-2 HISTORICAL BACKGROUND 3 1-3 FUNDAMENTAL QUANTITIES OF MECHANICS 4 1-3-1 Newton's Laws 5 1-3-2 Mass and Weight 8	3-3 EQUILIBRIUM OF A PARTICLE 65 3-3-1 Two-dimensional Problems 65 3-3-2 Three-dimensional Problems 70 SUMMARY 79
1-4 UNITS OF MEASUREMENT 10	4 RIGID BODIES: EQUIVALENT FORCE/
1-4-1 The U.S. Customary System of Units 12 1-4-2 The International System of Units (SI) 12	MOMENT SYSTEMS 85
1-5 DIMENSIONAL CONSIDERATIONS 16	4-1 INTRODUCTION 86
1-5-1 Dimensional Homogeneity 16	4-2 MOMENTS AND THEIR CHARACTERISTICS 86
1-6 METHOD OF PROBLEM SOLVING 19 1-7 SIGNIFICANCE OF NUMERICAL RESULTS 20	4-2-1 Principle of Moments: Varignon's Theorem 92
SUMMARY 23	4-3 VECTOR REPRESENTATION OF A MOMENT 98
	4-3-1 Moment of a Force About a Point 99 4-3-2 Moment of a Force About a Line (Axis) 108
2 CONCURRENT FORCE SYSTEMS 27	4-4 COUPLES 114 CAS MONTOLIGORIAL LA
2-1 INTRODUCTION 28	4-5 RESOLUTION OF A FORCE INTO A FORCE AND A COUPLE 122
2-2 FORCES AND THEIR CHARACTERISTICS 28 2-2-1 Scalar and Vector Quantities 29	4-6 SIMPLIFICATION OF A FORCE SYSTEM: RESULTANTS 127
2-2-2 Principle of Transmissibility 29 2-2-3 Classification of Forces 30 2-2-4 Free-body Diagrams 30	4-6-1 Coplanar Force Systems 1274-6-2 Noncoplanar, Parallel Force Systems 1334-6-3 General Force Systems 136
2-3 RESULTANT OF TWO CONCURRENT FORCES 31 2-4 RESULTANT OF THREE OR MORE CONCURRENT	SUMMARY 145 OR 231/1113/AM CIVA 231/ASSI 2 P
FORCES 35 2-5 RESOLUTION OF A FORCE INTO	5 DISTRIBUTED FORCES: CENTROIDS AND
COMPONENTS 37	CENTER OF GRAVITY 149
2-6 RECTANGULAR COMPONENTS OF A FORCE 42	147)
2-7 RESULTANTS BY RECTANGULAR	5-1 INTRODUCTION 150
COMPONENTS 49	5-2 CENTER OF MASS AND CENTER OF GRAVITY 151
SUMMARY 56	5-2-1 Center of Mass 151

LINES 157 5-3-1 Centroids of Volumes 157 5-3-2 Centroids of Areas 157 5-3-3 Centroids of Lines 157 5-3-4 Centroid, Center of Mass, or Center of Gravity by Integration 158 5-4 CENTROIDS OF COMPOSITE BODIES 171 5-5 THEOREMS OF PAPPUS AND GULDINUS 181 5-6 DISTRIBUTED LOADS ON BEAMS 188 5-7 FORCES ON SUBMERGED SURFACES 194 5-7-1 Forces on Submerged Plane Surfaces 195 5-7-2 Forces on Submerged Curved Surfaces 196	SHAFTS 325 8-3 AXIAL FORCE, SHEAR FORCE, AND BENDING MOMENTS IN MULTIFORCE MEMBERS 329 8-4 SHEAR FORCES AND BENDING MOMENTS IN BEAMS 333 8-5 SHEAR-FORCE AND BENDING-MOMENT DIAGRAMS 339 8-6 FLEXIBLE CABLES 349 8-6-1 Cables Subjected to a Series of Concentrated Loads 349 8-6-2 Cables with Loads Uniformly Distributed Along the Horizontal 356 8-6-3 Cables with Loads Uniformly Distributed Along Their Length 365
SUMMARY 203	SUMMARY 372
6 EQUILIBRIUM OF RIGID BODIES 209	9 FRICTION 377
 6-1 INTRODUCTION 210 6-2 FREE-BODY DIAGRAMS 210 6-2-1 Idealization of Two-dimensional Supports and Connections 211 6-2-2 Idealization of Three-dimensional Supports and Connections 215 6-3 EQUILIBRIUM IN TWO DIMENSIONS 226 6-3-1 The Two-force Body (Two-force Members) 227 6-3-2 The Three-force Body (Three-force Members) 227 6-3-3 Statically Indeterminate Reactions and Partial Constraints 228 6-3-4 Problem Solving 230 	9-1 INTRODUCTION 378 9-2 CHARACTERISTICS OF COULOMB FRICTION 378 9-3 ANALYSIS OF SYSTEMS INVOLVING DRY FRICTION 395 9-3-1 Wedges 396 9-3-2 Square-threaded Screws 396 9-3-3 Journal Bearings 398 9-3-4 Thrust Bearings 399 9-3-5 Flat Belts and V-belts 400 9-4 ROLLING RESISTANCE 419 SUMMARY 423
6-4 EQUILIBRIUM IN THREE DIMENSIONS 245 SUMMARY 255	10 SECOND MOMENTS OF AREA AND MOMENTS OF INERTIA 429
St. LNEWON is and in the many of the Link	10-1 INTRODUCTION 430
7-1 INTRODUCTION 262 7-2 PLANE TRUSSES 263 7-2-1 Method of Joints 266 7-2-2 Zero-force Members 278 7-2-3 Method of Sections 282 7-2-4 Forces in Straight and Curved Two-force Members 292 7-3 SPACE TRUSSES 295 7-4 FRAMES AND MACHINES 302 7-4-1 Frames 303 7-4-2 Machines 305 SUMMARY 315	10-2-1 Parallel-axis Theorem for Second Moments of Area 431 10-2-2 Second Moments of Area by Integration 431 10-2-3 Radius of Gyration of Areas 438 10-2-4 Second Moments of Composite Areas 442 10-2-5 Mixed Second Moments of Areas 451 10-3 PRINCIPAL SECOND MOMENTS 458 10-3-1 Mohr's Circle for Second Moments of Area 462 10-4-4 MOMENTS OF INERTIA 467 10-4-1 Radius of Gyration 468 10-4-2 Parallel-axis Theorem for Moments of Inertia 469 10-4-3 Moments of Inertia by Integration 470
8 INTERNAL FORCES IN STRUCTURAL MEMBERS 32	10-4-4 Moment of Inertia of Composite Bodies 4/1

10-5 PRINCIPAL MOMENTS OF INERTIA 486 SUMMARY 492	11-5 STABILITY OF EQUILIBRIUM 520 11-5-1 Stable Equilibrium 520 11-5-2 Neutral Equilibrium 521
11 METHOD OF VIRTUAL WORK 497	11-5-3 Unstable Equilibrium 521 SUMMARY 531
11-1 INTRODUCTION 498	
11-2 DEFINITION OF WORK AND VIRTUAL WORK 498	APPENDIX A VECTOR OPERATIONS 535
11-2-1 Work of a Force 498	,
11-2-2 Work of a Couple 500 11-2-3 Virtual Work 501	APPENDIX B CENTROIDS OF VOLUMES, AREAS, AND LINES 553
11-3 PRINCIPLE OF VIRTUAL WORK AND	
EQUILIBRIUM 505 11-3-1 Equilibrium of a Particle 505 11-3-2 Equilibrium of a Rigid Body 505 11-3-3 Equilibrium of an Ideal System of Connected	APPENDIX C SECOND MOMENTS AND MOMENTS OF INERTIA 557
Rigid Bodies 506	APPENDIX D COMPUTATIONAL METHODS 563
11-4 POTENTIAL ENERGY AND EQUILIBRIUM 516	303
11-4-1 Elastic Potential Energy 517 11-4-2 Gravitational Potential Energy 518	ANSWERS TO SELECTED PROBLEMS 581
11-4-3 The Principle of Potential Energy 519	INDEX 595