

# CONTENTS

## **PREFACE**

### **1 SYSTEMS OF UNITS AND DIMENSIONAL CONSISTENCY**

- Learning Goals 1
- 1.1 Introduction 1
- 1.2 The SI System of Units 2
- 1.3 The English System of Units 9
- 1.4 Dimensional Consistency 11
- 1.5 Review 14
- Problems 16
- References 19

### **2 FLUID PROPERTIES**

- Learning Goals 20
- 2.1 Introduction 21
- 2.2 Temperature 21
- 2.3 Absolute Temperature 23
- 2.4 Density, Specific Weight, Specific Volume,  
and Specific Gravity 24
- 2.5 Pressure 29

- 2.6 Surface Tension 35
- 2.7 Compressibility 38
- 2.8 Viscosity 40
- 2.9 Review 47
- Problems 50
- References 54

### **3 FLUID STATICS**

**56**

- Learning Goals 56
- 3.1 Introduction 57
- 3.2 Pressure Relationships 57
- 3.3 Pressure Measurement—Manometry 65
- 3.4 Buoyancy of Submerged Bodies 74
- 3.5 Forces on Plane-Submerged Surfaces 78
- 3.6 Location of the Center of Pressure 85
- 3.7 Stresses in Cylinders and Spheres 90
- 3.8 Review 93
- Problems 96
- References 109

### **4 FLUID DYNAMICS**

**110**

- Learning Goals 110
- 4.1 Introduction 110
- 4.2 Conservation of Mass—The Continuity Equation 111
- 4.3 Work and Energy 116
- 4.4 Conservation of Energy—The Bernoulli Equation 122
- 4.5 Review 132
- Problems 134
- References 143

### **5 THE ENERGY EQUATION**

**144**

- Learning Goals 144
- 5.1 Introduction 144
- 5.2 The Energy Equation 145
- 5.3 Power 157
- 5.4 Review 160
- Problems 162
- References 168

**6 STEADY FLOW OF INCOMPRESSIBLE FLUIDS  
IN PIPES****170**

- Learning Goals 170
- 6.1 Introduction 171
- 6.2 Character of Flow in Pipes—Laminar and Turbulent 171
- 6.3 Evaluation of Reynolds Number 173
- 6.4 Laminar Flow in Pipes 175
- 6.5 Boundary Layer 178
- 6.6 Friction Pressure Losses in Turbulent Pipe Flow 180
- 6.7 Other Losses 189
- 6.8 Noncircular Pipe Sections 200
- 6.9 Intersecting Pipes—Parallel Flow 202
- 6.10 Review 206
- Problems 209
- References 212

**7 DYNAMIC FORCES****214**

- Learning Goals 214
- 7.1 Introduction 215
- 7.2 Force, Mass, and Acceleration 215
- 7.3 Deflection of Streams by Stationary Bodies 218
- 7.4 Moving Vanes 224
- 7.5 Fan or Propeller 227
- 7.6 Review 231
- Problems 234
- References 236

**8 MEASUREMENTS****238**

- Learning Goals 238
- 8.1 Introduction 239
- 8.2 Pressure Measurements in Static Fluids 239
- 8.3 Dead-Weight Piston Gage 242
- 8.4 Manometer 243
- 8.5 Micromanometer 246
- 8.6 Barometers 249
- 8.7 McCleod Gage 251
- 8.8 Pressure Transducers 253