Table of contents provided by Syndetics

- Preface (p. xi)
- Chapter 1 Introduction to Renewable Energy (p. 1)
- 1-1 Why Renewable Energy? (p. 1)
- Consequences of Fossil Fuel Combustion (p. 5)
- Renewable Energy Sources (p. 7)
- 1-2 Fossil Fuels and Nuclear Energy (p. 9)
- **Coal** (p. 9)
- **Oil** (p. 11)
- Natural Gas (p. 12)
- Nuclear Energy (p. 13)
- Electricity (p. 15)
- **References** (p. 15)
- **Problems** (p. 15)
- Chapter 2 A Review of Thermal Sciences (p. 19)
- 2-1 Thermal Sciences (p. 19)
- **2-2 Thermodynamics** (p. 19)
- Heat and Other Forms of Energy (p. 20)
- Specific Heats of Gases, Liquids, and Solids (p. 21)
- Energy Transfer (p. 23)
- The First Law of Thermodynamics (p. 24)
- Energy Balance for Closed Systems (p. 25)
- Energy Balance for Steady-Flow Systems (p. 25)
- Saturation Temperature and Saturation Pressure (p. 27)
- **2-3 Heat Transfer** (p. 29)
- Conduction Heat Transfer (p. 29)
- Thermal Conductivity (p. 31)
- Convection Heat Transfer (p. 35)
- Radiation Heat Transfer (p. 37)
- 2-4 Fluid Mechanics (p. 41)
- Viscosity (p. 42)
- Pressure Drop in Fluid Flow in Pipes (p. 44)
- 2-5 Thermochemistry (p. 49)
- Fuels and Combustion (p. 49)
- Theoretical and Actual Combustion Processes (p. 51)
- Enthalpy of Formation and Enthalpy of Combustion (p. 52)
- First-Law Analysis of Reacting Systems (p. 55)
- 2-6 Heat Engines and Power Plants (p. 58)
- **Thermal Efficiency** (p. 60)
- Overall Plant Efficiency (p. 62)
- 2-7 Refrigerators and Heat Pumps (p. 63)
- **References** (p. 65)
- **Problems** (p. 65)
- Chapter 3 Fundamentals of Solar Energy (p. 77)
- **3-1 Introduction** (p. 77)

- **3-2 Radiation Fundamentals** (p. 77)
- Blackbody Radiation (p. 80)
- **3-3 Radiative Properties** (p. 84)
- Emissivity (p. 85)
- Absorptivity, Reflectivity, and Transmissivity (p. 85)
- The Greenhouse Effect (p. 88)
- **3-4 Solar Radiation** (p. 89)
- **3-5 Solar Data** (p. 96)
- **References** (p. 99)
- **Problems** (p. 99)
- Chapter 4 Solar Energy Applications (p. 105)
- 4-1 Introduction (p. 105)
- 4-2 Flat-Plate Solar Collector (p. 106)
- 4-3 Concentrating Solar Collector (p. 111)
- 4-4 Solar-Power-Tower Plant (p. 114)
- **4-5 Solar Pond** (p. 117)
- 4-6 Photovoltaic Cell (p. 118)
- 4-7 Passive Solar Applications (p. 123)
- Trombe Wall (p. 124)
- Solar Heat Gain through Windows (p. 124)
- **References** (p. 131)
- **Problems** (p. 131)
- Chapter 5 Wind Energy (p. 139)
- **5-1 Introduction** (p. 139)
- **5-2 Wind Turbine Types and Power Performance Curve** (p. 140)
- 5-3 Wind Power Potential (p. 143)
- **5-4 Wind Power Density** (p. 145)
- **5-5 Wind Turbine Efficiency** (p. 147)
- Betz Limit for Wind Turbine Efficiency (p. 148)
- 5-6 Considerations in Wind Power Applications (p. 153)
- References (p. 157)
- **Problems** (p. 158)
- Chapter 6 Hydropower (p. 163)
- **6-1 Introduction** (p. 163)
- 6-2 Analysis of a Hydroelectric Power Plant (p. 165)
- 6-3 Impulse Turbines (p. 173)
- **6-4 Reaction Turbines** (p. 177)
- 6-5 Turbine Specific Speed (p. 185)
- 6-6 Run-of-River Plants and Waterwheels (p. 186)
- **References** (p. 189)
- **Problems** (p. 189)
- Chapter 7 Geothermal Energy (p. 195)
- **7-1 Introduction** (p. 195)
- 7-2 Geothermal Applications (p. 197)
- 7-3 Geothermal Heating (p. 198)
- Degree-Day Method for Annual Energy Consumption (p. 200)

- **7-4 Geothermal Cooling** (p. 205)
- Absorption Cooling System (p. 205)
- 7-5 Geothermal Heat Pump Systems (p. 208)
- Heat Pump Systems (p. 209)
- Ground-Source Heat Pump Systems (p. 210)
- 7-6 Geothermal Power Production (p. 215)
- 7-7 Geothermal Cogeneration (p. 226)
- References (p. 230)
- **Problems** (p. 230)
- Chapter 8 Biomass Energy (p. 243)
- **8-1 Introduction** (p. 243)
- 8-2 Biomass Resources (p. 243)
- 8-3 Conversion of Biomass to Biofuel (p. 244)
- 8-4 Biomass Products (p. 245)
- **Ethanol** (p. 245)
- Biodiesel (p. 246)
- Methanol (p. 246)
- **Pyrolysis Oil** (p. 247)
- **Biogas** (p. 247)
- **Producer Gas** (p. 248)
- Synthesis Gas (p. 248)
- 8-5 Electricity and Heat Production by Biomass (p. 249)
- 8-6 Solid Municipality Waste (p. 250)
- References (p. 255)
- **Problems** (p. 255)
- Chapter 9 Ocean Energy (p. 261)
- 9-1 Introduction (p. 261)
- 9-2 Ocean Thermal Energy Conversion (p. 261)
- 9-3 Wave Energy (p. 265)
- **Power Production from Waves** (p. 266)
- Wave Power Technologies (p. 270)
- **9-4 Tidal Energy** (p. 272)
- References (p. 277)
- **Problems** (p. 277)
- Chapter 10 Hydrogen and Fuel Ceils (p. 281)
- 10-1 Hydrogen: An Energy Carrier (p. 281)
- 10-2 Fuel Cells (p. 286)
- Thermodynamic Analysis of Fuel Cells (p. 289)
- **References** (p. 297)
- **Problems** (p. 297)
- Chapter 11 Economics of Renewable Energy (p. 301)
- **11-1 Engineering Economics** (p. 301)
- **11-2 The Time Value of Money** (p. 302)
- Effect of Inflation and Taxation on Interest Rate (p. 305)
- 11-3 Life Cycle Cost Analysis (p. 306)
- Cost-Benefit Analysis (p. 306)

- Unit Product Cost (p. 309)
- Comparison of Projects Based on Life Cycle Cost Analysis (p. 309)
- **11-4 Payback Period Analysis** (p. 311)
- **References** (p. 313)
- **Problems** (p. 313)
- Chapter 12 Energy and the Environment (p. 319)
- **12-1 Introduction** (p. 319)
- **12-2 Air Pollutants** (p. 321)
- **Particulate Matter** (p. 324)
- Sulfur Dioxide (p. 325)
- Nitrogen Oxides (p. 329)
- Hydrocarbons (p. 331)
- Carbon Monoxide (p. 332)
- Ozone, Smog, and Acid Rain (p. 333)
- 12-3 Emissions from Automobiles (p. 336)
- Catalytic Converters (p. 339)
- **12-4 The Greenhouse Effect** (p. 342)
- **CO 2 Production** (p. 344)
- 12-5 Stratospheric Ozone Depletion (p. 350)
- **12-6 Nuclear Waste** (p. 351)
- **References** (p. 352)
- **Problems** (p. 353)
- Appendix 1 Property Tables (Si Units) (p. 359)
- Appendix 2 Property Tables (English Units) (p. 371)
- **Index** (p. 385)