

# Contents

<i>Preface</i>		v
Chapter 1	Thermodynamic Concepts	1
	1.1 Introduction	1
	1.2 Intelligent Computer-Aided Software	1
	1.3 Review of Thermodynamic Concepts	4
	1.4 Thermodynamic Cyclic Systems	6
	1.5 Cycles	10
	1.6 Carnot Cycle	11
	1.7 Carnot Corollaries	14
Chapter 2	Vapor Cycles	15
	2.1 Carnot Vapor Cycle	15
	2.2 Basic Rankine Vapor Cycle	19
	2.3 Improvements to Rankine Cycle	28
	2.4 Actual Rankine Cycle	29
	2.5 Reheat Rankine Cycle	36
	2.6 Regenerative Rankine Cycle	41
	2.7 Low-Temperature Rankine Cycles	52
	2.8 Solar Heat Engines	54
	2.9 Geothermal Heat Engines	58
	2.10 Ocean Thermal Energy Conversion	71
	2.11 Solar Pond Heat Engines	76
	2.12 Waste Heat Engines	79
	2.13 Vapor Cycle Working Fluids	81
	2.14 Kalina Cycle	81
	2.15 Nonazeotropic Mixture Rankine Cycle	82
	2.16 Supercritical Cycle	84
	2.17 Design Examples	87
	2.18 Summary	97

Chapter 3	Gas Closed-System Cycles	99
3.1	Otto Cycle	99
3.2	Diesel Cycle	111
3.3	Atkinson Cycle	123
3.4	Dual Cycle	126
3.5	Lenoir Cycle	132
3.6	Stirling Cycle	135
3.7	Miller Cycle	141
3.8	Wicks Cycle	146
3.9	Rallis Cycle	148
3.10	Design Examples	154
3.11	Summary	163
Chapter 4	Gas Open-System Cycles	165
4.1	Brayton or Joule Cycle	165
4.2	Split-Shaft Gas Turbine Cycle	174
4.3	Improvements to Brayton Cycle	178
4.4	Reheat and Intercool Brayton Cycle	179
4.5	Regenerative Brayton Cycle	185
4.6	Bleed Air Brayton Cycle	189
4.7	Feher Cycle	199
4.8	Ericsson Cycle	202
4.9	Braysson Cycle	207
4.10	Steam Injection Gas Turbine Cycle	212
4.11	Field Cycle	214
4.12	Wicks Cycle	216
4.13	Ice Cycle	218
4.14	Design Examples	220
4.15	Summary	224
Chapter 5	Combined Cycle and Cogeneration	227
5.1	Combined Cycle	227
5.2	Triple Cycle in Series	233
5.3	Triple Cycle in Parallel	237
5.4	Cascaded Cycle	239
5.5	Brayton/Rankine Combined Cycle	241
5.6	Brayton/Brayton Combined Cycle	246
5.7	Rankine/Rankine Combined Cycle	251
5.8	Field Cycle	254
5.9	Cogeneration	257
5.10	Design Examples	268
5.11	Summary	275

Chapter 6	Refrigeration and Heat Pump Cycles	277
6.1	Carnot Refrigerator and Heat Pump	277
6.2	Basic Vapor Refrigeration Cycle	280
6.3	Actual Vapor Refrigeration Cycle	286
6.4	Basic Vapor Heat Pump Cycle	289
6.5	Actual Vapor Heat Pump Cycle	293
6.6	Working Fluids for Vapor Refrigeration and Heat Pump Systems	296
6.7	Cascade and Multistaged Vapor Refrigerators	297
6.8	Domestic Refrigerator-Freezer System and Air-Conditioning-Heat Pump System	306
6.9	Absorption Air-Conditioning	310
6.10	Brayton Gas Refrigeration Cycle	313
6.11	Stirling Refrigeration Cycle	318
6.12	Ericsson Cycle	322
6.13	Liquefaction of Gases	324
6.14	Nonazeotropic Mixture Refrigeration Cycle	326
6.15	Design Examples	329
6.16	Summary	339
Chapter 7	Finite-Time Thermodynamics	341
7.1	Introduction	341
7.2	Rate of Heat Transfer	343
7.3	Heat Exchanger	345
7.4	Curzon and Ahlborn (Endoreversible Carnot) Cycle	351
7.5	Curzon and Ahlborn Cycle with Finite Heat Capacity Heat Source and Sink	364
7.6	Finite-Time Rankine Cycle with Infinitely Large Heat Reservoirs	369
7.7	Actual Rankine Cycle with Infinitely Large Heat Reservoirs	373
7.8	Ideal Rankine Cycle with Finite Capacity Heat Reservoirs	376
7.9	Actual Rankine Cycle with Finite Capacity Heat Reservoirs	390
7.10	Finite-Time Brayton Cycle	397
7.11	Actual Brayton Finite Time Cycle	405

7.12	Other Finite Time Cycles	411
7.13	Summary	411
7.14	Bibliography	412
	<i>Appendix</i>	417
	<i>Index</i>	421