CONTENTS

	PAGE
PREFACE	xi
INTRODUCTION	1
CHAPTER 1. FUNDAMENTAL CONCEPTS	9
1.1. The Structure of a Physical Theory	9
1.2. Primitive Observers	12
1.3. The Classical Formulations of Thermodynamics	14
1.4. Systems and States	16
1.5. Relations between States	22
1.6. The Axioms	27
CHAPTER 2. FORMAL PROCESSES	30
2.1. Definitions and Axioms	30
2.2. Addition of Processes	32
2.3. Ordering of Processes	32
2.4. Further Properties of Processes	34
CHAPTER 3. COMPONENTS OF CONTENT	37
3.1. Definition	37
3.2. Existence of Components of Content	39
CHAPTER 4. IRREVERSIBILITY	41
4.1. Irreversibility Functions	41
4.2. The Construction of an Irreversibility Function	43
4.3. Irreversibility and Entropy	45
CHAPTER 5. MECHANICAL SYSTEMS AND ADIABATIC PROCESSES	48
5.1. Physical Considerations	48
5.2. Mechanical States and Processes	52
5.3. Adiabatic Processes	53
CHAPTER 6. ENTROPY	56
6.1. Entropy Functions	56
6.2. The Construction of an Entropy Function	57

CHAPTER 7. TOPOLOGICAL CONSIDERATIONS 60

7.1. Components of Content 60
7.2. Entropy 64

CHAPTER 8. THERMODYNAMIC SPACE 72

8.1. Definitions 72
8.2. The Case of Finite Dimension 74
8.3. Mathematical Commentary 77

CHAPTER 9. EQUILIBRIUM STATES AND POTENTIAL 82

9.1. Equilibrium States 82
9.2. Components of Potential 84

CHAPTER 10. PERFECT EQUILIBRIUM STATES 90

10.1. Motivation 90
10.2. Properties of Perfect Equilibrium States 91
10.3. Perfect Thermodynamic Systems 93

CHAPTER 11. THERMODYNAMICS OF A RIGIDLY ENCLOSED SYSTEM 96

11.1. General Discussion 96
11.2. A Pathological Example 101
11.3. The Construction of an Energy Function 105
11.4. The Construction of an Entropy Function 108

CHAPTER 12. SYSTEMS OF VARIABLE VOLUME 112

12.1. Volume and Pressure 112
12.2. Simple Systems 116

CHAPTER 13. ELECTRIC AND MAGNETIC SYSTEMS 119

13.1. Electrostatic Systems 119
13.2. Magnetic Systems 124
13.3. Hysteresis 126

CHAPTER 14. GALILEAN THERMODYNAMICS 130

14.1. The Components of Content 131
14.2. Galilean Transformations 134
14.3. The Equilibrium Surface 135
14.4. Properties of Equilibrium States 136
14.5. Thermodynamic Particles 137
14.6. Local Properties in an Eqilibrium State 138
14.7. Some Special Cases 141
14.8. The Centrifugal Effect 144

CHAPTER 15. SYMMETRY IN THERMODYNAMICS 149

15.1. Introduction 149
15.2. The Principle of Equivalence 152
15.3. An Example 153
15.4. The Symmetry Group 155
15.5. The Transformation of States 157
15.6. The Transformation of Functions of State 159

CHAPTER 16. SPECIAL RELATIVISTIC THERMODYNAMICS 163

16.1. The Inhomogeneous Lorentz Group 164
16.2. The Components of Content 168
16.3. Rest Mass and Spin 171
16.4. The Representation of States in Space-Time 172
16.5. Centre of Mass and Spin Angular Momentum 173
16.6. The Transformation of Entropy 175
16.7. Equilibrium States and Temperature 177
16.8. Local Properties of an Equilibrium State 180
16.9. Conclusion 188

APPENDIX A. THE FORMAL THEORY 191

A.1. Notation 192
A.2. States and Processes 192
A.3. Components of Content 195
A.4. Quasi-Entropy 199
A.5. The Duality Principle 205
A.6. Boundedness 206
A.7. Equilibrium States 208
A.8. Potentials 210
A.9. Absolute Entropy 211

APPENDIX B. SUBADDITIVE FUNCTIONS ON A GROUP 215

B.1. Partially Ordered Sets 215
B.2. Subadditive Functions 216
B.3. The Extension Theorem 219

APPENDIX C. THE PHYSICAL BASIS FOR THE ADJOINT REPRESENTATION 223

C.1. The Case of Special Relativity 223
C.2. The General Case 226

REFERENCES 229

INDEX 231

SYMBOL INDEX 237