

Table of Contents

Preface	1
Unit 1. Thermodynamics	
Chapter 1: Temperature and Heat	7
1.1 Temperature and Thermal Equilibrium	8
1.2 Thermometers and Temperature Scales	9
1.3 Thermal Expansion	12
1.4 Heat Transfer, Specific Heat, and Calorimetry	19
1.5 Phase Changes	26
1.6 Mechanisms of Heat Transfer	35
Chapter 2: The Kinetic Theory of Gases	67
2.1 Molecular Model of an Ideal Gas	68
2.2 Pressure, Temperature, and RMS Speed	78
2.3 Heat Capacity and Equipartition of Energy	88
2.4 Distribution of Molecular Speeds	93
Chapter 3: The First Law of Thermodynamics	109
3.1 Thermodynamic Systems	110
3.2 Work, Heat, and Internal Energy	112
3.3 First Law of Thermodynamics	116
3.4 Thermodynamic Processes	122
3.5 Heat Capacities of an Ideal Gas	126
3.6 Adiabatic Processes for an Ideal Gas	128
Chapter 4: The Second Law of Thermodynamics	145
4.1 Reversible and Irreversible Processes	146
4.2 Heat Engines	148
4.3 Refrigerators and Heat Pumps	150
4.4 Statements of the Second Law of Thermodynamics	153
4.5 The Carnot Cycle	155
4.6 Entropy	160
4.7 Entropy on a Microscopic Scale	166
Unit 2. Electricity and Magnetism	
Chapter 5: Electric Charges and Fields	181
5.1 Electric Charge	182
5.2 Conductors, Insulators, and Charging by Induction	188
5.3 Coulomb's Law	192
5.4 Electric Field	197
5.5 Calculating Electric Fields of Charge Distributions	204
5.6 Electric Field Lines	213
5.7 Electric Dipoles	217
Chapter 6: Gauss's Law	235
6.1 Electric Flux	236
6.2 Explaining Gauss's Law	245
6.3 Applying Gauss's Law	251
6.4 Conductors in Electrostatic Equilibrium	265
Chapter 7: Electric Potential	285
7.1 Electric Potential Energy	286
7.2 Electric Potential and Potential Difference	293
7.3 Calculations of Electric Potential	305
7.4 Determining Field from Potential	316
7.5 Equipotential Surfaces and Conductors	319
7.6 Applications of Electrostatics	328
Chapter 8: Capacitance	345
8.1 Capacitors and Capacitance	345
8.2 Capacitors in Series and in Parallel	355
8.3 Energy Stored in a Capacitor	361
8.4 Capacitor with a Dielectric	365
8.5 Molecular Model of a Dielectric	368
Chapter 9: Current and Resistance	385

9.1 Electrical Current	386
9.2 Model of Conduction in Metals	391
9.3 Resistivity and Resistance	397
9.4 Ohm's Law	406
9.5 Electrical Energy and Power	409
9.6 Superconductors	415
Chapter 10: Direct-Current Circuits	431
10.1 Electromotive Force	432
10.2 Resistors in Series and Parallel	440
10.3 Kirchhoff's Rules	453
10.4 Electrical Measuring Instruments	466
10.5 RC Circuits	469
10.6 Household Wiring and Electrical Safety	475
Chapter 11: Magnetic Forces and Fields	493
11.1 Magnetism and Its Historical Discoveries	494
11.2 Magnetic Fields and Lines	496
11.3 Motion of a Charged Particle in a Magnetic Field	501
11.4 Magnetic Force on a Current-Carrying Conductor	506
11.5 Force and Torque on a Current Loop	511
11.6 The Hall Effect	514
11.7 Applications of Magnetic Forces and Fields	517
Chapter 12: Sources of Magnetic Fields	535
12.1 The Biot-Savart Law	536
12.2 Magnetic Field Due to a Thin Straight Wire	540
12.3 Magnetic Force between Two Parallel Currents	543
12.4 Magnetic Field of a Current Loop	546
12.5 Ampère's Law	549
12.6 Solenoids and Toroids	555
12.7 Magnetism in Matter	560
Chapter 13: Electromagnetic Induction	581
13.1 Faraday's Law	582
13.2 Lenz's Law	586
13.3 Motional Emf	591
13.4 Induced Electric Fields	598
13.5 Eddy Currents	602
13.6 Electric Generators and Back Emf	606
13.7 Applications of Electromagnetic Induction	613
Chapter 14: Inductance	627
14.1 Mutual Inductance	628
14.2 Self-Inductance and Inductors	631
14.3 Energy in a Magnetic Field	637
14.4 RL Circuits	639
14.5 Oscillations in an LC Circuit	645
14.6 RLC Series Circuits	648
Chapter 15: Alternating-Current Circuits	661
15.1 AC Sources	662
15.2 Simple AC Circuits	663
15.3 RLC Series Circuits with AC	670
15.4 Power in an AC Circuit	675
15.5 Resonance in an AC Circuit	679
15.6 Transformers	684
Chapter 16: Electromagnetic Waves	699
16.1 Maxwell's Equations and Electromagnetic Waves	700
16.2 Plane Electromagnetic Waves	706
16.3 Energy Carried by Electromagnetic Waves	712
16.4 Momentum and Radiation Pressure	717
16.5 The Electromagnetic Spectrum	722
Appendix A: Units	741
Appendix B: Conversion Factors	745

Appendix C: Fundamental Constants	749
Appendix D: Astronomical Data	751
Appendix E: Mathematical Formulas	753
Appendix F: Chemistry	757
Appendix G: The Greek Alphabet	759
Index	807