

CONTENTS

19.0 ELECTRIC CURRENT	7
19.1 ELECTRIC CURRENT IN METALS	7
19.2 RESISTORS	10
19.3 ELECTRIC CURRENT IN GASES	11
19.4 ELECTRIC CURRENT IN LIQUIDS	11
19.5 ELECTRIC CIRCUITS, ELECTROMOTIVE FORCE	12
19.5.1 Energy and Power in Electric Circuits	13
19.5.2 Kirchhoff's Rules	14
19.5.3 RC – circuit	14
19.5.4 The Displacement Current	17
20.0 MAGNETIC FIELD	17
20.1 MAGNETIC FIELD AND MAGNETIC FORCE	18
20.1.1 Force Acting by a Magnetic Field on a Moving Charged Particle	18
20.1.2 The Earth's Magnetic Field	19
20.1.3 Motion of a Charged Particle in a Magnetic Field	20
20.1.4 Cyclotron	21
20.1.5 The Mass Spectrometer	21
20.1.6 The Hall Effect	23
20.1.7 Electric Current in a Magnetic Field	24
20.1.8 A Current Loop in a magnetic Field	24
20.2 SOURCES OF A MAGNETIC FIELD	25
20.2.1 Magnetic Field of a Linear Current Carrying Conductor	27
20.2.2 Interaction Between Two Parallel Wires	27
20.2.3 The Magnetic Field in the Center of a Circular Loop	28
20.2.4 The Magnetic Field in the Center of an Ideal Solenoid	28
20.3 MAGNETIC PROPERTIES OF MATTER	29
21.0 ELECTROMAGNETIC INDUCTION	31
21.1 PRACTICAL USAGE OF FARADAY'S LAW	33
21.1.1 A Slidewire Generator	33
21.1.2 A Simple Alternator (generator of ac voltage)	34
21.2 INDUCTORS. SELFINDUCTANCE	35
21.2.1 Inductance of an Ideal Solenoid	36
21.2.2 Mutual Inductance	37
21.2.3 Electric Circuits with an Inductor	37
21.3 ALTERNATING CURRENT CIRCUITS (ac-circuits)	42
21.3.1 A Resistive ac Circuit	42
21.3.2 A Capacitive ac Circuit	42
21.3.3 An Inductive ac Circuit	43
21.3.4 RLC ac Circuit in Series	44
21.3.5 Root-Mean-Square Values of a Time Variable Quantity	46
21.3.6 Power in ac Circuits	46
22.0 SPECIAL THEORY OF RELATIVITY	47
22.1 RESULTS FOLLOWING FROM SPECIAL THEORY OF RELATIVITY	49
22.1.1 Time Dilation	49
22.1.2 Length Contraction	50
22.1.3 Simultaneity	51
22.1.4 Relativistic Momentum, Mass and Force	51
22.1.5 Relativistic Energy	52
22.1.6 Addition of Velocities	53
22.1.7 Invariance	54
22.1.8 The Light Cone	54
23.0 ELECTROMAGNETIC FIELD (WAVES)	57
23.1 ELECTROMAGNETIC WAVES (RADIATION)	57

23.1.1 Sources of Electromagnetic Waves	58
23.1.2 Spectrum of Electromagnetic Waves	59
23.1.3 Energy Transported by Electromagnetic Waves	59
23.1.4 Radiation Pressure	60
23.1.5 Electromagnetic Wave in Matter	61
24.0 OPTICS	61
24.1 FUNDAMENTAL LAWS OF OPTICS	62
24.1.1 The Huygens Principle	63
24.1.2 Light Reflection and Refraction	63
24.1.3 Total Internal Reflection	64
24.1.4 Diffraction of Light	65
24.1.5 Dispersion of Light	66
24.1.6 Polarization of Light	66
24.1.7 Polarization by Reflection	66
24.2 GOMETRICAL OPTICS	67
24.2.1 Images Formed by Reflection - Mirrors	68
24.2.2 Images Formed by Refraction - Lenses	71
24.3. ABERRATIONS	76
24.4 SOME OPTICAL INSTRUMENTS	76
24.4.1 The Magnifier	76
24.4.2 The Telescope	77
24.4.3 The Microscope	77
24.4.6 The Eye	78
24.5 WAVE OPTICS	80
24.5.1 Interference	82
24.5.2 Interference in Thin Films	83
24.5.3 A Two-slit Experiment	85
24.5.4 The Diffraction Grating	86
24.5.5 Michelson Interferometer	87
25.0 PARTICLE NATURE OF ELECTROMAGNETIC RADIATION	88
25.1 HEAT RADIATION. BLACKBODY RADIATION	89
25.1.1 Wien's Displacement Law	90
25.1.2 The Stefan-Boltzmann Law	90
25.1.3 The Planck Radiation Law	91
25.1.4 Radiation of Real Bodies	92
25.2 THE PHOTOELECTRIC EFFECT	93
25.2.1 X-rays	95
25.3 THE COMPTON EFFECT (SCATTERING)	96
25.4 ATOMIC SPECTRA	97
26.0 MODELS OF ATOMS	98
26.1 The Thomson Model	98
26.2 The Planetary Model	98
26.3 The Bohr Model of Hydrogen Atom	99
26.3.1 Series	100
27.0 WAVE NATURE OF PARTICLES	102
27.1 DE BROGLIE WAVES	102
27.1.2 Wave Nature of the Electron in a Hydrogen Atom	103
27.1.3 Experimental Confirmation of de Broglie Hypothesis	103
27.1.4 The Uncertainty Principle	105
27.1.5 The Electron Microscope	107
27.1.6 The Correspondence Principle	108
27.1.7 The Wave Function. Matter Waves. The Wave Packet	108
28.0 THE SCHRÖDINGER EQUATION	109
28.1 APPLICATIONS OF THE SCHRÖDINGER EQUATION	111
28.1.1 The Harmonic Oscillator	111

28.1.2 Particle in Box	113
29.0 QUANTUM MECHANICAL MODEL OF A HYDROGEN ATOM	116
29.1 SCHRÖDINGER EQUATION AND THE HUDROGEN ATOM	116
29.1.1 Solution for $F(r)$. Principal Quantum Number	117
29.1.2 Solution for $F(\theta)$. Magnetic Quantum Number	117
29.1.3 Solution for $F(\phi)$. Magnetic Quantum Number	119
29.1.4 Spin Quantum Number	121
30.0 MANY-ELECTRON ATOMS	121
31.0 NUCLEAR PHYSICS	123
31.1 Nucleus	123
31.1.1 Nuclear Structure	124
31.1.2 Binding Energy	124
30.1.3 Stability of Nuclei. Radioactivity. Radioactive Decays	125
30.1.4 The Decay Law	127
30.1.5 Radioactive Dating	129
30.1.6 Nuclear Fusion	129
30.1.7 Nuclear Fission	130
30.1.8 Interaction of Matter with Nuclear Radiation	132
30.1.9 Biological Effects of Radiation	133
32.0 ELEMENTARY PARTICLES. COSMOLOGY	134