

CONTENTS

1 OSCILLATIONS	9
1.1 Oscillations of Spring	9
1.2 Simple Harmonic Motion	11
1.3 Energy in Simple Harmonic Oscillator	14
1.4 Simple Pendulum	15
1.5 Physical Pendulum	16
1.6 Damped Harmonic Motion	17
1.7 Forced Oscillations – Resonance	19
1.8 Combination of Harmonic Motions	20
2 WAVE MOTION	24
2.1 Description of Wave Motion	24
2.2 Energy Transmitted by Waves	27
2.3 Representation of Travelling Wave	28
2.4 Wave Equation and Superposition Principle	29
2.5 Reflection and Refraction of Waves	31
2.6 Interference of Waves	33
2.7 Standing Waves	35
2.8 Sound Wave	37
2.9 Interference of Sound, Beats	40
2.10 Doppler Effect	41
3 ELECTROMAGNETIC WAVES	43
3.1 Maxwell's Equations	43
3.2 Differential Form of Maxwell's Equations	44
3.3 Wave Equations	46
3.4 Properties of Electromagnetic Waves	47
3.5 Energy in Electromagnetic Waves – Poynting Vector	49
3.6 Electromagnetic Spectrum	51
3.7 Interference – Young's Double Slit Experiment	51
3.8 Interference by Thin Film	53
3.9 Diffraction by Single Slit	56
3.10 Diffraction Grating	58
3.11 Plane Polarisation of Electromagnetic Waves	59
3.12 Polarisation by Reflection	61
3.13 Double Refraction	62
4 GEOMETRICAL OPTICS	63
4.1 Reflection of Light	63
4.2 Formation of Image by Plane Mirror	63
4.3 Formation of Image by Spherical Mirror	64
4.4 Refraction – Snell's Law	68
4.5 Refraction at Spherical Surface	69
4.6 Thin Lenses	71
4.7 Lens Equation	73
4.8 Simple Magnifier	75
4.9 Telescope	76

4.10	Microscope	77
4.11	Lens Aberrations	79
5	SPECIAL THEORY OF RELATIVITY	80
5.1	Galilean and Newtonian Relativity	80
5.2	Michelson–Morley Experiment. The Postulates	82
5.3	Lorentz Transformation	83
5.4	Length Contraction	85
5.5	Time Dilatation	86
5.6	Relativistic Addition of Velocities	88
5.7	Relativistic Mass, Momentum and Energy	89
5.8	Spacetime and Four–Vectors	92
5.9	Summing Up	97
6	QUANTUM PHYSICS	98
6.1	Black Body Radiation. Planck’s Quantum Hypothesis	98
6.2	Stability of Atoms	100
6.3	Atomic Spectra – Bohr’s Model	102
6.4	Wave Particle Duality	104
6.4.1	Photoelectric and Compton’s Effect	104
6.4.2	Diffraction of Particles	108
6.5	Wave Nature of Matter	108
6.6	Wave Function	109
6.7	The Uncertainty Principle	111
6.8	Schrodinger’s Equation	113
6.9	Solutions of Time–Independent Schrodinger’s Equation	116
6.9.1	The Zero Potential	116
6.9.2	The Step Potential – Energy Less Than Step Height	117
6.9.3	The Infinite Potential Well	119
6.9.4	The Potential Well of a Finite Height	123
6.9.5	The Simple Harmonic Oscillator Potential	124
6.9.6	The Barrier Potential	125
6.9.7	The Hydrogen Atom	127
6.10	Magnetic Dipole Moment, Spin	128
6.11	Multielectron Atoms. Exclusion Principle	130
6.12	Operators. Expectation Values	132
6.13	Solid State Physics	134
6.14	Crystal Binding	135
6.15	Band Theory of Solids	137
6.16	Semiconductors	141
6.17	Lasers	143
6.18	Superconductivity	145
6.19	The Specific Heat of a Crystalline Solid	148
7	NUCLEAR PHYSICS	149
7.1	Nuclear Terminology	149
7.2	Natural Radioactivity	152
7.3	Radioactive Decay	153
7.4	Equilibrium Condition – Radioactive Series	154
7.5	Measuring of Radiation Dosage	155

7.6 Alpha, Beta and Gamma Decay	157
7.7 Artificial Nuclear Reactions	160
7.8 Detectors of Particles	162
7.9 Particle Accelerators	164
7.10 Nuclear Fission	167
7.11 Nuclear Fusion	169
Appendix: Periodic Table of Elements	171
References	172