

CONTENTS

PREFACE	vii
1 REVIEW OF NUCLEAR PROPERTIES AND NUCLEAR DECAY	1
1.1 Introduction	1
1.2 Properties of Nuclear States	2
1.3 Alpha Rays	5
1.4 Beta Rays	7
1.5 Gamma Rays	9
1.6 Radioactive Decay	11
2 REVIEW OF NUCLEAR REACTIONS	15
2.1 Introduction	15
2.2 Kinematics of Nuclear Reactions	17
2.3 Types of Nuclear Reactions	18
2.4 Cross Section	19
2.5 Types of Experimental Measurements	21
2.6 Particle Accelerators and Neutron Sources	23
2.7 Nuclear Fission	24
3 INTERACTION OF NUCLEAR RADIATION WITH MATTER	26
3.1 Introduction	26
3.2 Interaction of Light Charged Particles with Matter	26
3.3 Interaction of Heavy Charged Particles with Matter	29
3.4 Absorption Coefficient of Gamma Rays	31
3.5 Photoelectric Effect	34
3.6 Compton Effect	34
3.7 Pair Production	36
4 NUCLEAR RADIATION DETECTORS	37
4.1 Introduction	37
4.2 Gas-filled Detectors	37
4.3 Ionization Chamber	39
4.4 Proportional Counter	41
4.5 Geiger Muller Counter	42
4.6 Scintillation Detectors	44
4.7 Semiconductor Radiation Detectors	49
4.8 Construction of a Semiconductor Radiation Detector	51
4.9 Neutron Counters	55
4.10 Brief Survey of Nuclear Electronic Systems	59
5 ALPHA RAY SPECTROMETERS	63
5.1 Introduction	63
5.2 Magnetic Spectrometer	63

5.3	Ionization Chambers and Proportional Counter	65
5.4	Scintillation Spectrometer	66
5.5	Semiconductor Radiation Detectors	66
5.6	Absorption Methods	67
6	BETA RAY SPECTROMETERS	69
6.1	Introduction	69
6.2	Magnetic Spectrometers	69
6.3	Electrostatic Spectrometers	77
6.4	Scintillation Spectrometers	77
6.5	Semiconductor Beta Ray Spectrometers	78
7	GAMMA RAY SPECTROMETERS	80
7.1	Introduction	80
7.2	Scintillation Gamma Ray Spectrometer	80
7.3	Ge (Li) Gamma Ray Spectrometer	94
7.4	Crystal Diffraction Spectrometer	99
7.5	Pair Spectrometer	100
7.6	Magnetic Spectrometer	101
8	SPECIAL EXPERIMENTAL TECHNIQUES	103
8.1	Introduction	103
8.2	Coincidence Measurements	103
8.3	Sum-coincidence Measurements	109
8.4	Anti-Compton Gamma Ray Spectrometry	110
8.5	Lifetime Measurements	112
8.6	Angular Correlation of Nuclear Radiation	116
8.7	Measurement of Internal Conversion Coefficients	118
9	ANALYSIS OF NUCLEAR SPECTROSCOPIC DATA	126
9.1	Introduction	126
9.2	Determination of Energies of Nuclear Energy Levels	126
9.3	Determination of Nuclear Spins and Parities	128
9.4	Internal Conversion Coefficients	131
9.5	Angular Correlation Measurements	132
9.6	Determination of Nuclear Moments	133
9.7	Measurement of Lifetimes of Nuclear States	134
9.8	Nuclear Level Scheme of ^{113}Cs —An Example	136
10	APPLICATIONS OF NUCLEAR SPECTROSCOPIC METHODS TO SOLID STATE PHYSICS AND CHEMICAL PHYSICS	140
10.1	Introduction	140
10.2	Positron Annihilation Studies	141
10.3	Mossbauer Effect	149
10.4	Perturbed Angular Correlations	153
	INDEX	159