

CONTENTS

SECTION A INTRODUCTION

CHAPTER 1	RADIATION SOURCES	3
I	UNITS AND DEFINITIONS	4
II	FAST ELECTRON SOURCES	6
III	HEAVY CHARGED PARTICLE SOURCES	11
IV	SOURCES OF ELECTROMAGNETIC RADIATION	16
V	NEUTRON SOURCES	26
CHAPTER 2	RADIATION INTERACTIONS	39
I	INTERACTION OF HEAVY CHARGED PARTICLES	40
II	INTERACTION OF FAST ELECTRONS	56
III	INTERACTION OF GAMMA RAYS	62
IV	INTERACTION OF NEUTRONS	71
V	RADIATION EXPOSURE AND DOSE	74
CHAPTER 3	GENERAL PROPERTIES OF RADIATION DETECTORS	79
I	SIMPLIFIED DETECTOR MODEL	79
II	CURRENT AND PULSE MODES OF OPERATION	80
III	PULSE HEIGHT SPECTRA	84
IV	COUNTING CURVES AND PLATEAUS	87
V	ENERGY RESOLUTION	89
VI	DETECTION EFFICIENCY	92
VII	DEAD TIME	95
CHAPTER 4	COUNTING STATISTICS AND ERROR PREDICTION	104
I	CHARACTERIZATION OF DATA	105
II	STATISTICAL MODELS	110
III	APPLICATIONS OF STATISTICAL MODELS	122
IV	ERROR PROPAGATION	131
V	OPTIMIZATION OF COUNTING EXPERIMENTS	139
VI	DISTRIBUTION OF TIME INTERVALS	141

SECTION B GAS-FILLED DETECTORS

CHAPTER 5	IONIZATION CHAMBERS	151
I	THE IONIZATION PROCESS IN GASES	152
II	CHARGE MIGRATION AND COLLECTION	155
III	DESIGN AND OPERATION OF DC ION CHAMBERS	159

IV	RADIATION DOSE MEASUREMENT WITH ION CHAMBERS	163
V	APPLICATIONS OF DC ION CHAMBERS	169
VI	PULSE MODE OPERATION	173
CHAPTER 6	PROPORTIONAL COUNTERS	182
I	GAS MULTIPLICATION	182
II	DESIGN FEATURES OF PROPORTIONAL COUNTERS	186
III	PROPORTIONAL COUNTER PERFORMANCE	191
IV	DETECTION EFFICIENCY AND COUNTING CURVES	206
V	VARIANTS OF PROPORTIONAL COUNTER DESIGN	210
CHAPTER 7	GEIGER-MUELLER COUNTERS	218
I	THE GEIGER DISCHARGE	219
II	FILL GASES	221
III	QUENCHING	222
IV	TIME BEHAVIOR	224
V	THE GEIGER COUNTING PLATEAU	227
VI	DESIGN FEATURES	229
VII	COUNTING EFFICIENCY	231
VIII	G-M SURVEY METERS	234
SECTION C	SCINTILLATION COUNTERS	
CHAPTER 8	SCINTILLATION DETECTOR PRINCIPLES	239
I	ORGANIC SCINTILLATORS	240
II	INORGANIC SCINTILLATORS	254
III	LIGHT COLLECTION AND SCINTILLATOR MOUNTING	263
CHAPTER 9	PHOTOMULTIPLIER TUBES	272
I	INTRODUCTION	272
II	THE PHOTOCATHODE	274
III	ELECTRON MULTIPLICATION	278
IV	PHOTOMULTIPLIER TUBE CHARACTERISTICS	284
V	ANCILLARY EQUIPMENT REQUIRED WITH PHOTOMULTIPLIER TUBES	293
VI	SCINTILLATION PULSE SHAPE ANALYSIS	298

CHAPTER 10	RADIATION SPECTROSCOPY WITH SCINTILLATORS	306
I	GENERAL CONSIDERATIONS IN GAMMA RAY SPECTROSCOPY	306
II	GAMMA RAY INTERACTIONS	308
III	PREDICTED RESPONSE FUNCTIONS	313
IV	PROPERTIES OF NaI(Tl) SCINTILLATION SPECTROMETERS	328
V	ELECTRON SPECTROSCOPY WITH SCINTILLATORS	346
VI	SPECIALIZED DETECTOR CONFIGURATIONS BASED ON SCINTILLATION	349
SECTION D	SEMICONDUCTOR DETECTORS	
CHAPTER 11	SEMICONDUCTOR DIODE DETECTORS	359
I	SEMICONDUCTOR PROPERTIES	360
II	THE ACTION OF IONIZING RADIATION IN SEMICONDUCTORS	372
III	SEMICONDUCTORS AS RADIATION DETECTORS	374
IV	SEMICONDUCTOR DETECTOR CONFIGURATIONS	385
V	OPERATIONAL CHARACTERISTICS	390
VI	APPLICATIONS OF SURFACE BARRIERS AND DIFFUSED JUNCTION DETECTORS	401
CHAPTER 12	LITHIUM-DRIFTED GERMANIUM DETECTORS	414
I	ION-DRIFTED DETECTOR FABRICATION	414
II	FUNDAMENTAL CHARACTERISTICS OF DRIFTED DETECTORS	419
III	Ge(Li) DETECTOR OPERATIONAL CHARACTERISTICS	420
IV	GAMMA RAY SPECTROSCOPY WITH Ge(Li) DETECTORS	433
CHAPTER 13	OTHER SOLID STATE DETECTORS	471
I	LITHIUM-DRIFTED SILICON DETECTORS	471
II	HIGH-PURITY GERMANIUM DETECTORS	492
III	SEMICONDUCTOR MATERIALS OTHER THAN SILICON OR GERMANIUM	502
IV	AVALANCHE DETECTORS	507

V	POSITION-SENSITIVE SEMICONDUCTOR DETECTORS	508
SECTION E NEUTRON DETECTORS AND SPECTROSCOPY		
CHAPTER 14	SLOW NEUTRON DETECTION METHODS	517
I	NUCLEAR REACTIONS OF INTEREST IN NEUTRON DETECTION	518
II	DETECTORS BASED ON THE BORON REACTION	523
III	DETECTORS BASED ON OTHER CONVERSION REACTIONS	531
IV	REACTOR INSTRUMENTATION	536
CHAPTER 15	FAST NEUTRON DETECTION AND SPECTROSCOPY	551
I	COUNTERS BASED ON NEUTRON MODERATION	552
II	DETECTORS BASED ON FAST NEUTRON-INDUCED REACTIONS	562
III	DETECTORS THAT UTILIZE FAST NEUTRON SCATTERING	570
SECTION F DETECTOR ELECTRONICS AND PULSE PROCESSING		
CHAPTER 16	PULSE PROCESSING AND SHAPING	599
I	DEVICE IMPEDANCES	599
II	COAXIAL CABLES	601
III	PULSE SHAPING	614
CHAPTER 17	LINEAR AND LOGIC PULSE FUNCTIONS	636
I	LINEAR AND LOGIC PULSES	636
II	INSTRUMENT STANDARDS	638
III	SUMMARY OF PULSE PROCESSING UNITS	647
IV	COMPONENTS COMMON TO MANY APPLICATIONS	649
V	PULSE COUNTING SYSTEMS	659
VI	PULSE HEIGHT ANALYSIS SYSTEMS	667
VII	SYSTEMS INVOLVING PULSE TIMING	680
VIII	PULSE SHAPE DISCRIMINATION	704
CHAPTER 18	MULTICHANNEL PULSE ANALYSIS	711
I	SINGLE CHANNEL METHODS	711
II	GENERAL MULTICHANNEL CHARACTERISTICS	715
III	THE MULTICHANNEL ANALYZER	720

IV	SPECTRUM STABILIZATION	730
V	COMPUTERIZED SPECTRUM ANALYSIS	732
 SECTION G MISCELLANEOUS RADIATION DETECTORS AND APPLICATIONS		
 CHAPTER 19 MISCELLANEOUS DETECTOR TYPES 745		
I	CERENKOV DETECTORS	745
II	LIQUID IONIZATION AND PROPORTIONAL COUNTERS	748
III	PHOTOGRAPHIC EMULSIONS	750
IV	THERMOLUMINESCENT DOSIMETERS	755
V	TRACK-ETCH DETECTORS	759
VI	NEUTRON DETECTION BY ACTIVATION FOILS	765
 CHAPTER 20 BACKGROUND AND DETECTOR SHIELDING 774		
I	SOURCES OF BACKGROUND	774
II	BACKGROUND IN GAMMA RAY SPECTRA	780
III	BACKGROUND IN OTHER DETECTORS	785
IV	SHIELDING MATERIALS	787
V	ACTIVE METHODS OF BACKGROUND REDUCTION	791
 APPENDIX: RADIATION EFFECTS AND EXPOSURE LIMITS 798		
I	RADIATION EFFECTS	798
II	QUANTIFICATION OF DOSE	799
III	TYPES OF EXPOSURE	801
INDEX		805