

CONTENTS

Foreword	<i>iii</i>
Preface	<i>v</i>
1. INTRODUCTION	1
1.0 INTRODUCTION	
1.0.1 Methods of detecting analytes	
1.0.2 Analytical targets	
1.1 ANALYTICAL TYPES	
1.1.1 Qualitative analysis	
1.1.2 Quantitative analysis	
1.2. VOLUMETRIC ANALYSIS OR TITRATION	
1.3. GRAVIMETRY	
1.3.1 The Universal law of Gravitation	
1.4. PRECIPITATION	
1.4.1 Conditions for precipitation	
1.4.2 Factors Affecting Precipitation	
1.5. TRADITIONAL ANALYTICAL TECHNIQUES	
1.5.1 Spectroscopy	
1.5.2 Mass spectroscopy	
1.5.3 Crystallography	
1.5.4 Electrochemical analysis	
1.5.5 Thermal analysis	
1.5.6 Separation techniques	
1.5.7 Hyphenated techniques	
1.5.8 Microscopy	

- 1.6. ROLE OF ANALYTICAL CHEMISTRY
- 1.7. ADVANTAGES AND LIMITATIONS
 - 1.7.1 Advantages of instrumental methods
 - 1.7.2 Advantages of chemical methods
 - 1.7.3 Limitations of instrumental methods
 - 1.7.4 Limitations of chemical methods
- 1.8. ERRORS
- 1.9. SIGNIFICANT FIGURES
- 1.10 Accuracy and precision
 - 1.10.1 Target analogy for accuracy versus precision
- 1.11 CONFIDENTIAL LIMIT
- 1.12 SIGNAL TO NOISE RATIO
- 1.13 SENSITIVITY
- 1.14 DETECTION LIMIT
- 1.15 SUMMARY

2. MICROSCOPY

35

- 2.0 INTRODUCTION
- 2.1 PRINCIPLE
 - 2.1.1 Magnification
 - 2.1.2 Resolving Power or Resolution
 - 2.1.3 Numerical aperture (NA)
 - 2.1.4 Refractive Index (RI)
 - 2.1.5 Illumination
 - 2.1.6 Working distance
- 2.2 TYPES
 - 2.2.1 Bright field microscope
 - 2.2.2 Dark field microscope
 - 2.2.3 Fluorescence microscope
 - 2.2.4 Phase contrast microscope
 - 2.2.5 Confocal microscopy
 - 2.2.6 Electron microscope
- 2.3 Flow cytometry

2.3.1	Principle	
2.3.2	Analysis and sorting	
2.3.3	Signal processing	
2.3.4	System and components	
2.3.5	Applications	
2.4	SUMMARY	
3.	CENTRIFUGATION	92
3.0	INTRODUCTION	
3.1	PRINCIPLE	
3.1.1	Sedimentation	
3.1.2	Sedimentation Velocity	
3.1.3	Rotors	
3.1.4	Centrifuge tubes	
3.2	TYPES	
3.2.1	Differential centrifugation	
3.2.2	Density gradient centrifugation	
3.2.3	Ultracentrifugation	
3.3	SUMMARY	
4.	SPECTROSCOPY-I	117
4.0	RADIATION	
4.1	Energy	
4.2	Atomic structure	
4.3	Electromagnetic radiation	
4.4	Electromagnetic spectrum	
4.5	THE DOPPLER EFFECT	
4.6	SPECTRA TYPES	
4.6.1	Continuous spectra	
4.6.2	Discrete spectra	
4.6.3	Bathochromic shift	
4.6.4	Pressure broadening	

- 4.7 SPECTROSCOPY
 - 4.7.1 Introduction
 - 4.7.2 Spectroscopy Types
- 4.8 UV - VISIBLE SPECTROSCOPY
 - 4.8.1 Nature of Electronic Transitions
 - 4.8.2 Principle of Absorption Spectroscopy
 - 4.8.3 Instrumentation
 - 4.8.4 UV-Visible absorption spectra
 - 4.8.5 Importance of conjugation
- 4.9 SPECTROFLUORIMETER
 - 4.9.1 Fluorescence
 - 4.9.2 Phosphorescence
 - 4.9.3 Singlet and Triplet states
 - 4.9.4 Excited state processes in molecules
 - 4.9.5 Principle
 - 4.9.6 Instrumentation
 - 4.9.7 Applications
- 4.10 ATOMIC ABSORPTION SPECTROSCOPY
 - 4.10.1 Introduction
 - 4.10.2 Principle
 - 4.10.3 Interferences
 - 4.10.4 Broadening of a spectra line
 - 4.10.5 Instrumentation
 - 4.10.6 Applications
- 4.11 ATOMIC EMISSION SPECTROSCOPY
 - 4.11.1 Principle
 - 4.11.2 Instrumentation
 - 4.11.3 Applications
- 4.12 CIRCULAR DICHROISM (CD)
 - 4.12.1 Dichroism
 - 4.12.2 Circular dichroism
 - 4.12.3 Principle or Operation
 - 4.12.4 Performance

4.12.5 Applications	
4.13 SUMMARY	
5. SPECTROSCOPY-II	197
5.1 INFRARED SPECTROSCOPY	
5.1.1 Introduction	
5.1.2 Principle	
5.1.3 Instrumentation	
5.1.4 Applications	
5.2 MASS SPECTROSCOPY	
5.2.1 History	
5.2.2 Principle	
5.2.3 Instrumentation	
5.2.4 Nature of mass spectra	
5.2.5 Applications	
5.3 ELECTRON SPIN RESONANCE SPECTROSCOPY	
5.3.1 Introduction	
5.3.2 Principle	
5.3.3 Instrumentation	
5.3.4 Applications	
5.4 SUMMARY	
6. ONLINE MONITORING AND CONTROL DEVICES	234
6.0 pH	
6.0.1 pH Measurement	
6.0.2 pH System	
6.1 TEMPERATURE	
6.1.1 Thermometer	
6.1.2 Thermistors	
6.1.3 Temperature controller	
6.2 DISSOLVED OXYGEN	
6.2.1 Temperature effect	
6.2.2 Environmental impact	

6.2.3	Dissolved oxygen affects in water supplies	
6.2.4	Oxygen electrode	
6.3	AGITATION	
6.3.1	Mixing features and properties	
6.3.2	Mixing equipments	
6.4	SENSOR	
6.5	X-rays	
6.5.1	X-rays source	
6.5.2	Diffractometer	
6.5.3	Electron density	
6.5.4	Crystals	
6.5.5	X-ray diffraction	
6.5.6	Bragg's law	
6.5.7	Fourier theory	
6.5.8	Production and detection of X-rays	
6.5.9	Limitations	
6.5.10	Applications	
6.6	SUMMARY	
7.	SEPARATION TECHNIQUES	271
7.0	High Performance Liquid Chromatography (HPLC)	
7.0.1	Introduction	
7.0.2	Instrumentation	
7.0.3	Applications	
7.1	GAS CHROMATOGRAPHY	
7.1.1	Introduction	
7.1.2	Principle	
7.1.3	Apparatus	
7.1.4	Applications	
7.2	ION-EXCHANGE CHROMATOGRAPHY	
7.2.1	Introduction	
7.2.2	Cation exchange resins	
7.2.3	Anion exchange resins	

7.2.4	Types of ionisable groups	
7.2.5	Ion exchange equilibrium	
7.2.6	Basis for separations	
7.2.7	Principle	
7.2.8	Applications	
7.3	GEL FILTRATION CHROMATOGRAPHY	
7.3.1	Introduction	
7.3.2	Principle	
7.3.3	Applications	
7.4	AFFINITY CHROMATOGRAPHY	
7.4.1	Introduction	
7.4.2	Matrix	
7.4.3	Ligand	
7.4.4	Principle	
7.4.5	Applications	
7.5	MEMBRANE SEPARATION	
7.5.1	Ultra filtration (UF)	
7.5.2	Reverse osmosis	
7.5.3	Diffusion/Dialysis	
7.6	SUMMARY	
8.	NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY	318
8.1	INTRODUCTION	
8.2	NUCLEAR SPIN AND MAGNETIC MOMENT	
8.2.1	Spinning nuclei-magnetic moments	
8.2.2	Magnetic moment and magnetic field	
8.3	TYPES	
8.3.1	Low resolution NMR	
8.3.2	High resolution NMR	
8.3.3	Instrument components	
8.4	PRINCIPLE	
8.5	FREQUENCY LOCK	

8.6	DOUBLE RESONANCE OR SPIN DECOUPLING	
8.7	NUCLEAR OVERHAUSER EFFECT (NOE)	
8.8	CARBON-13 NMR SPECTROSCOPY	
8.9	FOURIER TRANSFORM (FT) NMR	
8.9.1	Advantages	
8.10	APPLICATIONS	
8.11	SUMMARY	
Glossary		344
Index		364