

CONTENTS

PREFACE	xiii
CHAPTER 1 SOIL BASICS I: MACROSCALE FEATURES	1
1.1. Horizonation	7
1.2. Peds	11
1.3. Soil Color	15
1.4. Soil Naming	17
1.5. The Landscape	18
1.6. Relationship of Large Features to Soil Chemistry, Analysis, and Instrumentation	19
1.7. Conclusions	21
Problems	21
Bibliography	21
References	22
CHAPTER 2 SOIL BASICS II: MICROSCOPIC TO ATOMIC ORBITAL DESCRIPTION OF SOIL CHEMICAL CHARACTERISTICS	23
Soil Components Independent	24
2.1. Soil Solids	24
Soil Components Interacting	32
2.2. Bonding Considerations	32
Soil Components in Combination	35
2.3. Surface Features	35
2.4. Energy Considerations	37
2.5. Reaction Paths	38
2.6. Steric Factors	39
2.7. Rate Factors	39
2.8. All Factors Together	40
2.9. Micelles	40

2.10. Coated Surfaces	41
2.11. Conclusions	42
Problems	42
Bibliography	43
References	43
 CHAPTER 3 SOIL BASICS III: THE BIOLOGICAL AND ORGANIC COMPONENTS IN SOIL	 45
Soil Biota	46
3.1. Animals	46
3.2. Plants	48
3.3. Microorganisms	52
Biological and Organic Chemistry of Soil	56
3.4. Biochemical	56
3.5. Bioorganic	57
3.6. Organic Compounds	58
3.7. Analysis	64
3.8. Conclusions	67
Problems	67
Bibliography	68
References	68
 CHAPTER 4 SOIL BASICS IV: THE SOIL AIR AND SOIL SOLUTION	 71
4.1. Soil Air	71
4.2. Water	73
4.3. Solubility	76
4.4. Elements in Solution	76
4.5. Dissolved Gases	77
4.6. Compounds in Solution	77
4.7. Inorganic Ions in Solution	78
4.8. Organic Ions in Solution	81
4.9. Soil pH	82
4.10. The Soil Solution around Particles	83
4.11. Distribution between Soil Solids and Soil Solution	83
4.12. Oxidative and Reductive Reactions in the Soil Solution	85
4.13. Measuring Soil Water	86

4.14. Conclusion	89
Problems	89
Bibliography	90
References	90
CHAPTER 5 ELECTRICAL MEASUREMENTS	93
5.1. The Basic Electrochemical Cell	94
5.2. Electricity Generation in Soil	95
5.3. Potentiometry (Electrodes in Soil Measurements)	96
5.4. Voltammetry	105
5.5. Electrical Conductivity	106
5.6. Time Domain Reflectometry (TDR)	107
5.7. Porous Block	107
5.8. Other Methods	107
5.9. Conclusions	108
Problems	108
Bibliography	109
References	109
CHAPTER 6 TITRIMETRIC MEASUREMENTS	111
6.1. Soil Titration	113
6.2. pH Titration of Soil	114
6.3. Organic Matter	118
6.4. Ammonia	118
6.5. Kjeldahl—Organic Nitrogen	120
6.6. Nitrite and Nitrate	122
6.7. Carbonate Determination	123
6.8. Halogen Ion Determination	123
6.9. pH-Stat Titrations	124
6.10. Conclusions	124
Problems	125
Bibliography	125
References	126
CHAPTER 7 EXTRACTION	127
7.1. Isolation	127
7.2. Extraction	128
7.3. Drying Agents	133
7.4. Extraction Procedures	134

7.5. Extract Cleanup	139
7.6. Extract Analysis	142
7.7. Conclusions	142
Problems	143
Bibliography	143
References	144

CHAPTER 8 SPECTROSCOPY **147**

8.1. Spectral Overlap	148
8.2. Noise	149
8.3. X-ray Diffraction	149
8.4. X-ray Fluorescence	150
8.5. Atomic Spectroscopy	152
8.6. Ultraviolet and Visible Spectroscopy	156
8.7. The Visible Region	158
8.8. Color Measurement: The Spectrophotometer	159
8.9. Regression Analysis	161
8.10. Relationship to Original Sample	163
8.11. Infrared Spectroscopy	163
8.12. Nuclear Magnetic Resonance	167
8.13. Mass Spectroscopy	169
8.14. Conclusion	170
Problems	170
Bibliography	171
References	171

CHAPTER 9 CHROMATOGRAPHY **175**

9.1. Fundamentals of Chromatography	175
9.2. Gas Chromatography	176
9.3. High-Performance Liquid Chromatography	184
9.4. Thin-Layer Chromatography	186
9.5. Electrophoresis	188
9.6. Identification of Compounds Separated by Chromatographic Procedures	189
9.7. Quantification	191
9.8. Conclusion	191
Problems	192
Bibliography	192
References	193

CHAPTER 10 SPECIATION	195
10.1. Cations	198
10.2. Anions	202
10.3. Nitrogen	204
10.4. Phosphorus	205
10.5. Sampling, Sample Storage, and Speciation	206
10.6. Conclusions	207
Problems	208
Bibliography	208
References	209
INDEX	211