

# Table of Contents

<b>About the Authors</b> .....	i
<b>Acknowledgements and Dedication</b> .....	ii
<b>Introduction</b> .....	iii
<b>Chapter 1: Structure of Organic Compounds</b> .....	1
<b>1.1 Theory</b> .....	1
1) Hydrocarbons .....	1
2) Alcohols .....	2
3) Amines .....	3
4) Quarternary Ammonium Compounds .....	3
5) Aldehydes .....	3
6) Ketones .....	3
7) Esters .....	4
8) Fatty Carboxylic Acids .....	5
9) Anhydrides .....	6
10) Ethers .....	6
11) Epoxides .....	7
12) Alkyl Halides .....	7
13) Acyl Halides .....	7
14) Aromatics .....	7
15) Mercaptans .....	8
16) Lactones .....	8
17) Lactams .....	8
18) Amides .....	9
<b>1.2 Practice</b> .....	9
1) Exercises .....	9
2) Exercise Solutions .....	10
<b>Chapter 2: Raw Materials</b> .....	13
Background .....	13
1) Triglycerides .....	16
2) Methyl Esters .....	22

3) Fatty Acids . . . . .	22
A. Natural Acids . . . . .	22
B. Synthetic Linear Acids . . . . .	23
C. Synthetic Branched Acids . . . . .	24
D. Ozone Acids . . . . .	25
4) Fatty Alcohols . . . . .	25
A. Oxo Alcohols . . . . .	26
B. Ziegler Alcohols . . . . .	26
C. Natural Alcohols . . . . .	27
5) Reppe Chemistry . . . . .	28
A. Acetylene Chemistry . . . . .	28
B. Reactions of Alcohols and Acetylene-Vinyl Ethers . . . . .	29
C. Phenol-Acetylene Reaction . . . . .	29
D. Mercaptan Reactions . . . . .	30
E. Reactions of Aldehydes with Acetylene . . . . .	31
F. Tetrahydrofuran . . . . .	31
G. Lactams . . . . .	32
H. Propargyl Alcohol and Derivatives . . . . .	32
I. Acrylic Acid . . . . .	33
6) Alkanolamines . . . . .	34
A. Ethanolamines . . . . .	34
B. Isopropanolamines . . . . .	34
C. Mixed Alkanolamines . . . . .	35
<b>Chapter 3: Synthesis Approach . . . . .</b>	<b>37</b>
3.1 Analogues and Homologues . . . . .	39
3.2 Specificity and Selectivity . . . . .	40
<b>Chapter 4: Nucleophilic Substitution . . . . .</b>	<b>43</b>
4.1 Theory . . . . .	43
1) Sn1 . . . . .	44
2) Sn2 . . . . .	44
4.2 Practice . . . . .	45
1) Esters . . . . .	45
A. Direct Esterification . . . . .	47
1. Esterification Reaction from Methy Ester . . . . .	47
2. Esterification Reaction from Fatty Acid . . . . .	50
B. Trans esterification . . . . .	53

2) Amides . . . . .	56
A. Amidification from Methyl Ester . . . . .	57
B. Amidification from Fatty Acids . . . . .	60
C. Amidification from Triglycerides . . . . .	63
3) Carboxylates . . . . .	65
A. Carboxylation with Anhydrides . . . . .	65
B. Soap from Methyl Ester . . . . .	68
C. Soap from Fatty Acid . . . . .	71
D. Soap from Triglyceride . . . . .	73
E. Carboxylates . . . . .	76
4) Amphoterics . . . . .	78
A. Amido Betaines . . . . .	78
B. Alkyl Betaines . . . . .	81
C. Amino Propionates . . . . .	84
D. Sulfobetaines . . . . .	88
E. Phosphobetaines . . . . .	91
5) Quats . . . . .	95
A. Alkyl Quat—Benzyl Chloride . . . . .	95
B. Alkyl Quat—Dimethyl Sulfate . . . . .	99
6) Monoalkyl Phosphate . . . . .	101
A. Phosphation Reaction with Polyphosphoric Acid . . . . .	101
7) Sarcosinates . . . . .	104
8) Taurates . . . . .	106
A. Schotten-Baumann Taurates . . . . .	106
9) Isoethionates . . . . .	109

**Chapter 5: Sulfation/Sulfonation . . . . . 113**

5.1 Theory . . . . . 113

1) Sulfonation . . . . . 113

2) Sulfonation . . . . . 113

5.2 Practice . . . . . 115

1) Sulfonation—SO<sub>3</sub> . . . . . 116

2) Chlorosulfonic Sulfonation . . . . . 119

3) Sulfamic Acid Sulfonation . . . . . 123

4) Sulfonation of Alpha Olefin Sulfonate . . . . . 125

**Chapter 6: Fatty Tertiary Amine Oxidation . . . . . 131**

6.1 Theory . . . . . 131

1) Surfactant Activity . . . . . 132

2) Antimicrobial Activity .....	132
6.2 Practice .....	133
1) Amine Oxides .....	133
A. Peroxide Oxidation of Tertiary Amine .....	133
<b>Chapter 7: Reduction</b> .....	137
7.1 Theory .....	137
1) Hydrogenation .....	137
2) Dehydrogenation .....	137
3) Reduction .....	138
4) Oxidation .....	138
5) Catalysts .....	140
7.2 Practice .....	140
1) Hydrogenation .....	140
2) Hydrogenolysis .....	142
3) Group Specific Hydrogenolysis .....	143
<b>Chapter 8: Radical Polymers</b> .....	145
8.1 Theory .....	145
1) Conventional Radical Polymerization .....	145
2) Kinetics .....	146
3) Controlled “Pseudo-living” Radical Polymerization .....	146
4) Atom Transfer Radical Polymerization (ATRP) .....	147
5) Reversible Addition-Fragmentation Transfer (RAFT) .....	148
6) Nitroxi-Mediated Radical Polymerization (NMRP) .....	148
8.2 Practice .....	150
1) Non-Living Polymerization .....	150
A. Nonionic .....	151
B. Cationic .....	156
C. Anionic .....	162
2) Living Radical Polymerization .....	166
A. Reversible-Addition Fragmentation Transfer Radical Polymerization (RAFT) .....	166
B. Nitroxide-Mediated Radical Polymerization (NMRP) .....	170
C. Atom Transfer Radical Polymerization (ATRP) .....	170
<b>Chapter 9: Other Polymers</b> .....	173
9.1 Theory .....	173
1) Polyesters .....	173

2) Polyamides.....	174
3) Polyurethanes .....	176
9.2 Practice.....	178
1) Polyesters .....	178
2) Polyamides.....	181
3) Polyurethanes .....	183
<b>Chapter 10: Aldol Condensation.....</b>	<b>187</b>
10.1 Theory.....	187
10.2 Practice.....	187
1) Guerbet Alcohol .....	187
<b>Chapter 11: Diels-Alder Reactions .....</b>	<b>193</b>
11.1 Theory.....	193
11.2 Practice.....	194
1) Dimer Acid .....	194
A. Tall Oil ( <i>Tallol</i> ) .....	194
<b>Chapter 12: Ring Opening Reactions.....</b>	<b>199</b>
12.1 Theory.....	199
12.2 Practice.....	199
1) Alkoxylation .....	199
2) Ethenification .....	205
3) Carboxylates .....	207
A. Reaction with Anhydrides.....	207
4) Butyrolactone Ring Opening .....	210
A. Reaction to Make Carboxy .....	210
<b>Chapter 13: Ring Closing Reactions.....</b>	<b>213</b>
13.1 Theory.....	213
1) Ring-Containing Components.....	213
A. 3-Membered Rings.....	213
B. 4-Membered Rings.....	213
C. 5-Membered Rings.....	214
D. 6-Membered Rings.....	215
13.2 Practice.....	216
1) Imidazoline .....	216

2) Sorbitan Esters.....	220
3) Lactams .....	224
4) Alkylpolyglucoside.....	227
<b>Chapter 14: Analytical .....</b>	<b>233</b>
14.1 The mg KOH/gm System.....	233
1) Alkali Value.....	234
2) Acid Value .....	234
3) Hydroxyl Value .....	235
4) Saponification Value.....	236
5) Summary .....	236
<b>Chapter 15: Analytical Methods .....</b>	<b>237</b>
<b>Index .....</b>	<b>285</b>