

CONTENTS

Preface	v
Chapter 1. Introduction	1
1.1. Polymers and Macromolecules	2
1.2. The Polymers of Life	3
1.3. The Polymers of Commerce	5
1.4. Some Basic Definitions	8
1.5. Some History	13
1.6. Molecular Weights	24
References	31
PART I: LINEAR HOMOPOLYMERS	
Chapter 2. Natural Condensation Polymers: The Linear Polysaccharides	35
2.1. Building Blocks and Linkages	37
2.2. Cellulose -- Its Three-Fold Significance	41
2.3. The Occurrence and Definition of Cellulose	44
2.4. The Morphology and Composition of Natural Fibers	46
2.5. The Isolation and Purification of Cellulose	53
2.6. Analysis of Cellulose	56
2.7. Chemical Constitution of Cellulose	57
2.8. Chemical Properties of Cellulose	64
2.9. Crystalline Structure of Cellulose	68
2.10. Useful Derivatives of Cellulose	83
2.11. Amylose	102
2.12. Chitin	106
2.13. Other Linear Polysaccharides	109
2.14. Biosynthesis of Linear Polysaccharides	111
References	114

Chapter 3. Synthetic Condensation Polymers	123
3.1. Condensation and Its Products	124
3.2. Polyesters	128
3.3. Polyamides	134
3.4. Polyimides	139
3.5. Polysiloxanes (Silicone Fluids)	141
3.6. Polyphenylene Ethers	143
3.7. Polysulfones	146
3.8. Polycarbonates	149
3.9. Interfacial Polycondensation	150
3.10. Characteristics of Condensation Polymerization	152
References	162
Chapter 4. Addition (Chain-Growth) Polymers	167
4.1. Addition and Its Products	168
✓ 4.2. Poly(Vinyl Chloride)	173
4.3. Polystyrene	180
4.4. Linear Polyethylene	186
✓ 4.5. Acrylic Polymers	188
4.6. Fluorine-Containing Polymers	193
4.7. Poly (Vinyl Pyrrolidone)	198
4.8. Non-Vinyl Addition Polymers	199
4.9. Techniques for Addition (Chain Mechanism) Polymerization	203
4.10. Free-Radical Initiation	210
4.11. Anionic Initiation	222
4.12. Cationic Initiation	225
4.13. Initiation by Transition-Metal Catalysts	230
References	236
Chapter 5. Stereoregularity in Addition Polymers	243
5.1. Stereoisomerism in Polymers	244
5.2. Polypropylene	249
5.3. Natural Rubbers [Poly (Isoprenes)]	261
5.4. Poly (1,3-Butadiene)	273
5.5. Substituted Poly (1,3-Butadienes)	284
5.6. Stereoregular Poly (Methyl Methacrylate)	291
5.7. Stereoregularity in other Vinyl Polymers	299
References	303

PART II: BRANCHING AND MOLECULAR HETEROGENEITY

Chapter 6. Branched Homopolymers: Synthetic and Natural	309
6.1. Forms of Branched Polymers	309
6.2. Branched (Low-Density Polyethylene)	315
6.3. Poly (Vinyl Acetate) and Its Derivatives	320
6.4. Amylopectin and Glycogen	324
References	331
Chapter 7. Natural Heteropolymers: I. Heteropolysaccharides	335
7.1. Sources of Heteropolysaccharides	336
7.2. Plant Gums	340
7.3. Inulins, Levans, and Pectins	344
7.4. The Hemicelluloses	347
7.5. Polysaccharides of Algal Seaweeds	352
7.6. Mucopolysaccharides	355
References	359
Chapter 8. Natural Heteropolymers: II. Nucleic Acids	363
8.1. Role of Nucleic Acids	363
8.2. DNA - Occurrence and Isolation	370
8.3. DNA - Structural Replication	377
8.4. RNA - Isolation, Biosynthesis, and Sequence Analysis	385
8.5. DNA - Total Synthesis of a Gene	399
References	403
Chapter 9. Copolymers and Copolymerization	407
9.1. Varieties and Applications of Copolymers	408
9.2. The Copolymer Fibers, Plastics, and Surface-Coating Materials	416
9.3. The Copolymer Elastomers	422
9.4. The Copolymer Composition Equation	426
9.5. The Reactivity of Monomers	437
9.6. Copolymerization by Ionic Initiation	447

9.7.	Graft Copolymers	448
9.8.	Block Copolymers	455
	References	465
PART III: CROSS-LINKING AND CROSS-LINKED POLYMERS		
Chapter 10,	Cross-Linking in Synthetic Polymers	471
10.1.	Characteristics of Cross-Linked Polymers	472
10.2.	Phenol- and Urea-Formaldehyde Resins	480
10.3.	Other Cross-Linked Plastics and Resins	489
10.4.	Vulcanization of Rubber	496
10.5.	Vulcanization of Synthetic Elastomers	500
10.6.	Theoretical Treatment of Cross-Linking	505
	References	513
Chapter 11.	Natural Heteropolymers: 111. Polypeptides and Proteins	517
11.1.	Composition and Characteristics	518
11.2.	Isolation and Classification	531
11.3.	Primary Structure	540
11.4.	Structures of Higher Order	550
11.5.	The Genetic Code	558
11.6.	Chemical Synthesis	566
	References	571
Chapter 12.	Lignins	577
12.1.	Definition and Composition	578
12.2.	Role in Technology	588
12.3.	Isolation	594
12.4.	Biosynthesis and Structure	599
12.5.	Cross-Linking and Its Consequences	606
	References	617
Appendix.	Measuring the Molecular Weights of Polymers	623
A.1.	End-Group Analysis	623
A.2.	Methods based on Colligative Properties	624
A.3.	Viscosity	627
A.4.	Light Scattering	631
A.5.	Ultracentrifugation	635
A.6.	Gel Permeation Chromatography	641
	References	648
Author	Index	651
Subject	Index	677