

CONTENTS

1 INTRODUCTION AND BACKGROUND INFORMATION	
1.1 Introduction	1
1.2 Common Prejudices Against Enzymes	1
1.3 Advantages and Disadvantages of Biocatalysts	2
1.3.1 Advantages of Biocatalysts	2
1.3.2 Disadvantages of Biocatalysts	6
1.3.3 Isolated Enzymes versus Whole Cells	7
1.4 Enzyme Properties and Nomenclature	8
1.4.1 Mechanistic Aspects	10
1.4.2 Classification and Nomenclature	17
1.4.3 Coenzymes	19
1.4.4 Enzyme Sources	20
References	21
2 BIOCATALYTIC APPLICATIONS	
2.1 Hydrolytic Reactions	23
2.2.1 Mechanistic and Kinetic Aspects	23
2.1.2 Hydrolysis of the Amide Bond	40
2.1.3 Ester Hydrolysis	48
2.1.3.1 Esterases and Proteases	48
2.1.3.2 Lipases	72
2.1.4 Hydrolysis and Formation of Phosphate Esters	97
2.1.5 Hydrolysis of Epoxides	107
2.1.6 Hydrolysis of Nitriles	112
References	125
2.2 Reduction Reactions	135
2.2.1 Recycling of Cofactors	135
2.2.2 Reduction of Aldehydes and Ketones Using Isolated Enzymes	141
2.2.3 Reduction of Aldehydes and Ketones Using Whole Cells	149
2.2.4 Reduction of C=C Bonds Using Whole Cells	157
References	163
2.3 Oxidation Reactions	169
2.3.1 Oxidation of Alcohols and Aldehydes	169
2.3.2 Oxygenation Reactions	174
2.3.2.1 Hydroxylation of Alkanes	178
2.3.2.2 Hydroxylation of Aromatic Compounds	181

2.3.2.3	Epoxidation of Alkenes	183
2.3.2.4	Sulphoxidation Reactions	186
2.3.2.5	Baeyer-Villiger Reactions	189
2.3.2.6	Formation of Peroxides	194
2.3.2.7	Dihydroxylation of Aromatic Compounds	196
References		199
2.4	Formation of Carbon-Carbon Bonds	204
2.4.1	Aldol Reactions	204
2.4.2	Acyloin Reactions	214
2.4.3	Michael-Type Additions	216
References		218
2.5	Addition and Elimination Reactions	221
2.5.1	Cyanohydrin Formation	221
2.5.2	Addition of Water and Ammonia	224
References		226
2.6	Glycosyl Transferases Reactions	228
2.6.1	Glycosyl Transferases	228
2.6.2	Glycosidases	232
References		236
2.7	Halogenation and Dehalogenation Reaction	238
2.7.1	Halogenation	238
2.7.2	Dehalogenation	243
References		245
3	SPECIAL TECHNIQUES	
3.1	Enzymes in Organic Solvents	248
3.1.1	Ester Synthesis	255
3.1.2	Lactone Synthesis	272
3.1.3	Amide Synthesis	273
3.1.4	Peptide Synthesis	274
3.1.5	Peracid Synthesis	279
3.1.6	Redox Reactions	280
3.2	Immobilization	283
3.3	Modified and Artificial Enzymes	293
3.3.1	Polyethylene Glycol Modified Enzymes	293
3.3.2	Semisynthetic Enzymes	295
3.3.3	Catalytic Antibodies	297
References		301

4 STATE OF THE ART AND OUTLOOK	308
5 APPENDIX	
5.1 Abbreviations	311
5.2 Suppliers of Enzymes	312
Subject Index	313