

CONTENTS

Preface	(v)
Acknowledgement	(vii)
About the Authors	(ix)

CHAPTER 1 CONTROLLED DRUG DELIVERY SYSTEMS

Introduction	1
Terminology/Definitions	3
Rationale of Controlled Drug Delivery	4
General Advantages.....	5
Disadvantages.....	6
Selection of Drug Candidates.....	7
Approaches to Design Controlled-release Formulations.....	7
Dissolution Controlled-release	9
Based on Ion Exchange Principles	15
Physicochemical Properties of Drugs Suitable for Controlled Release Formulations	17
Biological Properties of Drugs Suitable for Controlled Release Formulations.....	22
<i>Pharmacokinetic Properties of a Drug</i>	22
<i>Pharmacodynamic Properties of the Drug</i>	30
Bibliography	30
Exercise	32
<i>A. Multiple Choice Questions</i>	32
<i>B. Short Questions</i>	35
<i>C. Long Questions</i>	36

CHAPTER 2 POLYMERS

Introduction	37
Classification of Polymers.....	38
Classification of Polymers by their Physical Properties.....	41
Properties of Polymers	42
<i>Physical Properties</i>	42

<i>Thermal Properties</i>	43
<i>Mechanical Properties</i>	46
Advantages	48
Disadvantages.....	48
Application of Polymers in Formulation of Controlled Release Drug Delivery Systems.....	48
Bibliography	66
Exercise	67
<i>A. Multiple Choice Questions</i>	67
<i>B. Short Questions</i>	70
<i>C. Long Questions</i>	70

CHAPTER 3 MICROENCAPSULATION

Introduction	71
<i>Definition</i>	72
<i>Advantages</i>	73
<i>Disadvantages</i>	73
Microspheres	73
<i>Characteristics of Microspheres</i>	75
<i>Advantages</i>	75
<i>Disadvantages</i>	75
Methods of Preparation	76
Microcapsules.....	77
Microparticles.....	79
<i>Methods of Microencapsulation</i>	81
Materials required for Microencapsulation	96
Bibliography	100
Exercise	101
<i>A. Multiple Choice Questions</i>	101
<i>B. Short Questions</i>	103
<i>C. Long Questions</i>	103

CHAPTER 4 MUCOSAL DRUG DELIVERY SYSTEM

Introduction	105
Principles of Bioadhesion/Mucoadhesion.....	107
<i>Diffusion Theory</i>	108

<i>Dehydration Theory</i>	108
<i>Electronic Theory</i>	108
<i>Adsorption Theory</i>	109
<i>Wetting Theory</i>	109
<i>Diffusion Theory</i>	110
<i>Fracture Theory</i>	110
<i>Mechanical Theory</i>	111
Advantages	112
Disadvantages	113
Transmucosal Permeability	113
Formulation considerations of Buccal Delivery Systems	114
<i>Anatomy of the Oral Mucosa</i>	114
<i>Buccal Mucosa</i>	115
<i>Permeability</i>	115
<i>Barriers to Penetration Across the Buccal Mucosa</i>	116
<i>Physiochemical Properties of Drug</i>	117
<i>Physiological Factors</i>	117
<i>Polymer Properties</i>	118
Mucoadhesive Dosage Forms	121
<i>Tablets</i>	121
<i>Film</i>	121
<i>Patches</i>	121
<i>Gels and Ointments</i>	122
Common Sites of Application of Mucoadhesive Drug Delivery System	122
<i>Buccal Delivery</i>	123
<i>Ophthalmic Delivery</i>	123
<i>Vaginal Delivery</i>	123
<i>Nasal Delivery</i>	124
Bibliography	124
Exercise	125
A. Multiple Choice Questions	125
B. Short Questions	128
C. Long Questions	129

CHAPTER 5 IMPLANTABLE DRUG DELIVERY SYSTEMS

Introduction	131
<i>Advantages</i>	133
<i>Disadvantages</i>	134
Concept of Implants	135

Mechanisms of Drug Release from Implantable Drug Delivery Systems.....	144
Classification of Implants.....	145
Concept of Osmotic Pump.....	145
<i>Advantages</i>	146
<i>Disadvantages</i>	146
<i>Excipients and Formulation Considerations</i>	147
<i>Factors Influencing the Drug Release from the Oral Osmotic Pump</i>	148
<i>Selection of Implant Material</i>	149
<i>Classification of Osmotic Pumps</i>	149
<i>Biodegradable Systems</i>	150
<i>Implantable Pump Systems</i>	151
<i>Mechanism of Drug Release from Biodegradable Implants</i>	154
Bibliography	155
Exercise	156
A. Multiple Choice Questions	156
B. Short Questions	158
C. Long Questions	159

CHAPTER 6 TRANSDERMAL DRUG DELIVERY SYSTEMS

Introduction.....	161
<i>Advantages of Transdermal Drug Delivery System</i>	162
<i>Disadvantages of Transdermal Drug Delivery System</i>	162
Anatomy & Physiology of Skin.....	162
<i>Epidermis</i>	163
<i>Dermis</i>	164
<i>Hypodermis</i>	165
<i>Subcutaneous Tissue</i>	165
<i>Skin Appendages</i>	165
Functions of the Skin.....	166
<i>Mechanical Function</i>	166
<i>Protective Function</i>	166
Permeation through Skin.....	167
<i>Ways of Penetration</i>	168
<i>The Principle involved in Transdermal Penetration</i>	171
Complex Barriers for Diffusion.....	172
<i>Barrier in Series</i>	172
<i>Barrier in Parallel</i>	173

Factors Affecting Permeation.....	175
Permeation Enhancers	177
<i>Chemical Permeation Enhancers</i>	177
<i>The Classification of Chemical Permeation Enhancers</i>	177
<i>Fatty Acids, the Skin Permeation Enhancers</i>	178
<i>Terpenes, the Skin Permeation Enhancers</i>	178
<i>Azone-like Compounds, the Skin Permeation Enhancers</i>	179
Basic Components of TDDS	180
Formulation Approaches	185
Bibliography	192
Exercise	193
A. Multiple Choice Questions	193
B. Short Questions	196
C. Long Questions	196

CHAPTER 7 GASTRORETENTIVE DRUG DELIVERY SYSTEMS

Introduction	197
<i>Anatomy and Physiology of Stomach</i>	198
Need for GRDDS	200
<i>Factors Affecting Gastro Retentive Drug Delivery</i>	200
Advantages	200
Disadvantages.....	201
Approaches for GRDDS.....	201
Bibliography	211
Exercise	213
A. Multiple Choice Questions	213
B. Short Questions	215
C. Long Questions	216

CHAPTER 8 NASOPULMONARY DRUG DELIVERY SYSTEM

Introduction	217
<i>Nasal Drug Delivery</i>	217
<i>Technological Aspects</i>	218
<i>Pulmonary Drug Delivery</i>	219
Formulation of Inhalers (Dry Powder and Metered Dose).....	219
<i>Pressurised Metered Dose Inhalers</i>	219
<i>Dry Powder Inhalers</i>	220

<i>Nebulizers and Aqueous Mist Inhalers</i>	221
Nasal Sprays.....	221
Nebulizers.....	222
<i>Fill Volume and Residual Volume</i>	223
Characterization of Nasopulmonary Drug Delivery System.....	224
Labelling Considerations.....	228
Bibliography	230
Exercise	231
<i>A. Multiple Choice Questions</i>	231
<i>B. Short Questions</i>	234
<i>C. Long Questions</i>	234

CHAPTER 9 NANOTECHNOLOGY AND ITS CONCEPTS

Introduction.....	235
Concepts.....	235
Approaches for Targeted Drug Delivery Systems.....	236
Ideal Properties of Targeted Drug Delivery System.....	237
Approaches of Targeted Drug Delivery.....	237
<i>Passive Targeting</i>	238
<i>Active Targeting</i>	238
<i>Inverse Targeting</i>	239
<i>Dual Targeting</i>	239
<i>Double targeting</i>	239
<i>Combination Targeting</i>	239
Carrier System for Drug Targeting.....	239
Liposomes.....	239
Monoclonal Antibodies and Fragments.....	240
Microspheres and Nanoparticles.....	240
<i>Lipoproteins</i>	241
<i>Quantum Dots</i>	241
<i>Folate Targeting</i>	241
Advantages.....	241
Disadvantages.....	242
Introduction to Liposomes.....	242
Classification of Liposomes.....	243
Niosomes.....	244

<i>Structure of Niosomes</i>	244
<i>Advantages of Niosomes</i>	245
Nanoparticles	246
<i>Types of Nanoparticles</i>	246
Monoclonal Antibodies	248
<i>Types of Monoclonal Antibodies</i>	249
<i>Structure and Function of Monoclonal Antibody</i>	249
Applications	251
Bibliography	252
Exercise	253
<i>A. Multiple Choice Questions</i>	253
<i>B. Short Questions</i>	258
<i>C. Long Questions</i>	258

CHAPTER 10 OCULAR DRUG DELIVERY SYSTEMS

Introduction	259
Advantages of Ocular Drug Delivery Systems	261
Disadvantages	261
Physiological Considerations	261
Pharmacokinetic Considerations	262
Intra Ocular Barriers and Methods to Overcome	262
Preliminary Study	267
Ocular Formulations	271
Ocuserts	276
<i>Advantages of Ocular Inserts</i>	278
<i>Disadvantages of Ocular Inserts</i>	278
Formulation Methods of Ocusert	279
<i>Solvent Casting Method</i>	279
<i>Drug Reservoir Film</i>	279
<i>Melt Extrusion Technique</i>	279
<i>Conclusion</i>	279
Bibliography	280
Exercise	281
<i>A. Multiple Choice Questions</i>	281
<i>B. Short Questions</i>	285
<i>C. Long Questions</i>	285

CHAPTER 11 INTRAUTERINE DRUG DELIVERY SYSTEMS

Introduction	287
<i>Types of IUDS</i>	289
Risk/ Side Effects	292
Advantages	292
Disadvantages.....	292
Development of Intrauterine Devices (IUDs) and Applications	293
Conclusion.....	295
Bibliography.....	295
Exercise	297
<i>A. Multiple Choice Questions</i>	297
<i>B. Short Questions</i>	298
<i>C. Long Questions</i>	298
Answers	299
Index	303