

CONTENTS

1.	ENZYME KINETICS	
1.1	Introduction	1
1.2	Michaelis-Menten theory and the pseudo-steady state hypothesis	2
1.3	Enzyme-substrate-inhibitor system and an experimental example	20
1.4	Allosteric enzymes and the Monod-Wyman-Changeux model	32
	References	40
2.	FACILITATED DIFFUSION	
2.1	Physiological background and observed phenomena	42
2.2	Steady state model and governing equations	46
2.3	Asymptotic solutions and comparison with experiment	53
2.4	Facilitated diffusion and the case of carbon monoxide	63
2.5	Biological interpretation of results and general principles for facilitated diffusion of a ligand by a macromolecular carrier	68
2.6	Model for muscle respiration: role of myoglobin	70
	References	82
3.	REDUCTION OF DIMENSIONALITY IN DIFFUSION PROCESSES: ANTENNA RECEPTORS OF MOTHS	
3.1	Introduction	83
3.2	Reduction of dimensionality in diffusion processes	87
3.3	Mean times for diffusion	90
3.4	Coupled three-dimensional and surface diffusion processes	98
3.5	Application of dimensional reduction in diffusion to the sex-attractant receptors of the silk moth	101
3.6	Collection efficiency of an isolated sensillum: Peclet number $Pe < 1$	107
3.7	Collection efficiency of an isolated sensillum: Peclet number $Pe \geq 1$	111
3.8	Application to antennae filter and threshold experiments in bombykol olfaction	118
	References	126
4.	BIOLOGICAL OSCILLATORS I. HOMOGENEOUS TEMPORAL OSCILLATIONS	
4.1	Introduction, Monod-Jacob model and practical examples	128
4.2	Lotka-Volterra system	136
4.3	General principles for real biological oscillators	141
4.4	Simple hypothetical model chemical reaction exhibiting	

	a limit cycle oscillation	152
4.5	Belousov-Zhabotinskii reaction and its model mechanism	159
4.6	Linear and global analysis of the model system	168
4.7	Model enzyme synthesis control system	178
4.8	Higher-order enzyme synthesis control systems, delay models, and some general results	184
4.9	Model oscillator with substrate inhibition	193
	References	199
5.	BIOLOGICAL OSCILLATORS II. SPATIAL STRUCTURE AND NON-LINEAR WAVE PHENOMENA	
5.1	Introduction	203
5.2	Kinematic waves: spatial structures without diffusion	212
5.3	Fisher equation and propagating wave solutions	217
5.4	Asymptotic wave form and stability of wave solutions of Fisher's equation	226
5.5	Travelling wave model for the Belousov-Zhabotinskii reaction	233
5.6	Travelling wavefront solutions for the Belousov-Zhabotinskii reaction and comparison with experiment	239
5.7	Reaction-diffusion travelling waves	244
5.8	Reaction-diffusion systems in finite domains: large time behaviour and spatial structures	252
5.9	Diffusive instability and spatial structures in reaction-diffusion systems in finite domains	264
	References	272
MATHEMATICAL APPENDICES		
A1.	SINGULAR PERTURBATION THEORY: MATCHED EXPANSION PROCEDURES	
A1.1	Introduction and basic definitions	275
A1.2	Simple illustrative examples and intuitive approach	279
A1.3	Matching technique and non-trivial example	292
A1.4	Asymptotic procedure for systems of first order differential equations	302
A1.5	Exponential asymptotic procedure	310
	References	313
A2.	BOUNDARY CONDITIONS AND FACILITATED DIFFUSION: MATHEMATICAL ANALYSIS	314
A3.	LINEAR DIFFUSION EQUATION: SPECIAL SOLUTIONS	
A3.1	Two-dimensional axially symmetric diffusion	327
A3.2	Three-dimensional radially symmetric diffusion in $a \leq r \leq b$	330

CONTENTS	xiii
A3.3 Similarity solutions for a class of diffusion equations	332
A4. HOPF BIFURCATION THEOREM AND LIMIT CYCLES	336
A5. SOME MATHEMATICAL RESULTS FOR REACTION-DIFFUSION SYSTEMS	
A5.1 Existence and uniqueness of bounded solutions for a class of reaction-diffusion equations	354
A5.2 Bounds for the speed of propagation of wave solutions of a model system for the Belousov-Zhabotinskii reaction	356
A5.3 General results for the Laplacian operator in bounded domains	359
INDEX	363