

Contents

Chapter 1

Autowave processes and their role in natural sciences

1.1	Autowaves in non-equilibrium systems	11
1.2	Mathematical model of an autowave system	12
1.3	Classification of autowave processes	14
1.4	Basic experimental data	15

Chapter 2

Physical premises for the construction of basic models

2.1	Finite interaction velocity. Reduction of telegrapher's equations	28
2.2	Nonlinear diffusion equation. Finite diffusion velocity	34
2.3	Diffusion in multicomponent homogeneous systems	36
2.4	Integro-differential equations and their reduction to the basic model	41
2.5	Anisotropic and dispersive media	44
2.6	Examples of basic models for autowave systems	46

Chapter 3

Ways of investigation of autowave systems

3.1	Basic stages of investigation	52
3.2	A typical qualitative analysis of stationary solutions in the phase plane	53
3.3	Study of the stability of stationary solutions	56
3.4	Small-parameter method	65
3.5	Axiomatic approach	67
3.6	Discrete models	69
3.7	Fast and slow phases of space-time processes	72
3.8	Group-theoretical approach	81
3.9	Numerical experiment	82

Chapter 4

Fronts and pulses: elementary autowave structures

4.1	A stationary excitation front	86
4.2	A typical transient process	90
4.3	Front velocity pulsations	94
4.4	Stationary pulses	98
4.5	The formation of travelling pulses	101
4.6	Propagation of pulses in a medium with smooth inhomogeneities	107

4.7	Pulses in a medium with a nonmonotonic dependence $v = v(y)$	109
4.8	Pulses in a trigger system	112
4.9	Discussion	114
Chapter 5		
Autonomous wave sources		
5.1	Sources of echo and fissioning front types	116
5.2	Generation of a TP at a border between "slave" and "trigger" media	120
5.3	Stable leading centres	123
5.4	Standing waves	130
5.5	Reverberators: a qualitative description	138
Chapter 6		
Synchronization of auto-oscillations in space as a self-organization factor		
6.1	Synchronization in homogeneous systems	146
6.2	Synchronization in inhomogeneous systems. Equidistant detuning case	148
6.3	Complex autowave regimes arising when synchronization is violated	153
6.4	A synchronous network of auto-oscillators in modern radio electronics	162
Chapter 7		
Spatially inhomogeneous stationary states: dissipative structures		
7.1	Conditions of existence of stationary inhomogeneous solutions	165
7.2	Bifurcation of solutions and quasi-harmonical structures	170
7.3	Multitude of structures and their stability	175
7.4	Contrast dissipative structures	182
7.5	Dissipative structures in systems with mutual diffusion	191
7.6	Localized dissipative structures	193
7.7	Self-organization in combustion processes	195
Chapter 8		
Noise and autowave processes		
8.1	Sources of noise in active kinetic systems and fundamental stochastic processes	203
8.2	Parametric and multiplicative fluctuations in local kinetic systems	204
8.3	The mean life time of the simplest ecological prey-predator system	209
8.4	Internal noise in distributed systems and spatial self-organization	212
8.5	External noise and dissipative structures — linear theory	216
8.6	Nonlinear effects — the two-box model	218
8.7	Wave propagation and phase transitions in media with distributed multiplicative noise	221
Chapter 9		
Autowave mechanisms of transport in living tubes		
9.1	Autowaves in organs of the gastrointestinal tract	226
9.2	Waves in small blood-vessels with muscular walls	330
9.3	Autowave phenomena in plasmodia of Myxomycetes	235
Concluding Remarks		243
References		245
Index		261