

Contents

Chapter 1	Introduction	1
Chapter 2	Medium of Simple Structure	6
2.1	Simple Chain	6
2.2	One-Dimensional Quasicontinuum	12
2.3	One-Dimensional Quasicontinuum (continued)	18
2.4	Equation of Motion and Elastic Energy Operator	27
2.5	Strain and Stress, Energy Density, and Energy Flux	33
2.6	Boundary Problems	39
2.7	The Dispersion Equation	43
2.8	Kernel of Operator Φ_ω in the Complex Region	48
2.9	Green's Function and Structure of the General Solution	57
2.10	Approximate Models	61
2.11	Solution of Basic Boundary Problems	66
2.12	Notes	75
Chapter 3	Medium of Complex Structure	76
3.1	Basic Micromodels	76
3.2	Collective Cell Variables	82
3.3	Phenomenology	89
3.4	Acoustical and Optical Modes of Vibration. General Solution and Green's Matrix	97
3.5	Long-Wave Approximation and Connection with One-Dimensional Analog of Couple-Stress Theories	100
3.6	Elimination of the Internal Degrees of Freedom in the Acoustic Region	101
3.7	Equivalent Medium of Simple Structure	105
3.8	Diatomeric Chain	108
3.9	The Cosserat Model	115
3.10	Notes	123
Chapter 4	Nonstationary Processes	124
4.1	Green's Functions of the Generalized Wave Equation	124
4.2	Investigation of the Asymptotic Behavior	130
4.3	Decomposition into Packets and Factorization of Wave Equations	134
4.4	Energy Method and Quantum-Mechanical Formalism	140

VIII Contents

4.5	Characteristics of the Evolution of a Packet	145
4.6	Superposition of Packets	149
4.7	Solutions Localized in the Neighborhood of Extrema of the Dispersion Curve	152
4.8	The Case of External Forces	155
4.9	Weakly Inhomogeneous Medium	158
4.10	Local Defects	163
4.11	The Structure of the Green's Function of an Inhomogeneous Medium	170
4.12	The Scattering Matrix	175
4.13	Connection of the S-Matrix with Green's Functions	185
4.14	Scattering on Local Defects	189
4.15	Notes	192
Chapter 5 Nonlinear Waves		194
5.1	Korteweg-de Vries Model	194
5.2	Connection Between the KdV-Model and Nonlinear Wave Equation	200
5.3	Deformed Soliton	204
5.4	The Nonlinear Chain	208
5.5	Conservation Laws	214
5.6	Decay of the Initial Perturbation and the Distribution Function of Solitons	216
5.7	The Soliton Gas	220
5.8	Notes	223
Chapter 6 Inverse Scattering Method		224
6.1	Basic Idea of the Method	224
6.2	Inverse Scattering Problem for the Operator $L = d^2/dx^2 + u(x)$	228
6.3	N -Soliton Solutions of the KdV-Equation	234
6.4	Complete Integrability of the KdV-Equation	240
6.5	Shabat's Method	246
6.6	N -Soliton Solutions for the Equation of Nonlinear String	251
6.7	The Toda Lattice	253
6.8	Fermi-Pasta-Ulam Problem	261
6.9	Perspectives of the Method	266
6.10	Notes	271
Appendices		273
1.	Summary of Fourier Transforms	273
2.	Retarded Functions and Dispersion Relations	276
3.	Expansion of Functions, Given at a Finite Number of Points, in Special Bases	281
References		285
Subject Index		287

