Contents

Preface	vii
Introduction	ix
1 LINEAR APPROXIMATION	1
§ 2 General Solution of the Linearized Equations	1
3 Linearized Korteweg-de Vries Equation	4
2 EXAMPLES OF DISPERSIVE MEDIA	8
§ 4 Gravitational Waves on Fluid Surfaces	8
5 The Boussinesq Equation	10
§ 6 Ion-sound Waves in Unmagnetized Plasma	15
7 Non-linear Waves in Magnetized Plasma	18
8 Non-linear Electromagnetic Waves in Isotropic Dielectrics	25
S 9 Sound Waves with Dispersion	32
3 NON-LINEAR STATIONARY WAVES	37
§ 10 Steady Solutions of the Boussinesq Equations § 11 Stationary Waves Propagating Transversely to the Magnetic Field	37
in Rarefied Plasma	44
§ 12 Other Examples of Stationary Waves	47
4 NON-LINEAR WAVES IN WEAKLY DISPERSIVE MEDIA	53
3 13 The Burgers Equation	53
3 14 Solution of the Burgers Equation	59
15 The Korteweg-de Vries Equation	62
16 Conservation Laws for the Korteweg-de Vries Equation	66
17 General Pattern of the Evolution of Initial Perturbations in Weakly	
Dispersive Media	69
18 Analytical Solution of the Korteweg-de Vries Equation 19 Asymptotic Expressions for the Amplitudes of Solitons and "Tails"	72
for Large Values of σ	80

CONTENTS

 § 20 Self-similar Solutions of the Korteweg-de Vries Equation § 21 Quasi-linear Solutions of the Korteweg-de Vries Equation § 22 Flow Around a Thin Body in a Dispersive Medium § 23 Shock Waves in Dispersive Media 	83 85 92 101
5 WAVES OF ENVELOPES	106
 § 24 Non-linear Geometrical Optics § 25 Instability Criteria for Stationary Waves § 26 Evolution of the Wave Envelopes in the Hydrodynamic Approximation § 27 Non-linear Parabolic Equation § 28 Self-modulation of Waves (Modulational Instability) § 29 Self-focusing and Self-channelling of Waves § 30 Electro-acoustic Waves in Plasma 	106 109 112 120 128 135 141
APPENDIX A NON-LINEAR WAVES WITH SLOWLY VARYING PARAMETERS (ADIABATIC APPROXIMATION OF WHITHAM)	147
A1 Variation Principle A2 Adiabatic Invariants A3 Non-linear Geometrical Optics	147 152 156
APPENDIX B EVOLUTION OF ELECTRO-ACOUSTIC WAVES IN PLASMA WITH NEGATIVE DIELECTRIC PERMITTIVITY	158
 B1 Boundary Conditions B2 Excitation and Evolution of Electro-acoustic Waves B3 Solution of the Boundary-value Problem B4 General Solution of the Fundamental Equations 	158 161 170 174
References	177
Index	181
Other Titles in the Series in Natural Philosophy	185