Contents

Pr	eface v				
1.	Introducti	ion 1			
	1.1 1.2 1.3	Plan of the Book 2			
2.	Quasi Par	articles and Collective Modes 9			
	2.1 2.2 2.3	Introduction 9 Description of Quasi Particles 10 Description of Interactions between Elementary Excitations 12			
3.	Collective	Excitation of a System of Electrons 15			
	3.1 3.2 3.3	Bohm-Pines Theory 16			
4.	Macroso	copic Equations and Energy Theorems 39			
		Introduction 39			
		Derivation of Macroscopic Equations of an Electron Plasma 40			
	4.3	Classification of Waves Supported by an Electron Plasma: Electrokinetic Waves 43			
	4.4	1			
	4.5 4.6	Small-signal Power Theorem for Dispersive Media 60 Energy-Momentum Transformation 63			
5.		ies and Instability Criteria 67			
		Introduction 67			
	5.2	Instabilities due to Coupling between Passive and			
		Active Modes 68			
	5.3	Mathematical Criteria for Identifying Amplifying Waves and Absolute Instabilities 72			
6.	Passive E	Electrokinetic Waves 83			
	6.1	Introduction 83			
	6.2	Propagation in an Infinite Medium 84			
	6.3	Propagation in a Finite Medium 99			

106

105

7. Active Interactions of Electrokinetic Waves

Introduction 105 Transverse Waves

7.1

7.2

viii Contents
7.3 Longitudinal and Hybrid Waves 112
7.4 Instabilities Involving a Transverse Component of a Magnetostatic Field 129
8. Interaction of Electrokinetic Waves with Sound Waves 133
8.1 Introduction 133
8.2 Macroscopic Model of Piezoelectric Media 134
8.3 Longitudinal Phonon-Plasmon Interactions 136
8.4 Deformation Potential Interactions 152
8.5 Transverse Phonon-Helicon Interactions 154
9. Interaction of Spin Waves with Electrokinetic Waves 159
9.1 Introduction 159
9.2 Macroscopic Model of Magnetic Medium and the
Spin-wave Spectrum 160
9.3 Interaction of Spin Waves with Electrokinetic Waves 17
10. Collision-induced Instabilities in Solids 191
10.1 Introduction 191
10.2 Collision-induced Single-stream Transverse-wave
Instabilities 192
10.3 Collision-induced Two-stream Instabilities in
Electron-hole Plasmas 208
11. Interaction with External Circuit Waves 221

- 11.1 Introduction 221
- 11.2 Interaction of Drifting Carriers in Solids with External Circuit Waves in a Parallel Magnetic Field 222
- 11.3 Interaction of Drifting Carriers in Solids with External Circuit Waves in a Perpendicular Magnetic Field 226

12. Negative Resistance Effects in Solids 229

- 12.1 Introduction 229
- 12.2 Description of Bulk Negative Resistance Effects 231
- 12.3 Origin of Negative Resistance Effects in Solids 238
- 12.4 Small-signal Wave Propagation in a Negative Differential Resistance Medium 236

13. Quantum-mechanical Approach to Wave Interactions 245

- 13.1 Introduction 245
- 13.2 Correspondence between Normal-mode Amplitudes and Quantum Operators 246

- 13.3 Amplification of Waves due to Quanta with Negative Energy 249
- 13.4 Description of Nonlinear (or Parametric) Interactions 251

14. Pinch Effect in Solids 255

- 14.1 Introduction 255
- 14.2 Theory of Pinch Effect in Solids 256
- 14.3 Experiments 262

References 269

Index 277