Contents

Foreword	. ix
Preface to the Second Edition	. xi
Preface to the First Edition	. xiii
I. Introduction	. 1
References	. 4
II. Elements of the Theory of Lattice Dynamics	. 6
1. Equations of Motion of a Vibrating Lattice	
2. The Cyclic Boundary Condition and Ledermann's Theorem	
3. Normal Coordinates of a Lattice	. 46
4. Correlation Functions and Green's Functions	. 57
5. Historical Survey	. 68
References	. 77
III. Applications of Group Theory to Lattice Dynamics	. 82
1. Introduction	. 82
2. The Symmetry of the Dynamical Matrix and Multiplier	
Representations	. 82
3. Transformation Properties of the Eigenvectors of the	
Dynamical Matrix	. 94
4. Additional Degeneracies Due to Time Reversal Symmetry	. 106
References	. 128
IV. Theory of the Vibrational Frequency Spectra of Solids	. 129
1. Introduction	. 129
2. Expressions for Frequency Spectra	. 137
3. Singularities in Frequency Spectra	. 150
4. Topological Basis for Singularities in Frequency Spectra.	. 158
5. Approximate Spectrum Calculations	. 166
References	. 186
V. Calculations of Thermodynamics Functions without the Use	
	. 189
, - In-	
1. Thirring's Expansion and Its Analytic Continuation	. 189
2. Houston's Method	. 193
References	. 198

vi Contents

VI.	Dyn	amical Theory of Ionic Crystals	00
	1.	Introduction	00
	2.	The Macroscopic and Lorentz Fields in an Ionic Crystal;	
		Ewald's Method	01
	3.	The Rigid Ion Model	21
	4.	Polarizable Ions	34
	5.	Phenomenological Theory	44
	6.	Polaritons	57
	7.	Optical Activity	69
	8.	Vibrational Frequency Spectra of Crystals with Long Range	
		Interactions between Ions	88
		References	97
			^^
VII.	Sca	ttering of X Rays and Cold Neutrons by Lattice Vibrations \dots 3	00
			00
	2.	Localization of an Atom about Its Equilibrium Position 3	04
	3.	Theory of the Scattering of X Rays by Thermal Lattice	
		violations :	11
	4.	Experimental Determination of Frequency Spectra by X-Ray	
		11. E	20
	5.	The Determination of Lattice Vibrational Spectra by Slow	
			25
	6.	Experimental Determination of Frequency Spectra by	
			34
	7.	1 tall 110 10 0 111110 110110110 = 1111 = 1111111	43
		References	48
		70	53
VIII.	The	Effect of Defects and Disperse.	
	2000	THE COMMENT OF THE CO	53
	2.	rayleigh 5 Theorems	56
	3.	The Equations of Motion of a Crystal Containing an Isolated	
		impulity ritoring and river continue	60
	4.	ino i toquenej epectum et a	84
	5.	The violational Greek of anietics	96
	6.	Time-Dependent Displacement and Momentum Correlation	20
		Tunetions	99
	7.	The Use of Symmetry and Group Theory in the Solution of	^^
		Lattice Bynamical Delect Treatment	02
		Examples	28
	9.	Expansions in 10 wers of the impanty	76
	10.	Disordered Crystals	92
		References	14

CONTENTS vii

IX. The Effects of Surfaces on the Vibrations of Crystal Lattices	•	٠		520
1. Introduction				520
2. Surface Vibration Modes				521
3. The Green's Function for a Crystal Slab				564
4. The Surface Contribution to the Specific Heat of a Crys				582
5. Scattering from Crystal Surfaces			•	595
6. The Interaction of Defects with Crystal Surfaces .				620
7. Scattering of Phonons by Crystal Surfaces				629
References				634
X. Statistical Mechanical Properties of Systems of Coupled Harmon Oscillators	oni	ic ·		637
1. Introduction				637
2. Brownian Motion			•	637
3. Poincaré Cycles				649
4. Nonequilibrium Processes in Disordered Crystals .				657
5. Energy Flow in Crystals				664
References				665
Appendix. The Role of the Conduction Electrons in Determining the Phonon Frequencies of Metals			•	667
References				672
Author Index	•	٠	•	673
Subject Index				683