

Contents

PREFACE	page v
1. MACROSCOPIC THEORY	1
1.1 <i>Electromagnetic field in a solid</i>	1
1.2 <i>Dielectric constant and optical conductivity</i>	4
1.3 <i>Crystal symmetry</i>	7
1.4 <i>Propagation of waves</i>	8
1.5 <i>Kramers-Krönig relations</i>	13
1.6 <i>The sum rule</i>	19
1.7 <i>Dispersion theory of classical oscillators</i>	22
2. CRYSTAL LATTICE ABSORPTION	25
2.1 <i>Vibrational modes of a crystal lattice</i>	25
2.2 <i>Photon-phonon interaction</i>	28
2.3 <i>Microscopic theory of infra-red dispersion</i>	33
2.4 <i>Two-phonon absorption</i>	37
3. INTERBAND TRANSITIONS	41
3.1 <i>Electron energy bands</i>	41
3.2 <i>Direct transitions</i>	44
3.3 <i>Critical points</i>	48
3.4 <i>Absorption band edges</i>	53
3.5 <i>Indirect transitions</i>	56
3.6 <i>Infra-red absorption in superconductors</i>	59
4. FREE CARRIER ABSORPTION	62
4.1 <i>Classical theory</i>	62
4.2 <i>Intraband transitions</i>	65
4.3 <i>Electron transport</i>	69
4.4 <i>Surface admittance</i>	73
4.5 <i>Infra-red absorption in metals</i>	76
4.6 <i>Free carrier absorption in semiconductors</i>	80

5. PLASMA EFFECTS	84
5.1 <i>Free electron model</i>	84
5.2 <i>Volume plasmons</i>	88
5.3 <i>Surface plasmons</i>	92
6. EXCITON EFFECTS	97
6.1 <i>Electron-hole interaction</i>	97
6.2 <i>Optical absorption</i>	100
6.3 <i>Inert-atom solids and alkali halides</i>	101
6.4 <i>Semiconductors</i>	104
6.5 <i>Spatial dispersion</i>	107
7. NON-LINEAR OPTICS	111
7.1 <i>Classification of non-linear effects</i>	113
7.2 <i>Non-linear susceptibilities</i>	115
7.3 <i>Second harmonic generation</i>	119
7.4 <i>Parametric amplification and oscillation</i>	126
7.5 <i>Third order effects</i>	130
REFERENCES	135
INDEX	137