

Charles C. Coleman

Modern Physics for Semiconductor Science



**WILEY-
VCH**

WILEY-VCH Verlag GmbH & Co. KGaA

Contents

Preface *ix*

1 Relativity *1*

- 1.1 Introduction *1*
- 1.2 Newtonian Relativity *2*
- 1.3 The Lorentz–Fitzgerald Transformation *10*
- 1.4 Einstein Relativity *20*
- 1.5 Problems *29*

2 Classical Applied Statistics *35*

- 2.1 Introduction *35*
- 2.2 Distribution Functions *36*
- 2.3 Mean Free Path *46*
- 2.4 Gaussian Distribution *52*
- 2.5 Maxwell–Boltzmann Distribution *57*
- 2.6 Density-of-States Functions *66*
- 2.7 Failures of Maxwell–Boltzmann Statistics *72*
- 2.8 Problems *78*

3 Quantum Mechanics *83*

- 3.1 Introduction *83*
- 3.2 Blackbody Radiation *84*
- 3.3 Bose–Einstein Statistics *88*
- 3.4 Molar Specific Heat of Solids *92*
- 3.5 Photoelectric Effect *96*
- 3.6 Bohr Model of the Hydrogen Atom *101*
- 3.7 Lasers *113*
- 3.8 Problems *124*

4 Wave Mechanics *129*

- 4.1 Introduction *129*
- 4.2 de Broglie Waves *130*
- 4.3 Wave Properties *134*

4.4	One-dimensional Schrödinger Equation	143
4.5	Constant-potential Problems	152
4.6	Problems	164
5	Condensed Matter	167
5.1	Introduction	167
5.2	Waves in Lattices	167
5.3	Phonon Properties	174
5.4	Pauli Exclusion and Fermi–Dirac Statistics	181
5.5	Free-electron Theory	188
5.6	Superconductivity	203
5.7	Band Theory	214
5.8	Problems	222
6	Semiconductors	225
6.1	Introduction	225
6.2	Charge-carrier Properties	226
6.3	Intrinsic Semiconductors	238
6.4	Extrinsic Semiconductors	249
6.5	Problems	257
7	Semiconductor Junctions	261
7.1	Introduction	261
7.2	Metal–Metal Junctions	262
7.3	Internal Junction Currents	267
7.4	Metal–Semiconductor Contacts (Schottky Junction)	275
7.5	MIS Junctions	291
7.6	Semiconductor–Semiconductor or p-n Junctions	294
7.7	Two Applications	306
7.8	Problems	312
	Answers to Selected Problems	313
	Index	317