

Table of Contents

Preamble

Table of Contents

Chapter I. THE BASIC STRUCTURES OF SOLIDS

I-1. Introduction. I-2. Atoms and Binding Forces	3
I-3. Crystal Structures	16
I-4. Crystalline Solids	29
I-5. Polycrystalline and Non-Crystalline Solids	34
I-6. The Phase Diagrams	38
I-7. Techniques on Crystal Growth and Thin Film Deposition	41
I-8. Crystal Imperfection	46
I-9. Diffusion in Solids	54
I-10. Physical Diagnostic Tools	58
Glossary	67
References	71
Exercises for Chapter I	72

Chapter II. ELECTRICAL PROPERTIES OF SOLIDS

II-1. Introduction. II-2. Electrons in a Solid	81
II-3. Energy Distribution of the Electrons	85
II-4. The Energy Band Diagram	87
II-5. Mathematical Formulation of the Conduction Processes	90
II-6. Conductors	95
II-7. Semiconductors	101
II-8. Other Conduction Mechanisms	116
II-9. Velocity Saturation and Negative-Resistance Effect	121
II-10. Insulators	123
Glossary for End-of-Chapter Review	138
References	141
Exercises for Chapter II	142

Chapter III. P-N JUNCTIONS AND RELATED DEVICES

III-1. Introduction. III-2. Concept of a P-N Junction	149
III-3. Schottky Junction and its Electronic Properties	174
III-4. Metal-Semiconductor Contact	185
III-5. MIS Junction and Field-Effect Properties	188
III-6. Materials Considerations	193
III-7. Structures and Operation of Transistors	194
III-8. Non-Ideal Effects and other Performance Parameters	205
III-9. New Transistors	219
Glossary for End-of-Chapter Review	227
References	232
Exercises for Chapter III	233

Chapter IV. OPTICAL PROPERTIES OF SOLIDS

IV-1. Introduction. IV-2. Review of the Properties of Light	239
IV-3. The Absorption Process	248
IV-4. The Emission Process	258
IV-5. Imagers	269
IV-6. Displays	282
IV-7. Power Generation	301
IV-8. Optical Signal Transmission Media	305
Glossary	312
References	316
Exercises for Chapter IV	317

Chapter V. MAGNETIC AND SUPERCONDUCTING PROPERTIES OF SOLIDS

V-1. Introduction	323
V-2. Magnetic Properties of Solids	324
V-3. Sources of Magnetization	329
V-4. Magnetic Anisotropy and Invar Alloys	343
V-5. Amorphous Magnetic Materials	347
V-6. Soft Magnets and Hard Magnets	348
V-7. Magnetic Devices and Applications	351
V-8. Properties of Superconductors	360
V-9. Applications of Superconductors	368
V-10. Superconducting Materials	381
Glossary for End-of-Chapter Review	384
References	388
Exercises for Chapter V	389

Chapter VI. MICROMACHINES, SENSORS AND PACKAGING MATERIALS

VI-1. Introduction. VI-2. Micromachining	396
VI-3. Polysilicon Films Used in Micro-Structures	410
VI-4. Applications of Micro-Structures	411
VI-5. Heat and Temperature Sensors	416
VI-6. Displacement and Flow Sensors	421
VI-7. Chemical Sensors	439
VI-8. Optical Sensors	442
VI-9. Design of a Pressure Transducer	446
VI-10. Grounding, Shielding and Interference	450
VI-11. Packaging Materials	452
Glossary for End-of-Chapter Review	459
References	462
Exercises for Chapter VI	463

Appendix