

Preface

This book is intended to cover the vast and fast growing field of semiconducting materials and devices in accordance with the modern trends. The level of the book covers the syllabi being taught at the undergraduate standard of engineering institutes in India and abroad for students of Electronics and Telecommunication, Electrical Engineering, Materials Science, and Applied Physics. It also covers the syllabi of various competitive and other national level examinations across the globe. The contents of the book will be fully useful to the electronics students of postgraduate studies. The book may be used as a reference book by scientists, engineers, and research scholars for basic, advanced and up-to-date information.

This book is organized into six parts, containing 16 chapters. In Part I, the first two Chaps. 1 and 2 provide an elementary viewpoint on properties and applications of semiconductor materials; some recent advances like spintronic materials, ferromagnetic semiconductors, left-handed materials, DMS, photocatalytic semiconductors, etc.; materials science of crystal structures and imperfections, atomic models and bonding in them. Basic information on semiconductor devices, narrow and wide bandgap semiconductors are given in brief. These chapters are essentially needed to develop the understanding of the subject. Chapters 3 and 4 describe the carrier transport and excess carriers in semiconductors, respectively. These chapters provide detailed mathematical information about the phenomena related to various semiconductor behaviour.

Part II consisting of Chaps. 5 and 6, deals with junctions and interfaces. Chapter 5 describes p–n junctions, diodes and their breakdown mechanism; while Chap. 6 explains a large variety of specific diodes. The Part III comprises Chaps. 7–9. Chapter 7 deals with majority carrier diodes, their operation and response under different biasing conditions. Chapter 8 provides information on construction, characteristics, performance and application of microwave diodes, varactor diode, photodiodes; IMPATT, TRAPATT, BARITT and Gunn diodes, etc. In Chap. 9, the optoelectronic devices describe the solar cells, photodetectors, LEDs and semiconductor lasers, etc.

Part IV, comprising Chaps. 10–12, deals with BJT, FETs and power semiconductor devices. In Chap. 10, various aspects of bipolar junction transistors are dealt

in, Chap. 11 provides a thorough discussion on MESFETs, MOSFETs, IGFETs, etc. Chapter 12 focuses on p-n-p-n diode, thyristors, silicon-controlled rectifiers, bilateral devices, etc.

Part V, comprises Chaps. 13 which deals with the brief details of various aspects of semiconductor fabrication. It elaborates the method of production of silicon, semiconductor crystal growth, zone refining, construction of microelectronic circuit. It also deals with manufacturing of wafers, lithography, molecular beam epitaxy, masking, fabrication technique of p-n junction and transistor manufacturing processes.

The last Part VI, comprises of Chaps. 14–16. Chapter 14 incorporates specialized semiconductors in vivid fields like solar cells, thermoelectrics, photocatalytic, plasmonics, photonic, photovoltaic semiconductors, etc. Chapters 15 and 16 presents a comprehensive detail of modern trends in the research and development of semiconductor materials and devices. In Chap. 15, nanostructured semiconducting materials and devices are described; while in Chap. 16, the recent advances and emerging trends in semiconducting materials and devices are given. Both these chapters present up-to-date information about the subject.

Basic and prerequisite information has also been included for easy transition to newer topics. Latest developments in the fields of semiconducting materials, their sciences, processes and applications have been accommodated. Latest topics in optoelectronic devices, metal-semiconductor junctions, heterojunctions, MISFET, LEDs, semiconductor lasers, photodiodes, switching diodes, tunnel diodes, Gunn diode, solar cells, varactor diode, IMPATT diode, advanced semiconductors, etc., have been included.

Topics like *electron theories, high-field effects, Hall effect, transit-time effects, drift and diffusion, breakdown mechanisms, equilibrium and transient conditions, switching, biasing* have been explained. A variety of semiconducting materials and devices, microelectronics, memory devices, advance and futuristic materials are described. Information on ideal diode, real diode, backward diode, etc., are provided to include the contents on more advanced semiconductor devices.

Review and objective type questions based on concepts, design, construction, applications and practical orientations, are included. Wherever required, the mathematical equations have been incorporated to understand the contents easily and in-full, however, they have been kept to a minimum, throughout the text. A large number of numerical and theoretical examples have been worked-out for easier understanding to the readers. Numerical exercises for practice and self-valuation are also given with their answers, in order to develop confidence to users. SI units, in general, have been incorporated throughout the text but for familiarity, the MKS units have also been used. Review, objective and numerical problems are enriched with questions of different examinations of many universities and national level institutes. The book is substantiated by a large number of diagrams, tables, equations and glossary of terms.

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work has been included. Every effort has been made to seek permission from the copyright holders to reproduce the matter in this book. However, the authors of this book desire excuse from those contributors who could not be contacted, or from those whose acknowledgement is missed undeliberately.

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K.M. Gupta
Nishu Gupta

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